SOIL SURVEY OF

# Elkhart County, Indiana

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Purdue University
Agricultural Experiment Station

Issued April 1974

**Major fieldwork for this soil survey was done in the period 1960–67. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service and the Purdue University Agricultural Experiment Station. It is part of the technical assistance furnished to the Elkhart County Soil and Water Conservation District. Elkhart County provided financial assistance to help complete this survey.**

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

# HOW TO USE THIS SOIL SURVEY

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

## Locating Soils

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

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. 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. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the 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 from the soil descriptions and from the discussions of the interpretive groupings.

*Foresters and others* can refer to the section "Use of the Soils for Woodland," where the soils of the county are grouped according to their suitability for trees and shrubs planted for various purposes.

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

*Community planners and others* can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the sections "Town and Country Planning" and "Recreation."

*Engineers and builders* can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

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

*Newcomers in Elkhart County* may 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," which gives additional information about the county.

***Cover picture:*** **Wooded stream bottoms and adjacent uplands provide multipurpose recreational areas. Areas of Plainfield fine sand and Alluvial land, mixed.**

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# Contents





Issued April 1974

# SOIL SURVEY OF ELKHART COUNTY, INDIANA

BY FRANK KIRSCHNER AND PAUL MCCARTER, SOIL CONSERVATION SERVICE

FIELDWORK BY SAMUEL LEHMAN AND PAUL MCCARTER, SOIL CONSERVATION SERVICE [1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

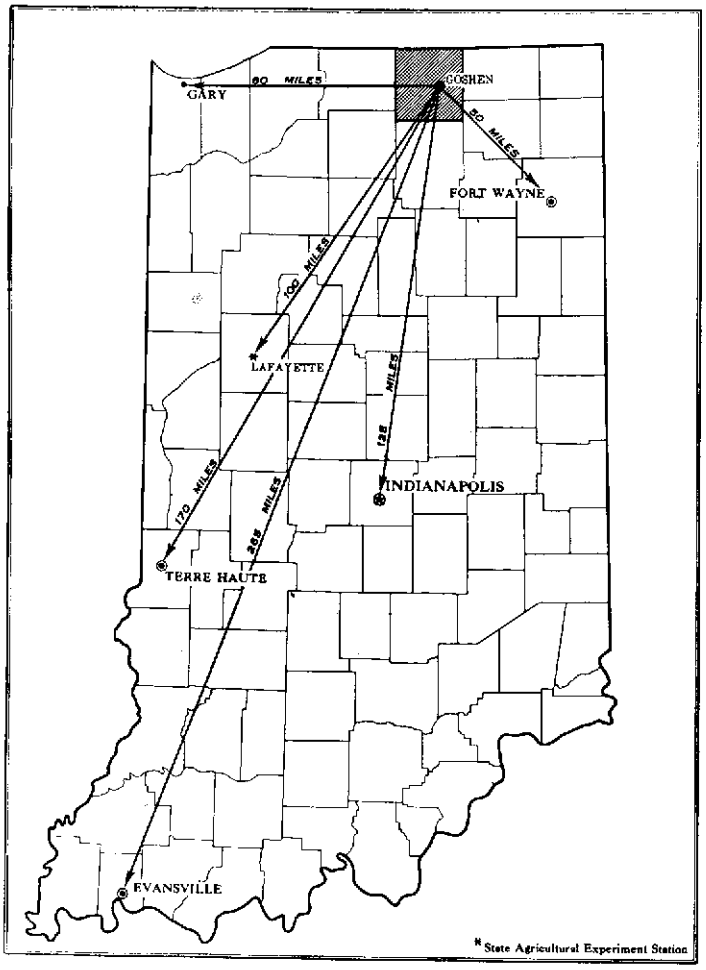


*Figure 1.*—**Location of Elkhart County in Indiana.**

ELKHART COUNTY is in the extreme north-central part of Indiana (fig. 1). It has a total area of 299,520 acres, or 468 square miles. Goshen, the county seat, is near the center of the county. The climate provides for ample precipitation and favorable temperature for farming. The physiography consists of nearly level and gently sloping eolian and outwash sands in the northern part of the county, nearly level to moderately sloping outwash terraces and plains in the northern and central parts, and nearly level to strongly sloping glacial till plains in the eastern and western parts. The county is drained mainly by the Elkhart and St. Joseph Rivers. Farming probably is the main source of income in the county. Corn and soybeans are the main crops grown. Fruit and nursery crops also are important as a source of income, as are livestock and livestock products. The diversified industrial enterprises in the county provide full-time employment for many residents. In order for farm and nonfarm interests to achieve common objectives, a thorough understanding of soil and water resources is necessary.

## How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Elkhart County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

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 nationwide, uniform procedures (*4*)[2]. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

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

[1] Part of the fieldwork was done by FRANK KIRSCHNER, ROBERT MONTGOMERY, CHARLES MONTGOMERY, and DWIGHT HARRIS, Soil Conservation Service.

[2] Italicized numbers in parentheses refer to Literature Cited, page 94.

other geographic feature near the place where a soil of that series was first observed and mapped. Oshtemo and Rawson, 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 affect their behavior in the undisturbed 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 soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Oshtemo loamy sand, 0 to 2 percent slopes, is one phase within the Oshtemo series, and Rawson loam, 0 to 2 percent slopes, is one phase within the Rawson series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication 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 the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. 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 phase.

In most areas surveyed there are places where soil material is so gravelly, so shallow, so variable in texture, or so frequently worked by wind and water that it cannot be classified by soil series. These places are shown on a soil map and are described in the survey like other mapping units, but they are given descriptive names, such as Alluvial land, loamy, or Alluvial land, mixed, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil 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 soil. 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 such 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 soil surveys. The soil scientists set up trial groups based on the yield and practice tables and other data. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultations. 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 Elkhart 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, because the soils in any one association ordinarily differ in slope, depth, drainage, or other characteristics that affect management. The seven soil associations in Elkhart County are described in the following paragraphs.

### *1. Plainfield-Chelsea-Tyner association*

*Deep, excessively drained and somewhat excessively drained, coarse-textured soils that developed in sandy outwash*

This association is in the northern part of the county (fig. 2). It consists mainly of nearly level and gently sloping soils on broad outwash plains and makes up about 18 percent of the county.

About 40 percent of the association consists of Plainfield soils, about 20 percent of Chelsea soils, about 15 percent of Tyner soils, and about 25 percent of minor soils.

The Plainfield, Chelsea, and Tyner soils are nearly level to moderately sloping and occupy broad areas between depressions and drainageways. Plainfield soils have a fine sand surface layer that is mainly dark brown. The subsoil is yellowish-brown fine sand. Chelsea soils have a dark-brown and dark grayish-brown surface layer of fine sand. The subsoil is mainly brown fine sand that contains thin, horizontal lenses of dark-brown loamy sand, 4 to 7 inches apart. Tyner soils have a surface layer of dark-brown loamy sand and a subsoil of dark yellowish-brown and dark-brown loamy sand.

Minor soils in this association are of the Oshtemo, Maumee, Gilford, Tedrow, and Tawas series. Oshtemo soils are somewhat excessively drained and occur on areas between depressions and drainageways. The Maumee and Gilford soils are poorly drained and occupy depressions and drainageways. Tedrow soils are somewhat poorly drained and occupy low-lying flats and drainageways. Tawas soils occupy deep depressions and are very poorly drained, organic soils underlain by sand and gravel at a depth of 12 to 42 inches.

A large proportion of this association is used for crops. Corn, soybeans, small grain, and grasses and legumes for forage are the most common crops. Some areas are used

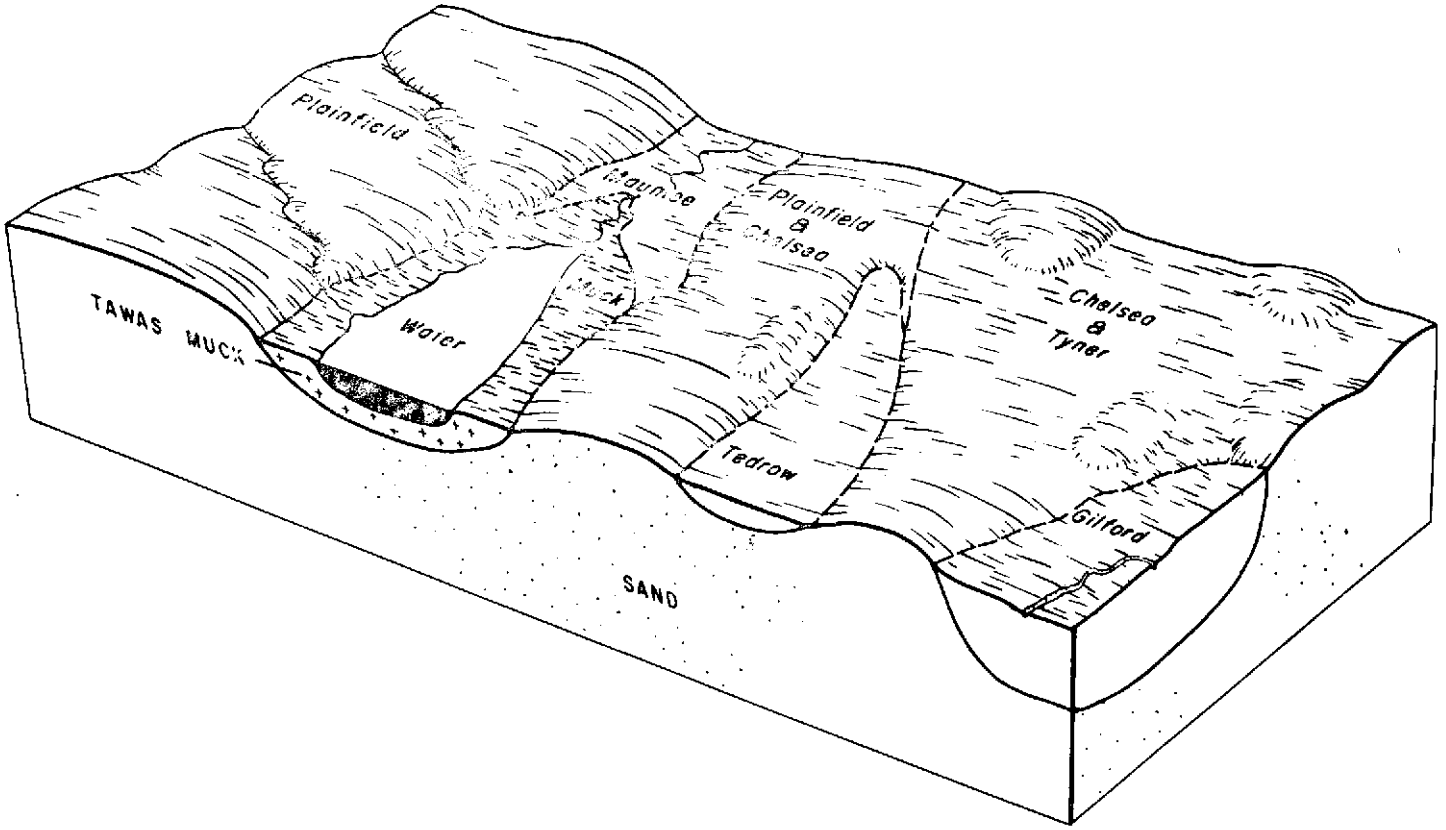


***Figure 2.*—Relationship of soils to topography and underlying materials in the Plainfield-Chelsea-Tyner association.**

for nursery stock and Christmas trees. Crops grown on this association respond to applications of supplemental water, and a wide variety of field and special crops can be grown under irrigation. Some areas, particularly in the northwestern part of the county, are used for residential and industrial development. Most of this association has slight limitations for homesites and for septic tank absorption fields. Soil blowing is a hazard that affects the use and management of the soils of this association. Droughtiness and low fertility are important limitations. Wetness and a seasonally high water table are limitations on the minor soils that are poorly drained.

### 2. *Oshtemo-Fox association*

*Deep and moderately deep over sand and gravel, somewhat excessively drained and well-drained, coarse textured and moderately coarse textured soils that developed in loamy outwash*

This association consists of nearly level to moderately steep soils on broad outwash plains along the major streams and rivers (fig. 3). It makes up about 20 percent of the county. The largest areas are along the St. Joseph, Elkhart, and Little Elkhart Rivers and Turkey Creek. About 70 percent of the association consists of Oshtemo soils, about 8 percent of Fox soils, and about 22 percent of minor soils.

Oshtemo and Fox soils are nearly level to moderately steep and occupy breaks and broad areas between depressions and drainageways. The Oshtemo soils are somewhat excessively drained. They have a surface layer of brown loamy sand and a subsoil of mainly brown sandy loam. The underlying material, below a depth of 42 to 66 inches or more, is loose sand and gravel. The Fox soils are well drained and have a dark-brown sandy loam surface layer and a sandy clay loam subsoil that is mainly dark brown. Fox soils are underlain at a depth of 24 to 42 inches by loose sand and gravel.

Tawas, Gilford, and Sebewa soils and Alluvial land, mixed, are among the minor soils in this association. Gilford and Sebewa soils are poorly drained and occupy depressions on outwash flats and along large drainageways. Alluvial land, mixed, occupies the frequently flooded bottom lands along the major streams. It consists mainly of somewhat poorly drained or poorly drained alluvial soils that have a high water table. Tawas soils are very poorly drained organic soils that are underlain by sand and gravel at a depth of 12 to 60 inches. Other minor soils in the association are of the Homer and Brady series.

Most of this association is used for crops or pasture. The most common crops are corn, soybeans, small grain, and grasses and legumes for forage. Many areas, particularly near Goshen and Elkhart, are used for residential and industrial development. Droughtiness is an important limitation that affects the use and management of the major soils of this association. Crops grown on these soils respond well to applications of supplemental water, and a wide variety of field and special crops can be grown in irrigated areas. Wetness is a limitation for Gilford, Sebewa, and other minor soils, and Alluvial land, mixed, is subject to frequent flooding.

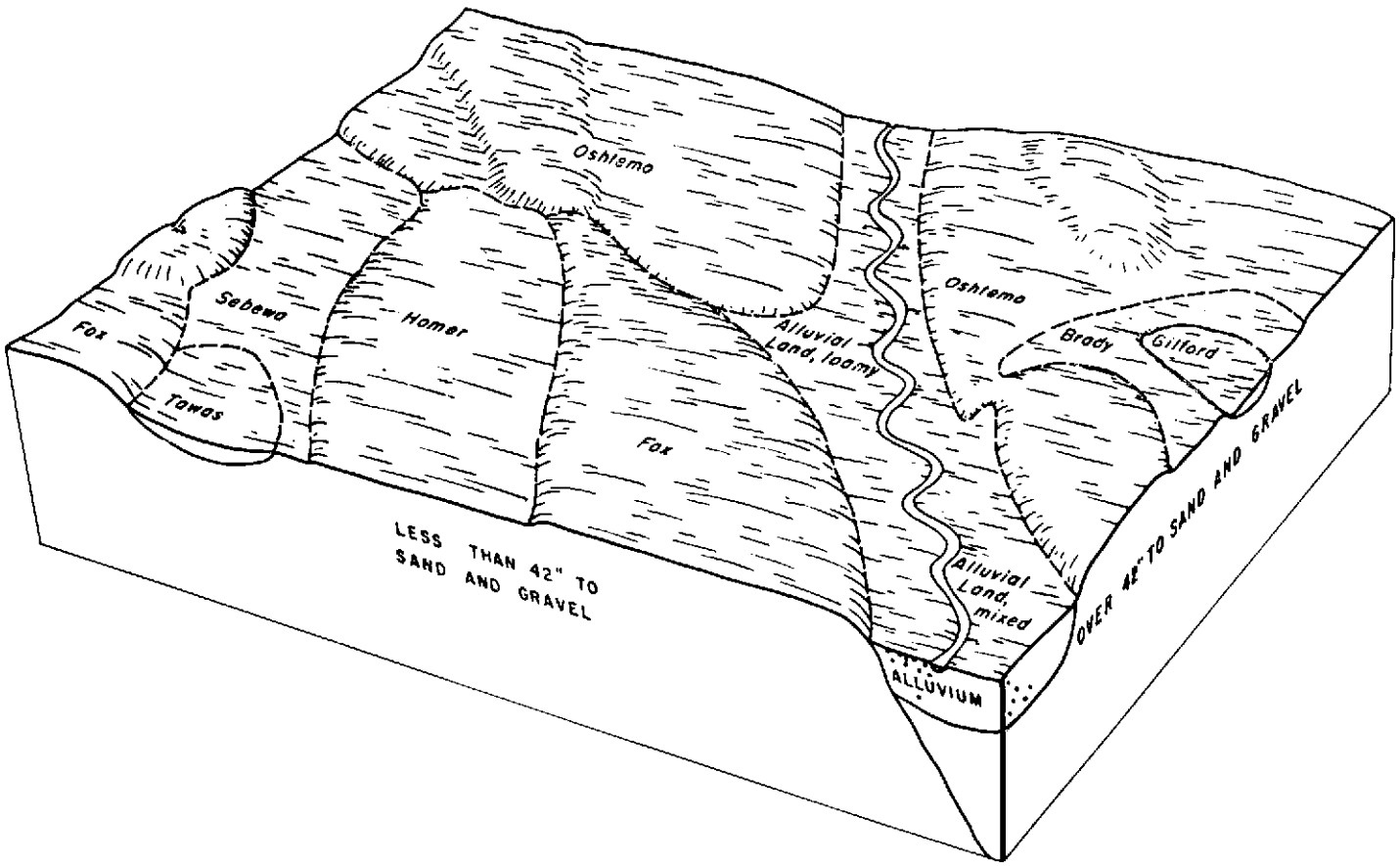


***Figure 3.*—Relationship of soils to topography and underlying materials in the Oshtemo-Fox association.**

The major soils of this association generally have slight limitations as sites for homes, with or without basements, and for septic tank absorption fields, but where the soils are moderately sloping or strongly sloping, the limitations are moderate. The minor soils of this association have severe limitations as sites for homes, with or without basements, and also for septic tank absorption fields.

### *3. Riddles-Crosby-Miami association*

*Deep, well-drained and somewhat poorly drained, moderately coarse textured and medium-textured soils that developed in loamy glacial drift*

This association consists of nearly level to moderately steep soils on uplands throughout the county (fig. 4). It makes up about 42 percent of the county. About 28 percent of the association consists of Riddles soils, about 25 percent of Crosby soils, about 12 percent of Miami soils, and about 35 percent of minor soils.

The Riddles soils are on ridges between drainageways and are well drained. They have a surface layer that is mainly dark grayish-brown sandy loam and a subsoil of dark-brown sandy clay loam and brown clay loam. The underlying material, below a depth of 42 to 66 inches or more, is loam glacial till.

Crosby soils are nearly level or gently sloping and occupy narrow drainageways and upland areas. These soils are somewhat poorly drained. They have a surface layer that is mainly dark-brown loam and a subsoil of grayish-brown and yellowish-brown, mottled clay loam. The underlying material, below a depth of 30 to 36 inches, is brown loam glacial till.

The Miami soils, like the Riddles soils, occupy ridges between drainageways. Miami soils are well drained and have a loam surface layer that is mainly dark brown. The subsoil is clay loam that is yellowish brown and dark brown. The underlying material, below a depth of 24 to 42 inches, is brown loam glacial till.

Brookston, Carlisle, Del Rey, Haskins, Metea, Oshtemo, and Rawson are the principal minor soils in this association. The Brookston soils are poorly drained and occupy depressions and drainageways. Del Rey soils are somewhat poorly drained and occupy areas that were formerly shallow lakes. Haskins soils also are somewhat poorly drained. The Oshtemo soils are somewhat excessively drained and occupy outwash areas that are underlain by deep deposits of sand and gravel. Rawson soils are well drained and occupy areas on glacial till plains and around lakebeds.

Most of this association is used for crops. Corn, soybeans, small grain, and grasses and legumes for forage are the most common crops. Some areas are used for woodland and for residential and industrial development. Erosion is an important hazard that affects the use and management of the sloping, well-drained soils. Wetness is a limitation for the Brookston, Crosby, Del Rey, and Haskins soils, and droughtiness is a limitation for the Oshtemo soils.

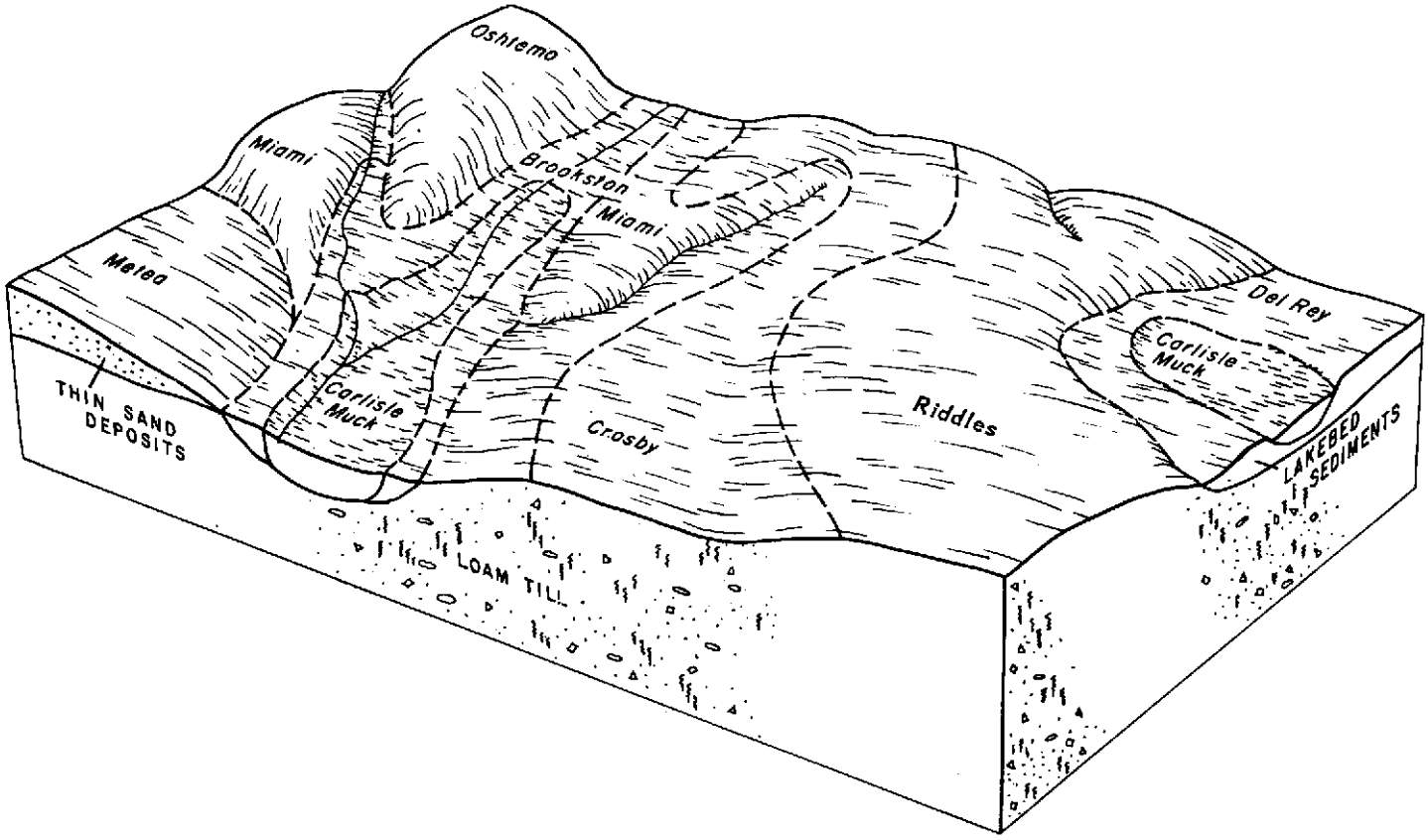


*Figure 4.*—**Relationship of soils to topography and underlying materials in the Riddles-Crosby-Miami association.**

The well-drained, level and gently sloping soils, which make up most of this association, have slight limitations as sites for homes, with or without basements. However, the moderately sloping to moderately steep soils have moderate or severe limitations. For these soils, limitations for septic tank absorption fields range from slight to severe, depending upon the steepness of the slopes. The somewhat poorly drained soils of this association have severe limitations as sites for homes with basements, moderate limitations as sites for homes without basements, and severe limitations for septic tank absorption fields. The poorly drained minor soils have severe limitations as sites for homes, with or without basements, and for septic tank absorption fields.

### *4. Crosby-Brookston association*

*Deep, somewhat poorly drained and poorly drained, medium-textured soils that developed in loamy glacial till*

This association consists of nearly level and gently sloping soils on the upland glacial till plain in the southwestern part of the county. It makes up about 13 percent of the county. About 60 percent of this association consists of Crosby soils, about 20 percent of Brookston soils, and about 20 percent of Riddles and Miami soils.

The Crosby soils are somewhat poorly drained and occupy areas between drainageways and depressions. They have a surface layer that is mainly dark-brown loam and a subsoil of grayish-brown and yellowish-brown, splotched clay loam. The underlying material is loam glacial till. Brookston soils are poorly drained and occupy depressions and drainageways. They have a surface layer that is mainly very dark gray silt loam and a subsoil that is mainly grayish-brown and yellowish-brown, splotched clay loam. They are underlain by loam glacial till. The Riddles and Miami soils are well drained and occupy knolls and breaks around drainageways.

Most of this association is used for crops. Corn, soybeans, small grain, and grasses and legumes for forage are the common crops. Some small areas are used for residential and industrial development. Wetness is the major limitation that affects the use and management of these soils. Erosion is a hazard on the sloping soils. Most of this association has severe limitations for homesites with basements and for septic tank absorption fields. However, the somewhat poorly drained soils have only moderate limitations for homesites without basements. Minor soils of this association that are well drained have slight to moderate limitations as sites for homes with or without basements. Limitations for septic tank absorption fields range from moderate to severe, depending upon the steepness of the slope.

### *5. Blount-Pewamo association*

*Deep, somewhat poorly drained and poorly drained, medium-textured and moderately fine textured soils that developed in silty clay loam glacial till*

This association consists of nearly level and gently sloping soils on the glacial till plain (fig. 5), north and east of Millersburg. It makes up about 3 percent of the county. About 50 percent of the association consists of

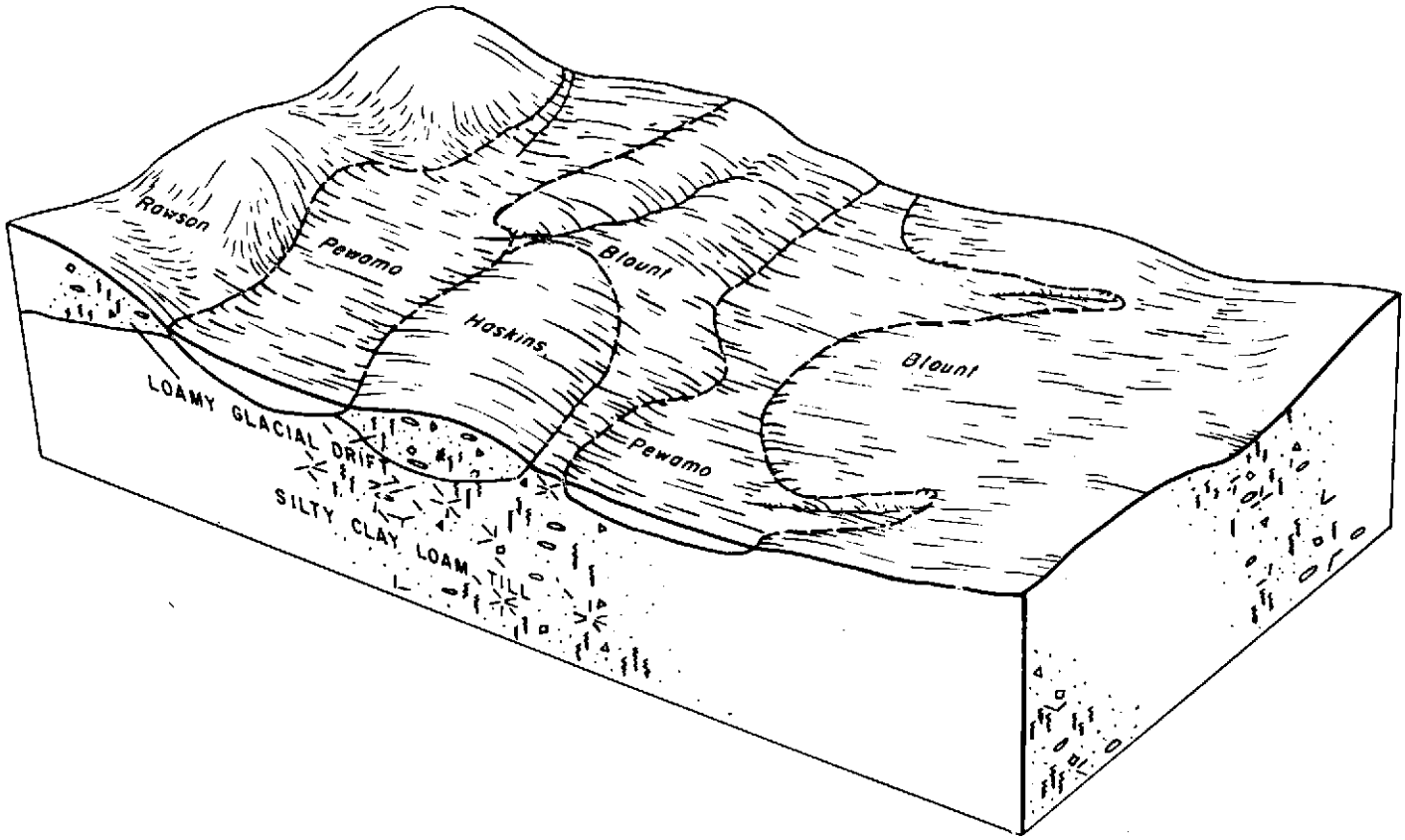


*Figure 5.*—**Relationship of soils to topography and underlying materials in the Blount-Pewamo association.**

Blount soils, about 30 percent of Pewamo soils, and about 20 percent of Rawson and Haskins soils.

The Blount soils are somewhat poorly drained and occupy areas between drainageways and depressions. They have a surface layer that is mainly dark-brown silt loam and a subsoil of grayish-brown and yellowish-brown, splotched silty clay loam and silty clay. The underlying material is silty clay loam glacial till. The Pewamo soils occupy drainageways and depressions and are poorly drained. They have a very dark gray silty clay loam surface layer and an olive-gray and brown, splotched silty clay subsoil. The underlying material is silty clay loam glacial till. The Rawson and Haskins soils are on uplands and in areas around lakebeds. Rawson soils are well drained, and Haskins soils are somewhat poorly drained.

Most of this association is used for crops. Corn, soybeans, small grain, and grasses and legumes for forage are the most common crops. Wetness is an important limitation that affects the use and management of the soils. Erosion is a hazard in the sloping areas of this association. The somewhat poorly drained soils, which make up most of this association, have severe limitations for homesites with basements, moderate limitations for homesites without basements, and severe limitations for septic tank absorption fields. The poorly drained soils have severe limitations for homesites, with or without basements, and for septic tank absorption fields. The minor soils that are well drained have slight to moderate limitations for homesites, with or without basements, depending upon the steepness of the slopes. They have moderate limitations for septic tank absorption fields.

### 6. *Volinia-Dickinson association*

*Deep, well-drained and somewhat excessively drained, medium-textured and moderately coarse textured soils that developed in loamy outwash underlain by sand and gravel*

This association occurs as two small areas south and east of Elkhart, one small area south of Bristol, and an area south of Goshen. It consists of nearly level prairie soils on broad outwash plains and makes up about 2 percent of the county. About 62 percent of the association consists of Volinia soils, about 20 percent of Dickinson soils, and the rest of less extensive soils.

The Volinia soils, which occupy the prairie south of Goshen, are well drained and have a thick, very dark brown and very dark grayish-brown loam surface layer. The subsoil is dominantly dark-brown sandy clay loam over dark yellowish-brown loamy sand. It is underlain by loose sand and gravel at a depth of 42 to 66 inches. The Dickinson soils, which occupy the prairie area near Elkhart and Bristol, have a thick, very dark brown and dark-brown sandy loam surface layer and a dark-brown and dark yellowish-brown sandy loam and loamy sand subsoil. The material below a depth of 40 to 60 inches or more is sand and gravel.

Among the minor soils in this association are soils of the Dowagiac and Oshtemo series. Dowagiac soils have

the same characteristics as Volinia soils, except that the dark-colored surface layer is thinner. Oshtemo soils are somewhat excessively drained and are underlain by sand and gravel at a depth of 42 to 66 inches or more.

Most of the areas of Dickinson soils near Elkhart and Bristol are suited to residential and industrial development. The area of Volinia soil south of Goshen is used primarily for crops, mainly corn and soybeans. Crops grown on this association respond to applications of supplemental water, and many kinds of field and special crops can be grown in irrigated areas. This association has only slight limitations for homesites, with or without basements, and for septic tank absorption fields. Some areas near Goshen are used for residential and industrial development, and this use is rapidly increasing.

### 7. *Carlisle-Tawas association*

*Deep, very poorly drained, very dark colored muck soils that developed in organic material*

This association occupies the deep, depressional areas of the uplands and outwash plains throughout the county. It makes up about 2 percent of the county. About 50 percent of the association is made up of Carlisle soils, about 35 percent of Tawas soils, and about 15 percent of Linwood and Edwards soils.

Carlisle soils have a black muck surface layer that is underlain, to a depth of 42 inches or more, by black muck and dark-brown, partially decomposed organic material. Tawas soils have a black muck surface layer that is underlain by very dark gray muck and dark-brown, partially decomposed organic material to a depth of 12 to 42 inches. Underlying the organic layers are sand and gravel. Linwood soils consist of 12 to 42 inches of muck and partially decomposed organic materials underlain by loamy mineral materials. Edwards soils consist of 12 to 42 inches of muck and partially decomposed organic materials underlain by marl.

Most of this association has been drained and is used for crops. Corn is the most common crop. Some areas are used for pasture. In undrained areas the natural vegetative cover is water-tolerant trees, shrubs, and grasses. Wetness and a high water table are important limitations that affect the use and management of these soils.

During dry periods soil blowing is a hazard in areas where there is no vegetative cover. This association has severe limitations for homesites and for septic tank absorption fields.

## *Descriptions of the Soils*

In this section the soil series and mapping units represented in this county are described. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The soils of each series are first described as a group. Important features common to all the soils of the series are listed, and the position of the soils on the landscape is given. Each series description has a short narrative description of a representative profile and a much more detailed description of the same profile, from which highly technical interpretations can be made. Following the profile is a brief statement of the range of characteristics of the soils in the series, as mapped in this county. Comparisons are made with other soils that either are located nearby or are generally similar to the soils of the series being described.

Each soil, or mapping unit, in the series is next described. Individual soils are delineated on the map and identified by soil symbols. Generally, these descriptions tell how the profile of the soil differs from that described as representative for the series. They also tell about the use and suitability of the soil described and something about management needs.

For full information about any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit. General information about the broad patterns of soils in the county is given in the section "General Soil Map." Unless otherwise indicated, the color names and color symbols given are for moist soil.

### Alluvial Land

This miscellaneous land type is made up of areas of alluvium recently deposited on first bottoms of major streams throughout the county. These areas are subject to flooding.

**Alluvial land, loamy** (Ad) consists of deep, moderately well drained and well drained alluvial soils that formed in loamy materials under mixed hardwoods. These materials were washed from uplands and outwash plains and were deposited by floodwaters.

The surface layer is fine sandy loam or loam, and the subsurface layer is silt loam, loam, or sandy loam. In places there are thin strata of sand or sandy clay loam. The material below a depth of 2 to 3 feet consists of various strata of material that ranges from silt loam to sand and contains scattered small amounts of gravel.

These areas, although subject to occasional flooding, are suited to many kinds of row crops commonly grown in the county. They can also be used for permanent pasture and trees. Isolated small areas can be used for wildlife habitat. Large areas have potential for recreational development. (Capability unit I–2)

**Alluvial land, mixed** (Am) consists of deep, somewhat poorly drained to well-drained alluvial soils that formed under mixed hardwoods in materials washed from uplands and outwash plains. The material at a depth below 2 to 3 feet is mainly stratified sand and gravel.

Areas on low bottoms are frequently flooded, and the water table is near the surface during most of the year. Many of the somewhat poorly drained areas are interlaced with abandoned stream channels that are partly filled with muck. The surface layer is dominantly silt loam or loam, and the subsurface layer is silt loam, loam, or sandy loam. Because of the high water table, most of these low-bottom areas are used for pasture or woodland. Drainage is not practical in most places, because outlets are not available.

Some moderately well drained or well drained areas are at slightly higher elevations and are only occasionally flooded. These soils have loam, sandy loam, or loamy sand surface and subsurface layers. Although occasionally flooded, some of these areas are suited to corn and soybeans. Most areas are well suited to permanent pasture,

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

| Soil | Acres | Percent | Soil | Acres | Percent |
|---|---|---|---|---|---|
| Alluvial land, loamy | 520 | 0.2 | Miami clay loam, 12 to 18 percent slopes, severely eroded | 485 | .2 |
| Alluvial land, mixed | 7,200 | 2.4 | Oshtemo loamy sand, 0 to 2 percent slopes | 34,000 | 11.3 |
| Aubbeenaubbee sandy loam | 418 | .1 | Oshtemo loamy sand, 2 to 6 percent slopes | 11,300 | 3.7 |
| Blount silt loam, 0 to 2 percent slopes | 4,450 | 1.5 | Oshtemo loamy sand, 6 to 12 percent slopes | 5,300 | 1.8 |
| Blount silt loam, 2 to 4 percent slopes, eroded | 1,050 | .4 | Oshtemo loamy sand, 12 to 18 percent slopes | 1,700 | .6 |
| Borrow pits | 700 | .2 | Oshtemo loamy sand, 18 to 25 percent slopes | 600 | .2 |
| Brady sandy loam | 3,850 | 1.3 | Pewamo silty clay loam | 2,100 | .7 |
| Brems loamy fine sand | 1,200 | .3 | Plainfield fine sand, 0 to 2 percent slopes | 12,800 | 4.2 |
| Bronson sandy loam | 1,250 | .4 | Plainfield fine sand, 2 to 6 percent slopes | 8,000 | 2.8 |
| Brookston silt loam | 9,600 | 3.2 | Plainfield fine sand, 6 to 12 percent slopes | 2,550 | .9 |
| Carlisle muck | 2,000 | .7 | Rawson loam, 0 to 2 percent slopes | 305 | .1 |
| Carlisle muck, drained | 2,350 | .8 | Rawson loam, 2 to 6 percent slopes | 1,650 | .6 |
| Chelsea fine sand, 0 to 2 percent slopes | 6,400 | 2.1 | Rawson loam, 6 to 12 percent slopes, eroded | 413 | .1 |
| Chelsea fine sand, 2 to 6 percent slopes | 4,200 | 1.4 | Rensselaer silt loam | 500 | .2 |
| Chelsea fine sand, 6 to 12 percent slopes | 600 | .2 | Riddles sandy loam, 0 to 2 percent slopes | 1,500 | .5 |
| Crosby loam, 0 to 2 percent slopes | 33,000 | 10.9 | Riddles sandy loam, 2 to 6 percent slopes | 14,250 | 4.7 |
| Crosby loam, 2 to 4 percent slopes | 22,200 | 7.3 | Riddles sandy loam, 6 to 12 percent slopes | 4,800 | 1.6 |
| Del Rey silt loam | 1,500 | .5 | Riddles sandy loam, 12 to 18 percent slopes, eroded | 660 | .2 |
| Dickinson sandy loam | 1,650 | .6 | Riddles sandy loam, 18 to 25 percent slopes, eroded | 670 | .2 |
| Dowagiac loam | 3,900 | 1.3 | Riddles loam, 0 to 2 percent slopes | 1,150 | .4 |
| Edwards muck | 650 | .2 | Riddles loam, 2 to 6 percent slopes, eroded | 11,700 | 3.9 |
| Fox sandy loam, 0 to 2 percent slopes | 4,450 | 1.5 | Riddles loam, 6 to 12 percent slopes, eroded | 1,550 | .5 |
| Fox sandy loam, 2 to 6 percent slopes | 550 | .2 | Sebewa loam | 4,100 | 1.4 |
| Fox sandy loam, 6 to 12 percent slopes, eroded | 236 | (1) | Shoals loam | 1,650 | .6 |
| Gilford sandy loam | 6,500 | 2.2 | Tawas muck | 1,850 | .6 |
| Gilford mucky sandy loam | 1,100 | .4 | Tawas muck, drained | 2,200 | .7 |
| Gravel pit | 465 | .2 | Tedrow loamy sand | 1,350 | .5 |
| Haskins loam, 0 to 2 percent slopes | 1,700 | .6 | Tyner loamy sand, 0 to 2 percent slopes | 9,800 | 3.2 |
| Haskins loam, 2 to 4 percent slopes | 1,600 | .5 | Tyner loamy sand, 2 to 6 percent slopes | 1,000 | .3 |
| Homer loam | 650 | .2 | Tyner loamy sand, 6 to 12 percent slopes | 630 | .2 |
| Linwood muck | 473 | .2 | Volinia loam | 3,800 | 1.3 |
| Made land | 1,600 | .5 | Wallkill silt loam | 488 | .2 |
| Marsh | 2,650 | .9 | Washtenaw silt loam | 770 | .4 |
| Maumee loamy fine sand | 3,250 | 1.1 | Whitaker loam | 380 | .1 |
| Metea loamy fine sand, 0 to 6 percent slopes | 1,300 | .4 | Water | 1,700 | .6 |
| Metea loamy fine sand, 6 to 12 percent slopes | 447 | .2 | Total | 299,520 | 100.0 |
| Miami loam, 2 to 6 percent slopes, eroded | 9,600 | 3.2 | | | |
| Miami loam, 6 to 12 percent slopes, eroded | 4,800 | 1.6 | | | |
| Miami loam, 12 to 18 percent slopes, eroded | 610 | .2 | | | |
| Miami clay loam, 6 to 12 percent slopes, severely eroded | 1,150 | .4 | | | |

[1] Less than 0.1 percent.

wildlife, or woodland, and certain selected areas are suited to outdoor laboratories or recreation. (Capability unit Vw–2)

## Aubbeenaubbee Series

The Aubbeenaubbee series consists of deep, somewhat poorly drained, moderately coarse textured soils. These soils are nearly level and occupy areas of the uplands. They formed under mixed hardwoods in sandy loam drift over loam glacial till.

In a representative profile, the surface layer is about 9 inches of dark-brown sandy loam. The subsurface layer is about 3 inches of grayish-brown sandy loam. The subsoil is about 26 inches thick. The upper part of the subsoil is mottled, light brownish-gray and yellowish-brown, friable sandy loam. The lower part is mottled, yellowish-brown, friable sandy clay loam and heavy loam. The underlying material is friable, mottled, yellowish-brown loam.

Aubbeenaubbee soils have moderately rapid permeability in the sandy loam upper layers and moderate to moderately slow permeability in the finer textured lower part. They have a moderate available moisture capacity, are low in organic-matter content, and have slow surface runoff. Wetness is a limitation. Drained areas are suitable for most crops commonly grown in the county.

Representative profile of an Aubbeenaubbee sandy loam in a cultivated field, 200 feet south and 100 feet east of the center of SW¼SE¼ sec. 31, T. 37 N., R. 5 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) when dry; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—9 to 12 inches, grayish-brown (2.5Y 5/2) sandy loam; many, coarse, distinct, light olive-brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure breaking to weak, medium, granular; friable; many dark yellowish-brown (10YR 4/4) iron stains; slightly acid; clear, wavy boundary.

B11g—12 to 22 inches, light brownish-gray (2.5Y 6/2) sandy loam; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; many dark yellowish-brown (10YR 4/4) iron stains; medium acid; gradual, wavy boundary.

B12g—22 to 26 inches, yellowish-brown (10YR 5/4) light sandy loam; many, coarse, distinct, light brownish-gray

(2.5Y 6/2) mottles; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

IIB22tg—26 to 34 inches, yellowish-brown (10YR 5/4) sandy clay loam; many, coarse, distinct, light brownish-gray (2.5Y 6/2) mottles; moderate, medium, subangular blocky structure; firm; thin clay films on some peds; medium acid; clear, wavy boundary.

IIB23tg—34 to 38 inches, yellowish-brown (10YR 5/4) heavy loam; few, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; friable to slightly firm; slightly acid; clear, wavy boundary.

IIC—38 to 60 inches, yellowish-brown (10YR 5/4) loam till; many, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; massive; friable; mildly alkaline; calcareous.

The solum ranges from 30 to 44 inches in thickness. The sandy drift ranges from 18 to 36 inches in thickness, which is variable within short distances. The B horizon is slightly acid to strongly acid in reaction. The Ap horizon ranges from dark brown (10YR 3/3) to dark grayish brown (10YR 4/2) and dark yellowish brown (10YR 4/4) in color. The B11 and B12 horizons range from sandy loam to loamy sand in texture. The B12 horizon is absent in some areas. The B2 horizon ranges from clay loam to loam. The underlying IIC horizon consists of loam till and in some areas contains thin strata of sand and silt.

Aubbeenaubbee soils are associated with Crosby and Haskins soils. They are coarser textured in the A horizon and upper part of the B horizon than Crosby soils and are coarser textured throughout the profile than Haskins soils.

**Aubbeenaubbee sandy loam** (0 to 2 percent slopes) (Au).—This deep, moderately coarse textured soil is somewhat poorly drained. It is on uplands mostly in the southern part of the county.

Included in mapping are small areas of Metea loamy sand and Riddles sandy loam on slightly higher positions. Slopes are more than 2 percent in some included areas.

Wetness is a limitation for this soil. Most areas are used for crops, such as corn, soybeans, small grain, and meadow. This soil is suited to cropping if it is adequately drained and fertilized. (Capability unit IIw–11)

## Blount Series

The Blount series consists of deep, somewhat poorly drained, medium-textured soils. These soils are nearly level to gently sloping and occupy areas of the glacial till plain. They formed under mixed hardwoods in silty clay loam glacial till.

In a representative profile, the surface layer is dark-brown silt loam about 8 inches thick. The subsurface layer is light brownish-gray, friable silt loam about 3 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish-brown silty clay loam that contains yellowish-brown mottles; the lower part is yellowish-brown silty clay that contains grayish-brown mottles. The underlying material is brown, firm silty clay loam that contains yellowish-brown mottles.

The available moisture capacity is high, and the organic-matter content is medium to low. Permeability is slow, and surface runoff is slow where the soils are nearly level and slow to medium where the soils are gently sloping. Use of these soils is limited by wetness, and erosion is a hazard in sloping areas. Most areas are used for corn, soybeans, small grain, grasses, and forage legumes.

Representative profile of Blount silt loam, 0 to 2 percent slopes, in a cultivated field, 480 feet south and 75 feet west of the northeast corner of the SE¼NE¼ sec. 35, T. 36 N., R. 7 E.:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silt loam, light brownish gray (10YR 6/2) when dry; weak, medium and coarse, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 11 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, faint, brown (10YR 5/3) mottles; very weak, medium to thick, platy structure breaking to weak, fine, subangular blocky; friable; slightly acid; clear, smooth boundary.

B21g—11 to 15 inches, grayish-brown (10YR 5/2) silty clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.

B22t—15 to 23 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, prismatic structure breaking to strong, medium, angular blocky; firm; dark grayish-brown (10YR 4/2) thin to moderately thick clay films on all ped faces; numerous iron-manganese concretions; strongly acid; gradual, smooth boundary.

B23t—23 to 33 inches, yellowish-brown (10YR 5/6) silty clay; many, fine, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, prismatic structure breaking to moderate, medium, angular blocky and subangular blocky; firm, dark-gray (10YR 4/1), thin clay films on most ped faces; medium acid; clear, smooth boundary.

C—33 to 60 inches, brown (10YR 5/3) silty clay loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; massive; firm; moderately alkaline; calcareous.

The solum ranges from 20 to 42 inches in thickness and in most places its depth coincides with the depth to carbonates. The Ap horizon ranges from dark brown to dark grayish brown or brown. The B2 horizons range from heavy silty clay loam to silty clay (with 38 to 48 percent clay). The C horizon ranges from silty clay loam to clay loam glacial till.

Blount soils have profiles similar to those of Haskins and Crosby soils. They have a finer textured A horizon and upper part of the B horizon than Haskins soils. They are finer textured throughout than Crosby soils.

**Blount silt loam, 0 to 2 percent slopes** (BlA).—This nearly level soil is in areas between depressions on the glacial till plain. It has the profile described as representative for the series.

Included in mapping are small areas of Blount soils with slopes of 2 percent or more and small areas of Pewamo silty clay loam in narrow drainageways.

Wetness is a limitation for this soil. Blinding tile with selected materials improves the efficiency of the drainage system. If fertility and soil tilth are maintained, row crops can be grown in most areas. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture if adequately drained and fertilized. In some years frost heaving is a problem for deep-rooted legumes. (Capability unit IIw–2)

**Blount silt loam, 2 to 4 percent slopes, eroded** (BlB2).—This soil is gently sloping. Its profile is similar to that described as representative for the series, except that the surface layer is about 4 inches thinner.

Included with this soil in mapping are small areas of Blount soils that have a thicker surface layer and small areas that have a somewhat coarser textured surface layer.

Wetness is a limitation, and erosion is a hazard on this soil. Erosion can be controlled by suitable conservation practices. This soil is suited to corn, soybeans, small

grain, and grasses and legumes for hay or pasture if adequately drained and fertilized. (Capability unit IIe-12)

## Borrow Pits

Borrow pits (Bp) consists of areas from which the soil material has been removed and, in most cases, has been used for fill. Many of these areas are along the toll road in the northern part of the county. The original soil material has been removed to a depth of 3 to 8 feet. In areas where the water table is shallow, some pits contain water.

Pits that contain water throughout the year are useful for wildlife and recreation. Some areas have been reclaimed for farm use. The farming value of these reclaimed areas is extremely variable. (Capability unit VIIe-3)

## Brady Series

The Brady series consists of deep, somewhat poorly drained, moderately coarse textured soils. These soils are nearly level and occupy drainageways of the outwash plains along the major streams of the county (fig. 6). They formed under mixed hardwoods in moderately coarse textured outwash material and are underlain by loose sand and gravel at a depth of 42 to 66 inches.

In a representative profile, the surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is about 6 inches of brown, friable sandy loam that contains dark yellowish-brown mottles. The subsoil is about 35 inches thick and is friable. The upper 16 inches is dark yellowish-brown sandy loam and contains grayish-brown mottles. The lower part is brown loamy sand that contains yellowish-brown mottles. The underlying material, to a depth of 60 inches, is loose, pale-brown sand that contains yellowish-brown mottles and is about 10 percent gravel.

Brady soils have a low available moisture capacity and are medium or low in content of organic matter. They have moderately rapid permeability and slow surface runoff. Wetness is a limitation. Drained areas are suited to most crops commonly grown in the county.

*Figure 6.*—**Plowing Brady sandy loam along the Little Elkhart River. The dark-colored soil is Gilford sandy loam.**

Representative profile of Brady sandy loam in a cultivated field, 250 feet south and 50 feet west of the northeast corner of sec. 16, T. 35 N., R. 7 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3), sandy loam, grayish brown (10YR 5/2) when dry; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—9 to 15 inches, brown (10YR 5/3) sandy loam; few, medium, faint, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, granular structure; friable; slightly acid; clear, wavy boundary.

B2t—15 to 31 inches, dark yellowish-brown (10YR 4/4) sandy loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; friable; thin clay films on peds; some manganese and iron concretions; medium acid; gradual, wavy boundary.

IIB3—31 to 50 inches, brown (10YR 5/3) loamy sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; 5 percent gravel; neutral; abrupt, irregular boundary.

IIC—50 to 60 inches, pale-brown (10YR 6/3) sand; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; 10 percent gravel; mildly alkaline; calcareous.

The solum ranges from 42 to 66 inches in thickness. The Ap horizon ranges from very dark gray (10YR 3/1) to dark brown (10YR 3/3) in color. The A2 horizon is brown (10YR 5/3), pale brown (10YR 6/3), or yellowish brown (10YR 5/4) and contains yellowish-brown (10YR 5/4–5/8) or dark yellowish-brown (10YR 4/4) mottles. The A horizon is 12 to 18 inches thick. The B2 horizon is dominantly sandy loam but ranges to sandy clay loam. The gravel content of the solum ranges from 0 to 15 percent, and the amount is higher near the larger streams. The B2 horizon ranges from dark yellowish brown (10YR 4/4) to brown (10YR 5/3) or yellowish brown (10YR 5/4). Mottles are common to many and grayish brown (10YR 5/2) to yellowish brown (10YR 5/6). The C horizon is sand or stratified layers of sand and gravel.

Brady soils are associated with Homer and Tedrow soils. They have a coarser textured solum than Homer soils and a finer textured solum than Tedrow soils.

**Brady sandy loam** (0 to 2 percent slopes) (Br).—This soil is in drainageways on outwash plains along the major streams.

Included in mapping are small areas of Bronson sandy loam. Also included are some areas of Brady soils that have a surface layer of loamy sand and some areas of soils that have a high iron content, are yellowish orange in color, and have a very sticky consistence. Little knowledge of any variation in crop response is available, but there are indications that these yellowish-orange soils may have a higher available moisture capacity than the surrounding Brady soil.

Wetness is a limitation for this soil. If the soil is artificially drained, special blinding is needed around the tile to keep the sand from entering. During prolonged dry periods, this soil is somewhat droughty. If adequately drained, this soil is suited to corn, soybeans, small grain, grasses, and legumes for hay or pasture. (Capability unit IIIw-4)

## Brems Series

The Brems series consists of deep, moderately well drained, coarse-textured soils. These soils are nearly level and occupy shallow drainageways of the sandy outwash plains. They formed under mixed hardwoods in sandy

outwash material. They are underlain by sand at a depth of 35 to 70 inches.

In a representative profile, the surface layer is dark-brown loamy fine sand about 9 inches thick. The subsurface layer is light yellowish-brown fine sand about 3 inches thick. The subsoil is about 25 inches of fine sand. The upper part is very friable, yellowish-brown fine sand, and the lower part is loose, light yellowish-brown sand that contains light brownish-gray mottles. The underlying material is loose, yellowish-brown sand that contains light brownish-gray mottles.

Brems soils have a very low available moisture capacity and are low in content of organic matter. They have rapid permeability and very slow surface runoff. Use of these soils is limited by droughtiness. The soils are suited to grasses and legumes for forage, and to trees.

Representative profile of Brems loamy fine sand in a cultivated field, 100 feet west and 20 feet south of the northeast corner of the SW¼ sec. 11, T. 38 N., R. 5 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) when dry; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A2—9 to 12 inches, light yellowish-brown (10YR 6/4) fine sand; very weak, medium, granular structure; very friable to loose; slightly acid; clear, wavy boundary.

B21—12 to 27 inches, yellowish-brown (10YR 5/4) fine sand; very weak, subangular blocky structure to structureless; very friable; medium acid; clear, wavy boundary.

B22—27 to 37 inches, light yellowish-brown (10YR 6/4) sand; common, fine, faint, yellowish-brown (10YR 5/6) and light brownish-gray (10YR 6/2) mottles; single grain; loose; strongly acid; clear, smooth boundary.

C—37 to 60 inches, yellowish-brown (10YR 5/4) sand; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; single grain; loose; mainly strongly acid but becoming slightly acid in lower part.

The solum ranges from 35 to 70 inches in thickness. The Ap horizon ranges from very dark grayish brown to dark brown in color. The A2 horizon ranges from yellowish brown to light yellowish brown, and the B2 horizon from yellowish brown to dark yellowish brown. The depth to mottling ranges from 20 to 30 inches. In some areas there are thin, discontinuous, dark-brown bands within the C horizon at a depth below 50 to 60 inches. The A horizon ranges from neutral to strongly acid in reaction, and the B horizon from medium to strongly acid.

Brems soils have a profile similar to that of Bronson soils. They have less clay in the B horizon than Bronson soils.

**Brems loamy fine sand** (0 to 2 percent slopes) (Bu).—This soil is in shallow drainageways on sandy outwash plains.

Included in mapping are small areas of Tedrow loamy sand and small areas of Brems soils that have slopes of more than 2 percent. Included in some areas are Brems soils that have a subsoil of loamy sand.

Droughtiness is the major limitation. In areas where the soil is bare of vegetation, soil blowing is a hazard during dry periods. This soil is suited to grasses and legumes for hay and pasture and is also suited to trees. If irrigated, this soil is suited to all crops commonly grown in the county, including berries and ornamental shrubs. (Capability unit IVs-1)

## Bronson Series

The Bronson series consists of deep, moderately well drained, moderately coarse textured soils. These soils are nearly level and occupy areas near depressions and in drainageways of the outwash plains along the main drainageways of the county. They formed under mixed hardwoods in moderately coarse textured outwash material underlain by loose sand and gravel.

In a representative profile, the surface layer is dark-brown sandy loam about 9 inches thick. The subsoil is friable, brown and yellowish-brown sandy loam about 37 inches thick. Grayish-brown and brown mottles are common below a depth of 25 inches. The underlying material, to a depth of 60 inches, is light brownish-gray, loose sand and gravel.

Bronson soils have a low available moisture capacity and low organic-matter content. They have moderately rapid permeability and slow runoff. Droughtiness is a limitation. These soils are suited to corn, soybeans, small grain, and grass and legumes for hay and pasture. They can also be used for trees.

Representative profile of Bronson sandy loam in a cultivated field, 600 feet east and 150 feet north of the southwest corner of the SE¼SE¼ sec. 36, T. 37 N., R. 5 E.:

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

B1—9 to 20 inches, brown (10YR 5/3) sandy loam; weak, medium, subangular blocky structure; friable; few iron and managnese concretions; about 10 percent fine gravel; neutral; clear, wavy boundary.

B21t—20 to 25 inches, yellowish-brown (10YR 5/4) sandy loam; weak, medium, subangular blocky structure; friable; few iron and manganese concretions; medium acid; clear, wavy boundary.

B22t—25 to 42 inches, dark yellowish-brown (10YR 4/4) sandy loam; common, coarse, faint, dark grayish-brown (10YR 4/2) mottles and common, medium, faint, brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; friable; about 20 percent fine gravel; thin, reddish-brown (5YR 4/4) clay films on some peds; medium acid; clear, irregular boundary.

B23t—42 to 46 inches, dark-brown (10YR 3/3) light sandy clay loam; many, medium, faint, dark grayish-brown (10YR 4/2) mottles; moderate, medium, subangular blocky structure; firm; few, dark reddish-brown (5YR 3/2) iron-manganese concretions; thin, very dark grayish-brown (10YR 3/2) clay films on some peds; mainly medium acid but becoming neutral in lower part; abrupt, irregular boundary.

IIC—46 to 60 inches, light brownish-gray (10YR 6/2), stratified sand and fine gravel; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 42 to 66 inches in thickness. The Ap horizon ranges from dark brown to dark grayish brown in color. The B horizon is dominantly sandy loam but ranges to sandy clay loam. In some areas the lower part of the B horizon is loamy sand with thin, discontinuous sandy loam bands. Mottles of low chroma occur below a depth of 18 to 24 inches.

Bronson soils are associated with the Brems and Fox soils. They have a finer textured solum than Brems soils and a coarser textured B horizon than Fox soils.

**Bronson sandy loam** (0 to 2 percent slopes) (Bv).—This soil is near depressions and in drainageways.

Included in mapping are small areas of Oshtemo loamy sand and Brady sandy loam. Also included are some areas of Bronson soils that have a surface layer of loamy sand.

Droughtiness is a limitation. Runoff is slow. Most areas are used for corn, soybeans, small grain, and grasses and

legumes for hay and pasture. If irrigated, this soil is suited to special crops, such as truck crops. (Capability unit IIIs-2)

## Brookston Series

The Brookston series consists of deep, poorly drained, medium-textured soils. These soils occupy broad flats, swales, and narrow drainageways (fig. 7). They formed under mixed hardwoods in loam glacial till.

In a representative profile, the surface layer is about 9 inches of very dark gray silt loam and about 6 inches of very dark grayish-brown light clay loam. The subsoil is about 31 inches of grayish-brown, firm clay loam that contains yellowish-brown mottles. The underlying material, to a depth of 60 inches, is friable to firm, yellowish-brown loam that contains grayish-brown mottles.

Brookston soils have a high available moisture capacity and are high in content of organic matter. They have slow permeability and slow surface runoff. Use of these soils is seriously limited by wetness. Drained areas are suited to most crops commonly grown in the county.

Representative profile of Brookston silt loam in a cultivated field, 120 feet north and 200 feet east of the southwest corner of NW¼ sec. 26, T. 35 N., R. 4 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silt loam; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A12—9 to 15 inches, very dark grayish-brown (10YR 3/2) light clay loam; weak, medium, subangular blocky structure; friable; neutral; clear, smooth boundary.

B21tg—15 to 23 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium and coarse, prismatic structure breaking to moderate, medium, angular blocky; firm; thin, dark-gray (10YR 4/1) clay films on most peds; neutral; clear, wavy boundary.

B22tg—23 to 46 inches, grayish-brown (2.5Y 5/2) clay loam; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium and coarse, prismatic structure breaking to moderate, medium, angular blocky; firm; thin, dark-gray (10YR 4/1) clay films on many peds; mainly neutral but mildly alkaline in the lower part; abrupt, wavy boundary.

C—46 to 60 inches, yellowish-brown (10YR 5/4) loam; many, coarse, distinct, grayish-brown (10YR 5/2) mottles; massive; friable to firm; mildly alkaline; calcareous.

*Figure 7.*—**The dark-colored soil in the swale is Brookston silt loam; lighter colored soil is Crosby loam, 0 to 2 percent slopes.**

The solum ranges from 30 to 50 inches in thickness. The Ap horizon ranges from black to very dark gray or very dark brown in color. The A1 horizon ranges from silt loam to silty clay loam in texture and from very dark gray to very dark grayish brown in color. The B horizon is clay loam or silty clay loam, and the C horizon is loam or light clay loam. The Bg horizon has a higher clay content in areas near Del Rey soils than in areas near Crosby soils.

Brookston soils are associated with Pewamo and Rensselaer soils. They have coarser textured B and C horizons than Pewamo soils. Brookston soils are underlain by loam till, whereas Rensselaer soils are underlain by stratified silt and sand.

**Brookston silt loam** (0 to 2 percent slopes) (Bw).—This soil occupies flats and depressions in the uplands.

Included in mapping are small areas of Washtenaw soils and of lighter colored Crosby soils. Also included are some areas of Brookston soils that have a surface layer of loam.

Wetness is a major limitation. Most areas are used for corn, soybeans, and small grain. If drained, this soil is suited to these crops. Undrained areas provide wildlife habitat. (Capability unit IIw-1)

## Carlisle Series

The Carlisle series consists of deep, black, very poorly drained organic soils. These soils occupy depressional areas of the uplands and outwash plains. The depressions were ponded areas in which plant remains accumulated over a long period of time. Carlisle soils developed under marsh vegetation in deep deposits of partially decomposed organic material.

In a representative profile, the surface layer is black muck about 7 inches thick. Below the surface layer is about 15 inches of black, friable muck that contains small amounts of peat. The organic material, to a depth of 60 inches, is black, friable muck that contains many, partially decomposed, dark-brown, fibrous and woody peat fragments.

Carlisle soils have a high available moisture capacity and very high organic-matter content. The permeability is moderately rapid, and surface runoff is very slow. Wetness is the major limitation. These soils are suited to row crops if fertility and wetness are controlled.

Representative profile of Carlisle muck, drained, in a cultivated field, 100 feet south and 30 feet east of the northwest corner of SE¼SW¼ sec. 26, T. 37 N., R. 6 E.:

Oa1—0 to 7 inches, black (10YR 2/1) muck; weak, coarse and very coarse, granular structure; friable; slightly acid; gradual, smooth boundary.

Oa2—7 to 22 inches, black (10YR 2/1) muck that contains small amounts of partially decomposed peat; weak, medium, granular structure; friable; neutral; diffuse, wavy boundary.

Oa3—22 to 60 inches, black (10YR 2/1) muck mixed with dark-brown (10YR 3/3), fibrous and woody peat (40 percent); neutral.

The organic deposits are more than 60 inches thick and range from medium acid to neutral in reaction. The Oa1 horizon ranges from black to very dark brown in color. The lower

horizons vary as to content and composition of peat fragments from few to many and from woody to fibrous.

Carlisle soils are associated with the Tawas, Linwood, and Edwards soils. They are thicker than Tawas soils, which are underlain by sand at a depth of 12 to 42 inches. They are also thicker than Linwood soils, which are underlain by loamy mineral material at a depth of 12 to 42 inches, or Edwards soils, which are underlain by marl at a depth of 12 to 42 inches.

**Carlisle muck** (0 to 2 percent slopes) (Ca).—This soil occupies undrained depressions. The profile is similar to that described as representative for the series, except that the mucky upper layers are thinner and the brownish, fibrous and woody peat is nearer the surface. These areas are covered with shallow water, or the water table is near the surface most of the year.

Included in mapping are small areas of Carlisle soils that have less than 42 inches of organic soil over mineral soil material. In some places the organic material below the surface layer is mostly peat.

Wetness is a severe limitation. In many cases drainage outlets cannot be located. Only a small percentage of the acreage is cropped and then only during dry years. Some areas are in native grass pastures. Many areas are used by wetland wildlife, and some areas provide food and cover for other wildlife. (Capability unit Vw–2)

**Carlisle muck, drained** (0 to 2 percent slopes) (Cd).—This soil occupies large, depressional areas. These areas have been drained, and the water table is about 30 inches below the surface through most of the year. This soil has the profile described as representative for the series.

Included in mapping are small areas of Carlisle soils that have less than 42 inches of organic soil over mineral soil material. Also included are small areas of Wallkill silt loam. In some areas the organic material below the surface layer is very high in content of peat and there are a few thin lenses of clay or sand in the muck or peat.

Wetness is a severe limitation for this soil. If the soil is dry and bare of vegetation, soil blowing is a hazard. Row crops can be grown each year if fertility and drainage are controlled. Most areas are used for corn and soybeans. They are also suited to many kinds of truck crops. (Capability unit IIIw–8)

## Chelsea Series

The Chelsea series consists of deep, excessively drained, coarse-textured soils. These soils are nearly level to moderately sloping and occur on sandy outwash plains and uplands. They formed under mixed hardwoods in sandy outwash materials.

In a representative profile, the surface layer is dark-brown fine sand about 8 inches thick. The subsurface layer is fine sand about 15 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. Below this, to a depth of 60 inches, is brown, loose fine sand that contains bands of dark-brown loamy fine sand ¼ to 1½ inches thick and totaling about 4 inches in thickness. The underlying material is pale-brown, loose fine sand.

Chelsea soils have a very low available moisture capacity and low organic-matter content. They have very rapid permeability and slow runoff. Droughtiness is a limitation for these soils, and they are subject to soil blowing. These soils are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. If irrigated, they are suited to all crops grown in the county, including truck crops.

Representative profile of Chelsea fine sand, 2 to 6 percent slopes, in a cultivated field, 300 feet west and 50 feet north of the southeast corner of NE¼SW¼ sec. 8, T. 37 N, R. 6 E.:

Ap—0 to 8 inches, dark-brown (10YR 3/3) fine sand, pale brown (10YR 6/3) when dry; very weak, medium and coarse, granular structure; very friable; neutral; abrupt, smooth boundary.

A21—8 to 19 inches, dark grayish-brown (10YR 4/2) fine sand; very weak, medium, subangular blocky structure to structureless; very friable; medium acid; gradual, smooth boundary.

A22—19 to 23 inches, dark-brown (7.5YR 4/4) fine sand; weak, medium, subangular blocky structure; very friable; medium acid; clear, wavy boundary.

A23 & B2t—23 to 60 inches, brown (10YR 5/3) fine sand; single grain; loose; bands of dark-brown (7.5YR 4/4) loamy fine sand, ¼ to 1½ inches thick and 4 to 7 inches apart, totaling 4 inches in thickness; medium acid; clear, wavy boundary.

C—60 to 68 inches, pale-brown (10YR 6/3) fine sand; single grain; loose; slightly acid to neutral.

The solum ranges from 4 to many feet in thickness. The A horizon is dominantly fine sand but ranges to loamy sand in some areas. The A horizon ranges from very dark grayish brown to brown in color, and the A23 horizon ranges from brown to yellowish brown. The B2t bands range from dark yellowish brown to dark brown and from loamy fine sand to sandy loam.

Chelsea soils are associated with the Plainfield and Tyner soils. They have finer textured strata within the B horizon than Plainfield soils. They have a coarser textured A horizon than Tyner soils. They have discontinuous, wavy bands of loamy sand within the B horizon, whereas Tyner soils have a continuous loamy sand B horizon.

**Chelsea fine sand, 0 to 2 percent slopes** (ChA).—This nearly level soil occupies the broad sandy outwash plains.

Included in mapping are small areas of Plainfield fine sand. Also included are a few blowouts in some areas where soil blowing has been severe. The surface layer is loamy sand in some areas.

Droughtiness is a limitation, and soil blowing is a hazard on this soil. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay and pasture. The soil also is suited to trees and permanent pasture. If irrigated, this soil is suited to special crops, including truck crops. (Capability unit IIIs–1)

**Chelsea fine sand, 2 to 6 percent slopes** (ChB).—This gently sloping soil is on sandy outwash plains and uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Chelsea soils that have slopes of less than 2 percent and areas that have a loamy sand surface layer.

Droughtiness is a limitation, and soil blowing is a hazard on this soil. Most areas are used for crops that are common in the county. If irrigated, this soil is suited to special crops, including truck crops. (Capability unit IIIs–1)

**Chelsea fine sand, 6 to 12 percent slopes** (ChC).—This moderately sloping soil occupies knolls and ridges of the sandy plains and uplands. Its profile is similar to that described as representative for the series, except that the surface layer is thinner and lighter colored.

Included in mapping are small areas of Plainfield fine sand and Tyner loamy sand. A few areas of Chelsea soils that have slopes of 12 to 18 percent also are included.

Erosion is a hazard on this soil, and droughtiness is a limitation. If suitable conservation practices are used, row crops can be grown frequently. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. This soil is suited to small grain, permanent pasture, and trees. (Capability unit IIIe–12)

## Crosby Series

The Crosby series consists of deep, somewhat poorly drained, medium-textured soils. These soils are nearly level and gently sloping and occupy upland areas of the glacial till plain. They formed under mixed hardwoods in medium-textured glacial till.

In a representative profile, the surface layer is about 9 inches of dark-brown loam and the subsurface layer is about 4 inches of light brownish-gray, friable loam. The subsoil is about 21 inches of grayish-brown and yellowish-brown, firm clay loam. The underlying material, to a depth of 60 inches, is brown, friable light clay loam glacial till that grades to loam.

Crosby soils have a high available moisture capacity and low organic-matter content. They have slow permeability and slow surface runoff. Wetness is a limitation. If wetness is controlled, these soils are suited to corn, soybeans, and small grain. They can also be used for pasture and hay crops.

Representative profile of Crosby loam, 0 to 2 percent slopes, in a cultivated field, 450 feet east and 210 feet north of the southwest corner of sec. 30, T. 37 N, R. 5 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) loam, light brownish-gray (10YR 6/2) when dry; weak, medium and coarse, granular structure; friable; neutral; clear, smooth boundary.

A2—9 to 13 inches, light brownish-gray (10YR 6/2) loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, granular structure; friable; slightly acid; gradual, smooth boundary.

B21tg—13 to 24 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure breaking to moderate, medium and coarse, subangular blocky; firm; thin, dark-gray (10YR 4/1) clay films on most peds; some iron-manganese concretions; strongly acid; diffuse, smooth boundary.

B22t—24 to 34 inches, yellowish-brown (10YR 5/4) clay loam; many, coarse, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium and coarse, subangular blocky structure; firm; thin, dark-gray (10YR 4/1) clay films on many peds; many iron-manganese concretions; neutral; gradual, smooth boundary.

C—34 to 60 inches, brown (10YR 5/3) light clay loam, grading to loam with depth; massive; friable; light-gray (10YR 7/2) lime coatings on peds; mildly alkaline; calcareous.

The solum ranges from 24 to 38 inches in thickness. The Ap horizon is loam and ranges from very dark grayish brown to dark brown or dark yellowish brown in color. The A2 horizon ranges from light brownish gray to pale brown or grayish brown. The B2 horizon ranges from silty clay loam to light clay loam and from dark grayish brown to light yellowish brown. The C horizon is loam or light clay loam.

The Crosby soils are associated with the Haskins, Del Rey, and Aubbeenaubee soils. They are coarser textured in the lower part of the B horizon and in the C horizon than Haskins soils. They are coarser textured throughout the profile than Del Rey soils. They are finer textured in the A horizon and in the upper part of the B horizon than Aubbeenaubee soils.

**Crosby loam, 0 to 2 percent slopes** (CrA).—This nearly level soil occupies areas between depressions and the small drainageways of the glacial till plains. It has the profile described as representative for the series.

Included in mapping were small areas of Crosby soils having slopes of more than 2 percent and areas of Brookston silt loam. Some areas of Crosby soils that have a silt loam surface layer and a silty clay loam subsoil also are included.

Wetness is a limitation for this soil. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay and pasture. If adequately drained, this soil is suited to these crops. It can also be used for permanent pasture and for trees tolerant of excessive wetness. (Capability unit IIw–2)

**Crosby loam, 2 to 4 percent slopes** (CrB).—This soil is gently sloping. Its profile is similar to that described as representative for the series, except that the surface layer is thin and lighter colored in some areas.

Included in mapping are small areas of Miami loam or Riddles loam on low ridges. Some small areas of Crosby soils that have a silt loam surface layer and a silty clay loam subsoil also are included.

Wetness is a limitation, and erosion is a hazard on this soil. If wetness and erosion are controlled, this soil is suited to corn, soybeans, and wheat. It also can be used for permanent pasture and for trees tolerant of excessive wetness. (Capability unit IIe–12)

## Del Rey Series

The Del Rey series consists of deep, somewhat poorly drained, medium-textured soils. These soils are nearly level and occupy areas on lakebed plains. They formed under mixed hardwoods in stratified, moderately fine textured and medium-textured sediments that settled out of slow-moving water in shallow lakes and stream backwaters.

In a representative profile, the surface layer is dark grayish-brown silt loam about 7 inches thick. The subsurface layer is light brownish-gray, friable silt loam about 2 inches thick. The subsoil is about 29 inches thick. The upper 4 inches is mottled, grayish-brown, firm light silty clay loam. The next 10 inches is mottled, grayish-brown, very firm silty clay. The next 7 inches is mottled, light olive-brown, firm heavy silty clay loam, and the lower 8 inches is mottled, yellowish-brown, firm light silty clay loam. The underlying material, to a depth of 60 inches, is light brownish-gray, firm heavy silt loam that contains brownish-yellow and light brownish-gray mottles.

Del Rey soils have a high available moisture capacity and low organic-matter content. They have slow permeability and slow surface runoff. Wetness is a limitation. Drained areas are suited to crops commonly grown in the county.

Representative profile of a Del Rey silt loam in a cultivated field, 500 feet east and 200 feet north of the southwest corner of sec. 10, T. 36 N., R. 4 E.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium and coarse, granular structure; friable; neutral; abrupt, smooth boundary.

A2—7 to 9 inches, light brownish-gray (10YR 6/2) silt loam; common, medium, distinct, brown (10YR 5/3) mottles; moderate, fine and medium, granular structure; friable; many iron-manganese concretions; neutral; clear, smooth boundary.

B21tg—9 to 13 inches, grayish-brown (10YR 5/2) light silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) and light-gray (10YR 7/2) mottles; moderate, medium and coarse, subangular blocky structure; firm; medium acid; clear, smooth boundary.

B22tg—13 to 23 inches, grayish-brown (2.5Y 5/2) silty clay; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, angular blocky structure; very firm; thin, dark grayish-brown (2.5Y 4/2) and very dark grayish-brown (2.5Y 3/2) clay films on most peds; few iron-manganese concretions; strongly acid; clear, smooth boundary.

B23t—23 to 30 inches, light olive-brown (2.5Y 5/4) heavy silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) and grayish-brown (2.5Y 5/2) mottles; moderate, medium, subangular blocky and angular blocky structure; firm; thin, dark grayish-brown (2.5Y 4/2) clay films on most peds; strongly acid; gradual, smooth boundary.

B3—30 to 38 inches, yellowish-brown (10YR 5/6) light silty clay loam; many, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; weak, medium and coarse, subangular blocky structure; firm; neutral; clear, smooth boundary.

Cg—38 to 60 inches, light brownish-gray (2.5Y 6/2) heavy silt loam; many, medium, distinct, brownish-yellow (10YR 6/6) and light brownish-gray (2.5Y 6/2) mottles; massive; firm; many gray (10YR 6/1) lime concretions; high silt content; mildly alkaline; calcareous.

The solum ranges from 24 to 48 inches in thickness. The A horizon is dominantly silt loam but ranges to loam in some areas. The Ap horizon ranges from very dark grayish brown to dark grayish brown in color. The B2 horizon ranges from light silty clay loam to silty clay and contains 35 to 45 percent clay. Dominant colors are grayish brown and yellowish brown. The underlying material is stratified and ranges from silt loam to silty clay loam. In some areas it has thin layers of fine sand or silt.

Del Rey soils are associated with Crosby and Whitaker soils. They are underlain by moderately fine textured, stratified lacustrine material, whereas Crosby soils are underlain by medium-textured glacial till. They have a lower sand content in the B horizon than the Whitaker soils and lack the stratified fine sand and silt underlying material of those soils. They are less permeable than Whitaker soils.

**Del Rey silt loam** (0 to 2 percent slopes) (De).—This soil occupies lakebed plains and slack water areas.

Included in mapping are small areas of Brookston silt loam and small areas of Del Rey soils that have slopes of more than 2 percent.

Wetness is a limitation for this soil. If adequately drained, it is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. It can also be used for permanent pasture and for trees tolerant of excessive wetness. (Capability unit IIw–2)

## Dickinson Series

The Dickinson series consists of deep, somewhat excessively drained, moderately coarse textured soils that formed under prairie grasses in loamy outwash material. These soils are nearly level and occupy areas of the outwash plains.

In a representative profile, the surface layer is very dark brown and dark-brown sandy loam about 14 inches thick. The subsoil is about 26 inches thick. The upper 16 inches is dark-brown, friable sandy loam, and the next 10 inches is dark yellowish-brown, loose loamy sand. The underlying material consists of two parts. The upper part is light yellowish-brown, loose sand that contains about 10 percent gravel. The lower part is very pale brown coarse sand and gravel.

Dickinson soils have a low available moisture capacity and high organic-matter content. They have moderately rapid permeability and slow runoff. Although droughtiness is a limitation, these soils are suited to all crops grown in the county, including truck crops.

Representative profile of Dickinson sandy loam in a cultivated field, 500 feet south and 250 feet west of the northeast corner of the NW¼SW¼ sec. 2, T. 37 N., R. 5 E.:

Ap—0 to 10 inches, very dark brown (10YR 2/2) sandy loam; moderate, medium, granular structure; friable; strongly acid; clear, smooth boundary.

A1—10 to 14 inches, dark-brown (10YR 3/3) sandy loam; moderate, medium, granular structure; friable; strongly acid; abrupt, smooth boundary.

B2—14 to 30 inches, dark-brown (7.5YR 4/4) sandy loam that contains about 10 percent gravel; weak, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

IIB3—30 to 40 inches, dark yellowish-brown (10YR 4/4) loamy sand that contains about 10 percent gravel; very weak, subangular blocky structure to structureless; loose; medium acid; gradual, wavy boundary.

IIC1—40 to 60 inches, light yellowish-brown (10YR 6/4) sand that contains about 10 percent gravel; single grain; loose; slightly acid; clear, irregular boundary.

IIC2—60 to 66 inches, very pale brown (10YR 7/3) coarse sand and gravel; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 36 to 50 inches in thickness. The Ap horizon is sandy loam and ranges from very dark brown to very dark gray in color. The A1 horizon ranges from very dark grayish brown to dark brown. The B horizon ranges from dark brown in the upper part to dark yellowish brown in the lower part. The underlying material is sand or sand and gravel.

Dickinson soils are associated with the Volinia and Dowagiac soils. They have a coarser textured B horizon than Volinia soils. They have a darker colored A horizon and a coarser textured B horizon than Dowagiac soils.

**Dickinson sandy loam** (0 to 2 percent slopes) (Dk).—This soil is on sandy outwash plains.

Included in mapping, around small depressions, are small areas of Dickinson soils having gentle and moderate slopes. These soils generally have a thinner and lighter colored surface layer than this Dickinson sandy loam.

Droughtiness is a limitation for this soil. Most areas are used for and are suited to corn, soybeans, and wheat. They can also be used for permanent pasture and trees. (Capability unit IIIs–2)

## Dowagiac Series

The Dowagiac series consists of deep, well-drained, medium-textured soils that formed in loamy outwash underlain by loose sand and gravel. These soils are nearly level and occupy outwash plains.

In a representative profile, the surface layer is very dark grayish-brown loam about 9 inches thick. The subsurface layer is dark brown, friable loam about 4 inches thick. The subsoil is about 39 inches thick. The upper 23 inches is dark-brown, firm sandy clay loam. The next 16

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inches is brown, very friable loamy sand that contains discontinuous bands of dark yellowish-brown sandy loam, 1 to 3 inches thick and 4 to 8 inches apart. The underlying material is yellowish-brown, loose coarse sand in the upper part and pale-brown, loose coarse sand and fine gravel in the lower part.

Dowagiac soils have a moderate available moisture capacity and high organic-matter content. They have moderate permeability and slow runoff. Use of these soils is limited by droughtiness. They are suited to all crops grown in the county.

Representative profile of Dowagiac loam in a cultivated field, 60 feet south and 160 feet west of the northeast corner of the NW¼NW¼ sec. 18, T. 36 N., R. 6 E.:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam; weak to moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A2—9 to 13 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable; neutral; clear, smooth boundary.

B2t—13 to 36 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium and coarse, subangular blocky structure; firm; few, thin clay films on peds; strongly acid; clear, wavy boundary.

IIB3&B2—36 to 52 inches, brown (10YR 5/3) loamy sand that contains discontinuous bands of dark yellowish-brown (10YR 3/4) sandy loam, 1 to 3 inches thick and 4 to 8 inches apart; weak, medium, subangular blocky structure to massive; very friable; strongly acid; clear, wavy boundary.

IIIC1—52 to 68 inches, yellowish-brown (10YR 5/4) coarse sand; single grain; loose; medium acid; clear, wavy boundary.

IIIC2—68 to 72 inches, pale-brown (10YR 6/3) coarse sand and fine gravel; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 40 to 60 inches in thickness. The Ap horizon is very dark grayish brown or dark brown. The B2t horizon ranges from clay loam to gravelly sandy clay loam in texture. The B3 horizon ranges from sandy loam to loamy sand or sand, and in some areas the sandy loam bands or strata are absent from this horizon. The C horizon is coarse sand or coarse sand and gravel.

Dowagiac soils are associated with Dickinson, Volinia, and Fox soils. They have a lighter colored A horizon and a finer textured B horizon than Dickinson soils. They have a thinner, dark-colored A horizon than Volinia soils and are deeper over sand and gravel than Fox soils.

**Dowagiac loam** (0 to 2 percent slopes) (Do).—This soil occupies outwash plains.

Included in mapping are small areas of Dowagiac soils having slopes of more than 2 percent. These soils generally have a thinner and lighter colored surface layer than this Dowagiac soil.

Droughtiness is a limitation for this soil. Most areas are used for and are suited to corn, soybeans, and wheat. They are also suited to pasture and trees. (Capability unit IIs–2)

## Edwards Series

The Edwards series consists of black, very poorly drained organic soils in depressional areas of the uplands, outwash areas, and lakebeds. These soils formed under swamp vegetation in deposits of partially decomposed organic material over marl.

In a representative profile, the surface layer is black muck about 11 inches thick. Below the surface layer is about 15 inches of dark, reddish-brown, friable muck that contains partially decomposed woody fragments and other plant remains. The underlying mineral material, to a depth of 60 inches, is gray marl that contains some shell fragments.

Edwards soils have a high available moisture capacity and very high organic-matter content. Permeability is moderately rapid in the organic layers and variable in the underlying marl. Runoff is very slow. Wetness is a severe limitation. If wetness is controlled, these soils are suited to all crops commonly grown in the county.

Representative profile of Edwards muck in a cultivated field, 50 feet east of the northwest corner of the SW¼ sec. 33, T. 38 N., R. 6 E.:

Oa1—0 to 11 inches, black (10YR 2/1) muck; moderate, medium and coarse, granular structure; friable; slightly acid; abrupt, smooth boundary.

Oa2—11 to 26 inches, dark reddish-brown (5YR 2/2) muck; weak, medium and coarse, granular structure; friable; many partially decomposed woody fragments; few shell fragments; slightly acid in upper part, becoming alkaline in lower part; abrupt, wavy boundary.

IILca—26 to 60 inches, gray (N 5/0) marl; structureless (massive); friable; few shell fragments; many partially decomposed remains of grassy plants in upper 2 inches of marl; moderately alkaline; calcareous.

The organic deposits range from 12 to 42 inches in thickness. The Oa1 horizon ranges from black to very dark brown in color, and the Oa2 horizon ranges from black to dark reddish brown. The underlying marl has a wide range of purity and color, and the upper layers of marl contain partially decomposed organic fragments.

Edwards soils are associated with Carlisle, Tawas, and Linwood soils. They have organic layers that are much thinner than those of Carlisle soils. They are underlain by marl, whereas Tawas soils are underlain by sand and Linwood soils are underlain by loam.

**Edwards muck** (0 to 2 percent slopes) (Ed).—This soil is in depressional areas of the uplands and outwash areas.

Included in mapping are small areas of Edwards soils in which the deposits of organic material are either deeper or more shallow than in this soil.

Wetness is a severe limitation for this soil. Soil blowing is a hazard if the soil is dry and bare of vegetation. Row crops can be grown each year if fertility and wetness are controlled. Most areas are used for corn and soybeans. This soil also is suited to truck crops. (Capability unit IVw–3)

## Fox Series

The Fox series consists of moderately coarse textured soils that are moderately deep over loose sand and gravel. These soils formed under mixed hardwoods in loamy outwash material. They are nearly level to moderately sloping and occupy outwash plains and knolls and ridges.

In a representative profile, the surface layer is dark-brown sandy loam about 9 inches thick. The subsurface layer is brown, friable light sandy loam about 4 inches thick. The subsoil is about 23 inches thick. The upper 3 inches is dark yellowish-brown, firm light sandy clay loam, the next 14 inches is dark-brown, firm sandy clay loam, and the lower 6 inches is dark reddish-brown, firm gravelly sandy clay loam. Tongue-like projections of the reddish-brown subsoil (fig. 8) extend into the underlying pale-brown, loose, stratified sand and gravel.

*Figure 8.*—**Loose sand and gravel have been removed to show these conical tongues of a Fox sandy loam.**

Fox soils have a moderate available moisture capacity and low organic-matter content. They have moderate permeability. Runoff is slow on the nearly level soils and rapid on the sloping soils. Droughtiness is a serious limitation for these soils, and erosion is a hazard on the sloping soils. Fox soils are suited to all crops commonly grown in the county.

Representative profile of Fox sandy loam, 0 to 2 percent slopes, in a cultivated field, 500 feet east and 200 feet north of the southwest corner of NW¼ sec. 23, T. 35 N., R. 7 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) when dry; weak, medium and coarse, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—9 to 13 inches, brown (10YR 4/3) light sandy loam; weak, medium, granular structure; friable; slightly acid; clear, smooth boundary.

B1—13 to 16 inches, dark yellowish-brown (10YR 4/4) light sandy clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B21t—16 to 30 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; thin clay films on some peds; medium acid; clear, irregular boundary.

B22t—30 to 36 inches, dark reddish-brown (5YR 3/2) gravelly sandy clay loam; weak, coarse, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

IIC—36 to 60 inches, pale-brown (10YR 6/3), stratified sand and gravel; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 24 to 42 inches in thickness. The Ap horizon ranges from very dark grayish brown to dark grayish brown in color. The B horizon ranges from sandy clay loam to silty clay loam or gravelly clay loam. Gravel content in the A and B horizons is commonly less than 10 percent, except in the B22t horizon, which may contain considerably more gravel. In places where the lower part of the B horizon contacts the sand and gravel, there may be a strong illuviated horizon of clay and organic matter. This layer normally has a darker color than the B horizon above. The underlying IIC material varies considerably in proportion of sand and gravel.

The Fox soils are associated with Oshtemo, Bronson, and Dowagiac soils. They have a finer textured B horizon and are more shallow to sand and gravel than Oshtemo or Bronson soils. They lack the leached loamy sand layer under the B2 horizon of Dowagiac soils.

**Fox sandy loam, 0 to 2 percent slopes** (FoA).—This nearly level soil occurs on outwash plains. It has the profile described as representative for the series.

Included in mapping are small areas of Oshtemo loamy sand and small areas of Fox soils having slopes of more than 2 percent. Also included are some small areas, mainly along Solomon Creek, with a seasonal high water table.

Droughtiness is a limitation for this soil. Most areas are used for and are suited to corn, soybeans, wheat, and grasses and legumes for hay and pasture. (Capability unit IIIs–2)

**Fox sandy loam, 2 to 6 percent slopes** (FoB).—This gently sloping soil is in areas around depressions and drainageways and on knolls and ridges.

Included with this soil in mapping are small areas of Oshtemo loamy sand and Fox loam. In some areas the surface layer is lighter colored than the one described as representative.

This soil is susceptible to erosion. Runoff is medium. Row crops can be grown most of the time if conservation practices are used to control erosion. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIIe–13)

**Fox sandy loam, 6 to 12 percent slopes, eroded** (FoC2).—This moderately sloping soil is on breaks around drainageways and potholes and on knolls and ridges. Its profile is similar to that described as representative for the series, except that the surface layer is thinner and lighter colored.

Included in mapping are small areas of Oshtemo loamy sand and small areas of Fox soils that have steeper slopes.

This soil is susceptible to serious erosion. Runoff is rapid. Row crops can be grown if conservation practices are used to control erosion. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. It also is suited to permanent pasture or trees. (Capability unit IIIe–13)

## Gilford Series

The Gilford series consists of deep, very poorly drained, moderately coarse textured soils. These soils occupy broad depressional areas of the outwash plains along the major drainageways of the county. They formed under water-tolerant trees and shrubs in loamy outwash material underlain by loose sand and gravel.

In a representative profile, the surface layer is about 12 inches of black and very dark gray sandy loam. The subsoil is about 19 inches thick. The upper part is gray,

friable sandy loam that contains yellowish-brown mottles, and the lower part is gray, friable sandy clay loam that contains light yellowish-brown mottles. The underlying material is gray, loose sand.

Gilford soils have medium available moisture capacity and high organic-matter content. They have moderately rapid permeability and slow runoff. Wetness is a limitation. Drained areas are suited to most crops commonly grown in the county.

Representative profile of Gilford sandy loam in a cultivated field, 100 feet west and 1,000 feet south of the northeast corner of sec. 6, T. 37 N., R. 6 E.:

Ap—0 to 8 inches, black (10YR 2/1) sandy loam; weak, medium, granular structure; very friable; neutral; abrupt, smooth boundary.

A1—8 to 12 inches, very dark gray (10YR 3/1) sandy loam; weak, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.

B21g—12 to 28 inches, gray (10YR 5/1) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; friable; neutral; clear, wavy boundary.

B22g—28 to 31 inches, gray (10YR 5/1) sandy clay loam; few, medium, distinct, light yellowish-brown (10YR 6/4) mottles; moderate, medium, subangular blocky structure; friable; neutral; clear, wavy boundary.

IIC1g—31 to 38 inches, gray (10YR 5/1) loamy sand; common, medium, distinct, brown (10YR 5/3) mottles; single grain; loose; neutral; clear, wavy boundary.

IIC2g—38 to 48 inches, gray (10YR 6/1) medium sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; 5 percent fine gravel; neutral; clear, wavy boundary.

IIC3g—48 to 60 inches, gray (10YR 6/1) medium sand; single grain; loose; 2 percent fine gravel; mildly alkaline; calcareous.

The solum ranges from 24 to 44 inches in thickness. The A horizon ranges from black to very dark grayish brown in color. The B horizon ranges from sandy loam to sandy clay loam in the upper part and to sandy clay loam or clay loam in the lower part; not more than 10 inches of the material is as coarse textured as sandy clay loam or clay loam. The C horizon is dominantly gray medium sand but ranges to gravelly sand.

Gilford soils are associated with the Maumee and Sebewa soils. Gilford soils have a finer textured solum than Maumee soils and a coarser textured solum than Sebewa soils.

**Gilford sandy loam** (0 to 2 percent slopes) (Gf).—This soil is in broad, depressional areas of the outwash plains along the major drainageways. Its profile is the one described as representative for the series.

Included in mapping are areas that have thin strata of loamy sand in the subsoil. Also included are areas of Gilford soils that contain thin strata of sandy loam, silt, or clay loam in the underlying material.

Wetness is a limitation for this soil. If wetness is controlled, this soil is suited to all crops commonly grown in the county. Most areas are used for corn, soybeans, and wheat. (Capability unit IIw–4)

**Gilford mucky sandy loam** (0 to 2 percent slopes) (Gm).—This soil occupies slight depressions within the broad, depressional areas of the outwash plains along the major drainageways. Its profile is similar to that described as representative for the series, except that the upper part of the surface layer is muck and is less than 8 inches thick.

Included in mapping are areas of Gilford soils that have a mucky loamy sand surface layer.

Wetness is a limitation. If wetness is controlled, this soil is suited to all crops commonly grown in the county. Most areas are used for corn, soybeans, and wheat. (Capability unit IIw–4)

## Gravel Pit

Gravel pit (Gp) consists of open excavations where the soil materials have been removed to expose the underlying sand and gravel. The excavations are of variable depth. In areas where the water table is near the surface, the pits contain water.

Gravel pit is typically associated with soils of the Fox and Oshtemo series. It has little value for farming. The water-filled pits are suited to wildlife and recreation. Dry pits with an adequate plant cover provide habitat for upland game. (Capability unit VIIe–3)

## Haskins Series

The Haskins series consists of deep, somewhat poorly drained, medium-textured soils. These soils are nearly level and gently sloping and occupy areas of the glacial till plains and areas around lakebeds.

In a representative profile, the surface layer is dark grayish-brown loam about 6 inches thick. The subsurface layer is about 4 inches of gray, friable loam that contains yellowish-brown mottles. The subsoil is about 29 inches thick. The upper 10 inches is grayish-brown, firm clay loam that contains yellowish-brown mottles. The next 10 inches is yellowish-brown, very firm heavy sandy clay loam that contains grayish-brown mottles. The lower part is about 9 inches of very firm, dark yellowish-brown light silty clay that contains gray mottles. The underlying material is yellowish-brown, firm heavy silty clay loam that contains gray mottles.

Haskins soils have a high available moisture capacity and medium or low organic-matter content. They have moderate permeability in the upper part and slow permeability in the lower part. Surface runoff is slow. Use of these soils is limited by wetness, and erosion is a hazard in areas where the soil is gently sloping. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture.

Representative profile of Haskins loam, 0 to 2 percent slopes, in a cultivated field, 500 feet east and 40 feet north of the southwest corner of the SW¼ sec. 25, T. 36 N., R. 7 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) loam, light brownish-gray (10YR 6/2) when dry; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2g—6 to 10 inches, gray (10YR 5/1) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine and medium, granular structure; friable; few iron-manganese concretions; slightly acid; clear, smooth boundary.

B21tg—10 to 20 inches, grayish-brown (2.5Y 5/2) clay loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, fine and medium, subangular blocky structure; firm; few iron-manganese concretions; thin, discontinuous clay films on some peds; medium acid; clear, smooth boundary.

B22t—20 to 30 inches, yellowish-brown (10YR 5/8) heavy sandy clay loam; many, medium, distinct, grayish-brown (2.5Y 5/2) mottles; moderate, medium, subangular blocky structure; very firm; thick, dark-gray (N 4/0) clay films on most peds; few iron-manganese concretions; 2 percent fine gravel; strongly acid; clear, wavy boundary.

IIB23t—30 to 39 inches, dark yellowish-brown (10YR 4/4) light silty clay; many, coarse, distinct, gray (10YR 5/1) mottles; moderate, fine to medium, angular blocky structure; very firm; thick, dark-gray (N 4/0) clay films on most peds; neutral; clear, wavy boundary.

IIC—39 to 60 inches, yellowish-brown (10YR 5/6) heavy silty clay loam; many, coarse, distinct, gray (10YR 5/1) mottles; massive; firm; many, small, white (10YR 8/1) lime nodules; mildly alkaline; calcareous.

The solum ranges from 24 to 48 inches in thickness. The loamy drift is variable in thickness over short distances; its thickness ranges from 19 to 42 inches. Pockets and thin strata of sand and gravel are common throughout the solum. The Ap horizon ranges from dark grayish brown (10YR 4/2) to dark brown (10YR 3/3) in color. The B2 horizon is sandy clay loam, clay loam, or silty clay loam. The IIB horizon ranges from 4 to 12 inches in thickness and is clay loam, silty clay loam, or silty clay. The IIC horizon ranges from silty clay loam to clay.

The Haskins soils are associated with the Blount, Crosby, and Aubbeenaubbee soils. They have coarser textured upper horizons than Blount soils and are finer textured in the lower part of the B horizon and in the C horizon than Crosby soils. They are finer textured throughout the profile than Aubbeenaubbee soils.

**Haskins loam, 0 to 2 percent slopes** (HaA).—This nearly level soil occupies areas and small drainageways of the glacial till plain and around lakebeds. Its profile is the one described as representative for the series.

Included in mapping are small areas of Blount silt loam and Rawson loam. Also included are areas of Haskins soils that have a surface layer of sandy loam.

Wetness is a limitation for this soil. Row crops can be grown most of the time if soil tilth is maintained. If adequately drained, this soil is suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. (Capability unit IIw–2)

**Haskins loam, 2 to 4 percent slopes** (HaB).—This gently sloping soil is in areas of the glacial till plains and around lakebeds. Its profile is similar to that described as representative for the series, except that the surface layer is slightly thinner and is lighter colored.

Included in mapping are small areas of Rawson loam. Also included are areas of Haskins soils where the texture of the surface layer is sandy loam.

Wetness is a limitation, and erosion is a hazard on this soil. Erosion can be controlled by use of suitable conservation practices. If adequately drained and fertilized, this soil is suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. (Capability unit IIe–12)

## Homer Series

The Homer series consists of somewhat poorly drained, medium-textured soils. These soils are nearly level and occupy outwash plains along the major streams of the county. They formed under mixed hardwoods in loamy outwash and are moderately deep over loose sand and gravel.

In a representative profile, the surface layer is dark-brown loam about 7 inches thick. The subsurface layer is grayish-brown, friable loam that contains yellowish-brown mottles and is about 3 inches thick. The subsoil is about 21 inches thick. The upper 4 inches is grayish-brown, friable sandy loam that contains yellowish-brown mottles. The next 13 inches is yellowish-brown, firm sandy clay loam that contains strong-brown mottles. The lower part is 4 inches of dark-brown, friable sandy loam that contains grayish-brown mottles. The underlying material is grayish-brown, loose, stratified gravel and sand.

Homer soils have a moderate available moisture capacity and moderate or low organic-matter content. They have moderately slow permeability, and surface runoff is slow. Wetness is a limitation. Drained areas are suited to most crops commonly grown in the county.

Representative profile of Homer loam in a cultivated field, 350 feet east and 20 feet south of the northwest corner of the SW¼SW¼ sec. 1, T. 35 N., R. 7 E.:

Ap—0 to 7 inches, dark-brown (10YR 3/3) loam, light brownish gray (10YR 6/2) when dry; weak, medium and coarse, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—7 to 10 inches, grayish-brown (10YR 5/2) light loam; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, granular structure; friable; about 5 percent fine gravel; slightly acid; clear, wavy boundary.

B1g—10 to 14 inches, grayish-brown (10YR 5/2) heavy sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; about 10 percent fine gravel; medium acid; clear, wavy boundary.

B2t—14 to 27 inches, yellowish-brown (10YR 5/4) sandy clay loam; many, coarse, distinct, grayish-brown (10YR 5/2) mottles and few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; firm; thin, patchy clay films on most peds; few iron and manganese concretions; about 10 percent fine gravel; medium acid; clear, irregular boundary.

B3—27 to 31 inches, dark-brown (10YR 4/3) sandy loam; few, fine, distinct, grayish-brown (10YR 5/2) mottles; very weak, medium, subangular blocky structure; friable; about 15 percent medium gravel; neutral; abrupt, irregular boundary.

IIC—31 to 60 inches, grayish-brown (10YR 5/2), stratified gravel and sand; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is dark grayish brown or dark brown. The B horizon ranges from gravelly sandy loam to clay loam and contains from about 5 to 15 percent gravel.

Homer soils are associated with the Brady, Whitaker, and Tedrow soils. They have a finer textured B horizon than Brady soils and contain more sand and gravel in the B and C horizons than Whitaker soils. They have a finer textured solum and more gravel in the C horizon than Tedrow soils.

**Homer loam** (0 to 2 percent slopes) (Ho).—This soil occupies outwash plains and valley trains.

Included in mapping are small areas of Sebewa loam. Also included are some areas of Homer soils that have a surface layer of sandy loam.

Wetness is a limitation. If wetness is controlled, this soil is suited to all crops commonly grown in the county. (Capability unit IIw–6)

## Linwood Series

The Linwood series consists of black, very poorly drained, organic soils. These soils occupy depressional areas of the uplands, outwash plains, and lakebeds. They developed under swamp vegetation in deposits of partially decomposed organic material over loamy mineral material.

In a representative profile, the surface layer is black muck about 9 inches thick. Below the surface layer is

about 13 inches of black, friable muck that contains partially decomposed woody fragments. The underlying material is about 6 inches of gray silty clay loam over about 8 inches of light olive-gray fine sandy loam. Below this is light brownish-gray loam that extends to a depth of 60 inches or more.

Linwood soils have a high available moisture capacity and very high organic-matter content. Permeability is moderately rapid in the organic material and moderate in the loamy mineral material. Runoff is very slow. If wetness is controlled, these soils are suited to row crops.

Representative profile of Linwood muck in a cultivated field, 50 feet west and 500 feet north of the southeast corner of sec. 26, T. 35 N., R. 4 E.:

Oa1—0 to 9 inches, black (10YR 2/1) muck; fine, granular structure; friable; few sand grains; slightly acid; clear, smooth boundary.

Oa2—9 to 22 inches, black (10YR 2/1) muck; weak, medium and coarse, granular structure; friable; few partially decomposed woody fragments; few sand grains; neutral; abrupt, wavy boundary.

IIC1g—22 to 28 inches, gray (5Y 5/1) silty clay loam; weak, medium, angular blocky structure; firm; neutral; abrupt, irregular boundary.

IIC2g—28 to 36 inches, light olive-gray (5Y 6/2) fine sandy loam; very weak, subangular blocky structure; friable; neutral; abrupt, irregular boundary.

IIC3g—36 to 60 inches, light brownish-gray (2.5Y 6/2) loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; structureless (massive); friable; few iron-manganese concretions; few yellowish-red (5YR 5/8) iron stains; neutral in upper part, mildly alkaline and calcareous below depth of 40 inches.

The organic deposits range from 12 to 42 inches in thickness. The Oa1 horizon ranges from black to very dark brown. The Oa2 horizon ranges from black to dark yellowish brown and dark reddish brown. The underlying mineral horizon ranges from sandy loam to silty clay loam. In some areas there are thin strata of silty or sandy material in the lower organic layer.

Linwood soils are associated with Tawas, Edwards, and Carlisle soils. They are underlain at a depth of 12 to 42 inches by loamy mineral material, whereas Tawas soils are underlain by sandy mineral material and Edwards soils by marl. The organic layer is thinner in Linwood soils than in Carlisle soils.

**Linwood muck** (0 to 2 percent slopes) (Lm).—This soil occupies depressional areas of the uplands, outwash plains, and lakebeds.

Included in mapping are small areas of Carlisle soils. Also included are some areas where the muck is underlain by silty clay or clay.

Wetness is a severe limitation for this soil. In areas where the soil is dry and bare of vegetation, soil blowing is a hazard. Row crops can be grown each year if wetness is controlled. Most areas are used for corn and soybeans. This soil also is suited to truck crops. (Capability unit IIw–10)

## Made Land

Made land (Ma) consists of areas where the soil profile has been disturbed and no series is recognizable. The areas have been leveled or filled with earth or trash and may consist of any combination of sand, silt, clayey material, and trash.

The suitability of this land type for farming is variable. Many areas are used for urban development. The suitability for such uses depends on the nature of the fill material and the stability of the underlying strata. (Capability unit VIIe–3)

## Marsh

Marsh (0 to 2 percent slopes) (Mh) consists of areas covered by shallow water most of the time. These areas occur around the edges of deep bodies of water and in undrained depressions. The material under the water is variable and consists of muck and peat, silt and clay, or sand and gravel. Some of these areas are bare of vegetation. Other areas have cattails, reeds, and water-tolerant shrubs and trees. During most summers, some of these areas are dry for short periods of time. They have little value for cropland, pasture, or forestry. They are suited to, and are important as, wildlife habitat. (Capability unit VIIIw–1)

## Maumee Series

The Maumee series consists of deep, very poorly drained, coarse-textured soils. These soils occupy broad, depressional areas of the sandy outwash plains. They formed under marsh grasses and water-tolerant trees and shrubs in sandy outwash material.

In a representative profile, the surface layer is about 14 inches of black and very dark brown loamy fine sand. The subsoil is about 22 inches of gray, friable loamy sand that contains yellowish-brown mottles. Discontinuous layers of sandy loam, 1 to 3 inches thick, occur in the lower part of the subsoil. The underlying material is gray, loose sand.

Maumee soils have a low available moisture capacity and high organic-matter content. They have rapid permeability and very slow runoff. Wetness is a limitation. Drained areas are suited to most crops commonly grown in the county.

Representative profile of Maumee loamy fine sand in a cultivated field, 500 feet south and 30 feet west of the northeast corner of the NE¼ sec. 22, T. 38 N., R. 5 E.:

Ap—0 to 7 inches, black (10YR 2/1) loamy fine sand; weak, medium and coarse, granular structure; very friable; slightly acid; clear, smooth boundary.

A1—7 to 14 inches, very dark brown (10YR 2/2) loamy fine sand; weak, medium, granular structure; friable; slightly acid; clear, smooth boundary.

B2g—14 to 36 inches, gray (10YR 6/1) loamy sand; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium and coarse, granular structure; friable; some material from A horizon appears in old root zones in the upper part; some layers of gray (10YR 5/1) sandy loam, 1 to 3 inches thick and discontinuous, occur below a depth of 24 inches; mainly slightly acid but neutral in lower part; clear, wavy boundary.

Cg—36 to 60 inches, gray (10YR 5/1) sand; single grain; loose; mildly alkaline.

The solum ranges from 30 to 48 inches in thickness. The A horizon ranges from black to very dark brown or very dark gray in color. Fillings of black loamy fine sand appear in the B horizon, and there are layers of gray sandy loam, 1 to 3 inches thick, below a depth of 24 inches.

Maumee soils are associated with the Gilford and Sebewa soils. They are loamy sand and sand below the surface layer, but Gilford and Sebewa soils have a B horizon of sandy loam, sandy clay loam, or clay loam and are underlain by sand and gravel.

**Maumee loamy fine sand** (0 to 2 percent slopes) (Mm).—This soil occupies flats and depressions.

Included in mapping are small areas of Maumee soils that have a thin muck surface layer. Also included are areas where the texture is sandy loam.

Wetness is a limitation. This soil is suited to all crops commonly grown in the county if the wetness is controlled. Special blinding around drainage tile is needed to keep the sand out of the tile. Most areas are used for corn, soybeans, and wheat. (Capability unit IIIw–1)

## Metea Series

The Metea series consists of deep, well-drained, coarse-textured soils. These soils are nearly level to moderately sloping and occupy uplands of the glacial till plains. They formed under mixed hardwoods in loamy sand drift over loam glacial till.

In a representative profile, the surface layer is about 9 inches of very dark grayish-brown loamy fine sand. The subsurface layer is about 6 inches of brown, friable loamy sand. The subsoil is about 29 inches thick. The upper 10 inches is yellowish-brown, friable loamy sand, the next 7 inches is yellowish-brown, firm sandy clay loam, and the lower 12 inches is yellowish-brown, friable loam. The underlying material consists of brown, friable loam till that contains distinct, grayish-brown mottles.

Metea soils have rapid permeability in the sandy upper part and moderate permeability in the lower part. They have a moderate available moisture capacity, are low in organic-matter content, and have slow surface runoff. Droughtiness is a limitation, especially for shallow-rooted crops. Metea soils are suited to crops commonly grown in the county.

Representative profile of Metea loamy fine sand, 0 to 6 percent slopes, in a cultivated field, 400 feet north and 250 feet west of the southeast corner of the SW¼SE¼ sec. 1, T. 35 N., R. 5 E.:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loamy fine sand, light brownish gray (10YR 6/2) when dry; very weak, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary.

A2—9 to 15 inches, brown (10YR 5/3) loamy sand; very weak, medium, granular structure; friable; slightly acid; gradual, wavy boundary.

B21—15 to 25 inches, yellowish-brown (10YR 5/4) loamy sand; very weak, medium, granular structure and fine, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

IIB22t—25 to 32 inches, yellowish-brown (10YR 5/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; thin clay films on most peds; slightly acid; clear, irregular boundary.

IIB3—32 to 44 inches, yellowish-brown (10YR 5/4) loam; common, medium, faint, brown (10YR 5/3) mottles; weak, coarse, subangular blocky structure; friable; slightly acid; gradual, irregular boundary.

IIC—44 to 60 inches, brown (10YR 5/3) loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; friable; few iron-manganese concretions; mildly alkaline; calcareous.

The solum ranges from 36 to 48 inches in thickness. Thickness of the sandy drift ranges from 20 to 40 inches and is variable within short distances. The Ap horizon ranges from very dark grayish brown to dark grayish brown or dark yellowish brown in color. The A2 horizon ranges from brown to grayish brown. The IIB2 horizon is sandy clay loam or clay loam. The C horizon ranges from loam to clay loam or silty clay loam.

Metea soils are associated with the Riddles soils. They have coarser textured upper horizons than Riddles soils. Metea soils are similar to the Tyner soils in the upper part of their profile, but they are underlain by glacial till, whereas the Tyner soils are underlain by sand and gravel.

**Metea loamy fine sand, 0 to 6 percent slopes** (MnB).—This nearly level and gently sloping soil occupies upland positions on the glacial till plains. It has the profile described as representative for the series.

Included in mapping are small areas of Aubbeenaubbee sandy loam in drainageways. Also included are areas of soils that have a thinner and lighter colored surface layer than this soil, and areas where the deposit of sandy drift is deeper.

Droughtiness is a limitation, especially for shallow-rooted crops. Soil blowing is a hazard in some areas. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIIs–2)

**Metea loamy fine sand, 6 to 12 percent slopes** (MnC).—This moderately sloping soil occupies knolls and narrow ridges on the glacial till plain. Its profile is similar to that described as representative for the series, except that the surface layer is thinner and is lighter colored.

Included in mapping are small areas having slopes of less than 6 percent or more than 12 percent and other areas where the loamy sand material is more than 42 inches deep.

This soil is susceptible to erosion. Runoff is medium. In some locations soil blowing is a hazard. Most areas are suited to and used for such crops as corn, soybeans, small grain, and grasses and legumes for hay or pasture. (Capability unit IIIe–13)

## Miami Series

The Miami series consists of deep, well-drained, medium-textured and moderately fine textured soils. These soils are gently to strongly sloping and occupy areas of the uplands. They formed under mixed hardwoods in medium-textured glacial till.

In a representative profile, the surface layer is about 8 inches of dark-brown loam, and the subsurface layer is about 5 inches of brown friable loam. The subsoil is about 26 inches thick. The upper 4 inches is yellowish-brown, firm light clay loam. The next 10 inches is dark yellowish-brown, firm clay loam, and the lower 12 inches is dark-brown, firm clay loam. The underlying material, to a depth of 60 inches, is brown, friable light clay loam and loam.

Miami soils have a high available moisture capacity and low organic-matter content. They have moderate to moderately slow permeability. Erosion is a hazard on these soils. Miami soils are suited to all crops commonly grown in the county.

Representative profile of Miami loam, 2 to 6 percent slopes, eroded, in a cultivated field, 250 feet south and 25 feet east of the northwest corner of the SW¼NW¼ sec. 12, T. 36 N., R. 5 E.:

Ap—0 to 8 inches, dark-brown (10YR 3/3) loam, light brownish gray (10YR 6/2) when dry; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 13 inches, brown (10YR 5/3) loam; weak, medium and thick, platy structure; friable; slightly acid; clear, smooth boundary.

B1—13 to 17 inches, yellowish-brown (10YR 5/4) light clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B21t—17 to 27 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, medium and coarse, subangular blocky and angular blocky structure; firm; thin, dark-brown (7.5YR 4/4) clay films on peds; strongly acid; gradual, wavy boundary.

B22t—27 to 39 inches, dark-brown (10YR 4/3) clay loam; moderate, medium and coarse, subangular blocky structure; firm; thin, dark yellowish-brown (10YR 3/4) clay films on peds; few iron and manganese concretions; mainly medium acid but becoming neutral in lower part; abrupt, wavy boundary.

C—39 to 60 inches, brown (10YR 5/3), coarse light clay loam and loam till; massive; friable; mildly alkaline; calcareous.

The solum ranges from 24 to 42 inches in thickness. The A horizon ranges from sandy loam to loam in texture, and the Ap horizon ranges from dark brown to dark yellowish brown in color. The B horizon is sandy clay loam, clay loam, or silty clay loam and ranges from dark brown to yellowish brown and dark yellowish brown. The C horizon is loam or light clay loam.

The Miami soils are associated with the Riddles and Rawson soils. They have a thinner B horizon and are not so deeply leached as Riddles soils. They are coarser textured in the lower part of the B horizon and in the C horizon than Rawson soils.

**Miami loam, 2 to 6 percent slopes, eroded** (MoB2).—This gently sloping soil is on knolls and breaks along depressions and drainageways of the uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Crosby loam in drainageways. Some areas of Miami soils that have a thicker surface layer also are included. Also, there are small included areas of Miami soils having slopes of more than 6 percent.

This soil is susceptible to erosion. Runoff is medium. Row crops can be grown most of the time if conservation practices are used to control erosion. This soil is used for and is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIe–1)

**Miami loam, 6 to 12 percent slopes, eroded** (MoC2).—This moderately sloping soil is on knolls and breaks along depressions and drainageways in the uplands. Its profile is similar to that described as representative for the series, except that the surface layer is thinner and has a browner color.

Included in mapping are small areas of Riddles loam and areas of soils that have a clay loam or sandy loam surface layer.

Erosion is a hazard on this soil. Runoff is medium or rapid. Row crops can be grown frequently if proper conservation practices are applied. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIIe–1)

**Miami loam, 12 to 18 percent slopes, eroded** (MoD2).—This strongly sloping soil occupies knolls and breaks along drainageways and depressions of the uplands. Its profile is similar to the one described as representative for the series, except that it is not so thick and the surface layer is thinner and browner in color.

Included in mapping are small areas of Miami soils that have a thicker surface layer and areas of Miami clay loam, severely eroded.

Erosion is a serious hazard on this soil. Runoff is rapid. If this soil is cultivated, conservation practices are needed to control erosion. This soil is suited to hay, pasture, and small grain. (Capability unit IVe–1)

**Miami clay loam, 6 to 12 percent slopes, severely eroded** (MrC3).—This moderately sloping soil occupies knolls and breaks along depressions and drainageways of the uplands. Its profile is similar to that described as representative for the series, except that it is thinner and the surface layer consists mostly of yellowish-brown clay loam.

Included in mapping are small areas of Miami soils having slopes of 12 to 18 percent.

Erosion is a serious hazard on this soil. Runoff is rapid. If this soil is cultivated, conservation practices are needed to control erosion. This soil is suited to hay, pasture, and small grain. (Capability unit IVe–1)

**Miami clay loam, 12 to 18 percent slopes, severely eroded** (MrD3).—This strongly sloping soil occupies breaks along drainageways (fig. 9) and depressions of the uplands. It has a profile similar to the one described as representative for the series, except that it is much thinner and the surface layer is clay loam.

Included in mapping are areas of Miami soils that have a surface layer of loam. Also included are small areas of Miami soils that have slopes in excess of 18 percent.

Erosion is a serious hazard on this soil. Runoff is rapid. If this soil is cultivated, conservation practices are needed to control erosion. This soil is suited to hay, pasture, and woodland. (Capability unit VIe–1)

## Oshtemo Series

The Oshtemo series consists of deep, somewhat excessively drained, coarse-textured soils. These soils are on outwash plains along the main streams of the county and on knolls and ridges of the uplands. They occur throughout the county but are more common along the major drainageways. They formed under mixed hardwoods in sandy outwash or alluvium underlain by sand and gravel.

*Figure 9.*—**Miami clay loam, 12 to 18 percent slopes, severely eroded, on short slopes in background.**

In a representative profile, the surface layer is dark-brown loamy sand about 10 inches thick. The subsurface layer is about 4 inches of brown, very friable loamy sand. The subsoil is about 34 inches thick. The upper 5 inches is strong-brown, very friable sandy loam. The next 10 inches is reddish-brown, friable sandy loam. Below this is 15 inches of strong-brown, loose heavy loamy fine sand. The lower 4 inches is dark-brown, loose loamy sand. The underlying material is light yellowish-brown, loose sand and gravel.

Oshtemo soils have a low available moisture capacity and low organic-matter content. They have moderately rapid permeability and slow runoff. Use of these soils is limited by droughtiness. They are suited to corn, soybeans, small grain, grasses and legumes for hay and pasture, and trees.

Representative profile of Oshtemo loamy sand, 0 to 2 percent slopes, in a cultivated field, 500 feet north and 50 feet east of the southwest corner of the NE¼NE¼ sec. 32, T. 38 N., R. 6 E.:

Ap—0 to 10 inches, dark-brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) when dry; weak, medium, granular structure; very friable; medium acid; clear, smooth boundary.

A2—10 to 14 inches, brown (7.5YR 5/4) loamy sand; weak, thick, platy structure; very friable; medium acid; clear, smooth boundary.

B1—14 to 19 inches, strong-brown (7.5YR 5/6) sandy loam; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

B2t—19 to 29 inches, reddish-brown (5YR 5/4) sandy loam; weak, medium, subangular blocky structure; friable; 5 percent gravel; thin clay films on some peds and bridging between many sand grains; medium acid; clear, wavy boundary.

B31—29 to 44 inches, strong-brown (7.5YR 5/6) heavy loamy fine sand; single grain; loose; 5 percent gravel; slightly acid; clear, wavy boundary.

B32—44 to 48 inches, dark-brown (7.5YR 4/4) loamy sand; single grain; loose; 10 percent gravel; slightly acid; clear, irregular boundary.

IIC—48 to 60 inches, light yellowish-brown (10YR 6/4), stratified gravel and sand; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 42 to 70 inches or more in thickness. The Ap horizon ranges from very dark grayish brown to dark brown in color, and the A horizons range from 12 to 20 inches in combined thickness. The B horizon is dominantly sandy loam but ranges to sandy clay loam. In some areas the lower part of the B horizon is loamy sand that contains thin, discontinuous bands of sandy loam. The B horizon ranges from reddish brown to strong brown or dark brown. The amount of gravel in the solum ranges from very little to as much as 20 percent in some areas. In some places the solum contains considerable amounts of bituminous shale. The C horizon ranges from stratified sand and gravel to almost all sand.

The Oshtemo soils are associated with the Fox, Tyner, and Bronson soils. They are deeper to loose, calcareous sand and gravel than Fox soils and have a coarser textured B horizon. Oshtemo soils have a finer textured B horizon than Tyner soils. Oshtemo soils lack the light-colored mottles found in the B horizon of Bronson soils.

**Oshtemo loamy sand, 0 to 2 percent slopes** (OsA).—This nearly level soil is on outwash plains along the main streams of the county. It has the profile described as representative for the series.

Included in mapping are small areas of Tyner loamy sand. Also included are areas that have calcareous sand and gravel at a depth of less than 42 inches. In some areas the texture of the surface layer is sandy loam. In places reddish iron stains are in the surface layer.

Droughtiness is a limitation for this soil. Runoff is slow. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. If irrigated, this soil is suited to all crops commonly grown in the county, including special crops. (Capability unit IIIs–2)

**Oshtemo loamy sand, 2 to 6 percent slopes** (OsB).—This soil occupies short breaks along drainageways and around potholes or on knolls.

Included in mapping are areas of Tyner loamy sand. Some included areas have calcareous sand and gravel at a depth of less than 42 inches. In some areas the texture of the surface layer is sandy loam. In places reddish iron stains are in the surface layer.

Erosion is a hazard, and droughtiness is a limitation on this soil. Runoff is slow or medium. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. If irrigated, this soil is suited to all crops commonly grown in the county, including special crops. (Capability unit IIIe–13)

**Oshtemo loamy sand, 6 to 12 percent slopes** (OsC).—This soil occupies breaks along drainageways and around potholes or on knolls. It has a profile similar to the one described as representative for the series, except that the surface layer is lighter colored.

Included in mapping are small areas of Tyner loamy sand and small areas in which there is calcareous sand and gravel at a depth of less than 42 inches. In some areas the texture of the surface layer is sandy loam.

Erosion is a hazard, and droughtiness is a limitation on this soil. Runoff is moderate. If proper conservation practices are used, row crops can be grown frequently on this soil. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. (Capability unit IIIe–13)

**Oshtemo loamy sand, 12 to 18 percent slopes** (OsD).—This strongly sloping soil is in areas around potholes and on high knolls. Its profile is similar to the one described as representative for the series, except that the surface layer is slightly thinner and is lighter colored.

Included in mapping are small areas of Tyner loamy sand and areas in which sand and gravel are at a depth of less than 42 inches. The surface layer is sandy loam in some areas.

Erosion is a hazard, and droughtiness is a limitation on this soil. Runoff is moderate. This soil is suited to grasses and legumes for hay or pasture and also to trees. If erosion control practices are used, row crops can be frequently grown. (Capability unit IVe–13)

**Oshtemo loamy sand, 18 to 25 percent slopes** (OsE).—This moderately steep soil is in areas around potholes, breaks, and high knolls. Its profile is similar to the one described as representative for the series, except that the surface layer is thinner and is lighter colored.

Included in mapping are small areas that have sand and gravel at a depth of less than 42 inches and areas where slopes are greater than 25 percent.

Erosion is a hazard on this soil. Runoff is moderate or rapid. This soil is suited to hay, pasture, or woodland. (Capability unit VIe–3)

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## Pewamo Series

The Pewamo series consists of deep, dark-colored, poorly drained, moderately fine textured soils. These soils occupy broad depressions and drainageways of the glacial till plain. They formed under mixed hardwoods in moderately fine textured glacial till.

In a representative profile, the surface layer is very dark gray silty clay loam about 13 inches thick. The subsoil is about 26 inches of olive-gray, firm silty clay that contains yellowish-brown or brown mottles. The underlying material, to a depth of 60 inches, is olive-brown silty clay loam that contains gray mottles.

Pewamo soils have a high available moisture capacity and high organic-matter content. They have slow permeability and slow surface runoff. Use of these soils is seriously limited by wetness. Drained areas are suited to most crops commonly grown in the county.

Representative profile of Pewamo silty clay loam in a cultivated field, 600 feet north and 300 feet east of the southwest corner of the NW¼SE¼ of sec. 27, T. 36 N., R. 7 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) when dry; moderate, medium and coarse, granular structure; firm; neutral; abrupt, smooth boundary.

A1—9 to 13 inches, very dark gray (10YR 3/1) silty clay loam; black (10YR 2/1) coatings on peds; moderate, fine and medium, subangular blocky structure; firm; slightly acid; clear, smooth boundary.

B21tg—13 to 29 inches, olive-gray (5Y 4/2) silty clay; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium and coarse, prismatic structure breaking to moderate, fine and medium, angular blocky; firm; thin, gray (N 5/0) clay films on most peds; few, very dark gray (10YR 3/1) organic stains in cracks and on peds; few, dark reddish-brown (5YR 3/4) iron stains; slightly acid; gradual, wavy boundary.

B22tg—29 to 39 inches, olive-gray (5Y 4/2) silty clay; many, fine, distinct, brown (10YR 5/3) mottles; moderate, medium, angular blocky structure; firm; thin, gray (N 5/0) clay films on some peds; few, dark reddish-brown (5YR 3/4) iron stains; very dark gray (10YR 3/1) organic fillings in root channels; neutral; clear, wavy boundary.

C—39 to 60 inches, olive-brown (2.5Y 4/4) silty clay loam; common, fine, distinct, gray (10YR 5/1) mottles; massive; firm; few, dark reddish-brown (5YR 3/4) iron stains on peds; mildly alkaline; calcareous.

The solum ranges from 36 to 50 inches in thickness. The Ap horizon ranges from black to very dark brown or very dark gray. The A horizon ranges from 10 to 15 inches in thickness. The B horizon is heavy silty clay loam or silty clay, and the C horizon is clay loam or silty clay loam.

The Pewamo soils are associated with the Brookston and Rensselaer soils. They are finer textured throughout the profile than Brookston soils. Pewamo soils have a finer textured B horizon than Rensselaer soils and are underlain by moderately fine textured glacial till, whereas those soils are underlain by stratified silt and sand.

**Pewamo silty clay loam** (0 to 2 percent slopes) (Pe).—This soil occupies broad flats of the glacial till plain.

Included in mapping are small areas of the lighter colored Blount soil at slightly higher elevations. Also included are some areas that have a surface layer of silt loam.

Wetness is the major limitation for this soil. Most areas are used for corn, soybeans, and small grains. If drained, this soil is suited to these crops. Undrained areas provide wildlife habitat. (Capability unit IIw–1)

## Plainfield Series

The Plainfield series consists of deep, excessively drained, coarse-textured soils that are level to moderately sloping and occupy outwash plains and knolls (fig. 10). These soils formed under mixed hardwoods in sandy outwash material.

In a representative profile, the surface layer is dark-brown fine sand about 9 inches thick. The subsurface layer is yellowish-brown sand about 4 inches thick. The subsoil is dark yellowish-brown and yellowish-brown, loose fine sand about 23 inches thick. The underlying material is light yellowish-brown, loose fine sand.

Plainfield soils have a very low available moisture capacity and low organic-matter content. They have very rapid permeability and slow runoff. Droughtiness is a limitation, and these soils are subject to blowing. They are used for corn, soybeans, small grain, and grasses and

*Figure 10.*—**Profile of Plainfield fine sand, 0 to 2 percent slopes, showing the dark-brown surface layer.**

legumes for hay or pasture. If irrigated, they are suited to all crops commonly grown in the county, including truck crops. They also are suited to pasture and Christmas trees.

Representative profile of Plainfield fine sand, 0 to 2 percent slopes, in a cultivated field, 500 feet east and 400 feet north of the southwest corner of sec. 8, T. 38 N., R. 6 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) fine sand, pale brown (10YR 6/3) when dry; very weak, medium, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—9 to 13 inches, yellowish-brown (10YR 5/4) fine sand; single grain; loose; medium acid; clear, wavy boundary.

B21—13 to 26 inches, dark yellowish-brown (10YR 4/4) fine sand; very weak, medium, subangular blocky structure to single grain; loose; strongly acid; gradual, wavy boundary.

B22—26 to 36 inches, yellowish-brown (10YR 5/6) fine sand; single grain; loose; strongly acid; gradual, wavy boundary.

C—36 to 60 inches, light yellowish-brown (10YR 6/4) fine sand; single grain; loose; about 5 percent gravel; slightly acid.

The solum ranges from 18 to 40 inches in thickness. The Ap horizon is dark brown to dark yellowish brown or dark grayish brown in color. The A horizon ranges from 11 to 15 inches in thickness. The B horizon is yellowish brown or dark yellowish brown. The C horizon ranges from strong brown to light yellowish brown.

Plainfield soils are associated with Chelsea and Tyner soils. They have a coarser textured B horizon than the Chelsea soils and lack the discontinuous, wavy B2 bands of those soils. They have a coarser textured solum than Tyner soils.

**Plainfield fine sand, 0 to 2 percent slopes** (PlA).—This nearly level soil is on broad, sandy outwash plains. It has the profile described as representative for the series.

Included in mapping are small areas of nearly level Chelsea fine sand. Also included are areas of a soil that has a surface layer of loamy fine sand.

Droughtiness is a severe limitation, and soil blowing is a hazard on this Plainfield soil. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. This soil is suited to trees or pasture (fig. 11). If irrigated, this soil is suited to all crops common in the county, including special crops. (Capability unit IVs-1)

**Plainfield fine sand, 2 to 6 percent slopes** (PlB).—This gently sloping soil is on sandy outwash plains and on knolls and ridges of the uplands.

Included in mapping are small areas of Chelsea fine sand. Also included are areas where the texture of the surface layer is loamy fine sand. Small blowouts occur in some areas; these are the result of blowing sand.

Droughtiness is a serious limitation, and soil blowing is a hazard on this soil. Most areas are used for corn,

*Figure 11.*—Scotch pine planted for Christmas trees on Plainfield fine sand, 0 to 2 percent slopes.

soybeans, small grain, and grasses and legumes for hay or pasture. This soil is suited to small grain, pasture, and woodland. If irrigated, this soil is suited to all crops commonly grown in the county, including special crops. (Capability unit IVs–1)

**Plainfield fine sand, 6 to 12 percent slopes** (PlC).—This moderately sloping soil occupies ridges and knolls of the uplands and is along drainageways in the sandy outwash plains. Its profile is similar to that described as representative for the series, except that the surface layer is thinner and lighter colored.

Included in mapping are small areas on ridgetops where slopes are less than 6 percent and some on ridges where slopes are more than 12 percent. Also included are areas where the texture of the surface layer is loamy fine sand. Small blowouts occur in some areas, because of blowing sand.

Droughtiness is a serious limitation, and soil blowing is a hazard on this soil. Although this soil is suited to small grain, pasture, woodland, and wildlife habitat, all crops common in the county are grown on it. (Capability unit VIs–1)

## Rawson Series

The Rawson series consists of deep, well-drained, medium-textured soils. These soils are nearly level to moderately sloping and occupy uplands and areas around lakebeds. They formed under mixed hardwoods in loamy glacial drift over fine textured or moderately fine textured glacial till or lakebed sediments.

In a representative profile, the surface layer is about 9 inches of dark yellowish-brown loam. The subsurface layer is about 4 inches of brown, friable loam. The subsoil is about 21 inches thick. The upper 7 inches is dark-brown, firm light clay loam. The next 10 inches is dark-brown to reddish-brown, firm clay loam, and the lower 4 inches is dark grayish-brown, firm heavy clay loam. The underlying material is brown, firm clay loam.

Rawson soils have a high available moisture capacity and low or moderate organic-matter content. They have moderate permeability in the upper part and slow permeability in the lower part. Erosion is a hazard on these soils. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. These soils are suited to crops commonly grown in the county.

Representative profile of Rawson loam, 2 to 6 percent slopes, in a cultivated field, 150 feet east and 50 feet south of the northwest corner of the NW¼ sec. 18, T. 36 N., R. 7 E.:

Ap—0 to 9 inches, dark yellowish-brown (10YR 3/4) loam, pale brown (10YR 6/3) when dry; weak, medium and coarse, granular structure; friable; neutral; abrupt, smooth boundary.

A2—9 to 13 inches, brown (10YR 5/3) light loam; weak, subangular blocky structure breaking to weak, medium and coarse, granular; friable; slightly acid; clear, wavy boundary.

B1—13 to 20 inches, dark-brown (7.5YR 4/4) light clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B2t—20 to 30 inches, dark-brown (7.5YR 4/4) to reddish-brown (5YR 4/4) clay loam; about 10 percent gravel; pebbles are ½ inch in diameter; moderate to strong, medium, subangular blocky structure; firm; thin, reddish-brown (5YR 4/4) clay films on peds; medium acid; clear, wavy boundary.

IIB3—30 to 34 inches, dark grayish-brown (10YR 4/2) heavy clay loam; weak, coarse, subangular blocky structure; some manganese and iron concretions; neutral; gradual, wavy boundary.

IIC—34 to 60 inches, brown (10YR 5/3) clay loam with very pale brown (10YR 7/3) lime coatings; massive; firm; mildly alkaline; calcareous.

The solum ranges from 20 to 42 inches in thickness. The A horizon ranges from fine sandy loam to silt loam but commonly is loam. The Ap horizon ranges from dark grayish brown to dark brown or dark yellowish brown in color. The B horizon ranges from dark brown to dark yellowish brown or reddish brown. The B2 horizon is sandy clay or clay loam. The C horizon ranges from clay loam to silty clay loam or silty clay.

Rawson soils are associated with the Miami and Riddles soils. They have a finer textured C horizon than Miami or Riddles soils.

**Rawson loam, 0 to 2 percent slopes** (RaA).—This nearly level soil occupies the glacial till plains and areas around lakebeds.

Included in mapping are small areas of Haskins loam. Also included are some areas that have fine sandy loam surface and subsurface layers and are sandy clay loam in the upper part of the subsoil. In some places there are thin lenses and pockets of sand and gravel in the subsoil, and in some areas the lower part of the subsoil contains brown or grayish-brown mottles.

This soil is used for corn, soybeans, small grain, and grasses and legumes for hay and pasture. It is suited to all crops commonly grown in the county. (Capability unit I–1)

**Rawson loam, 2 to 6 percent slopes** (RaB).—This gently sloping soil occupies the breaks around drainageways and slopes on the glacial till plains and areas around lakebeds. It has the profile described as representative for the series.

Included in mapping are small areas of Haskins loam and some areas that have fine sandy loam or silt loam surface and subsurface layers. In some places there are lenses and pockets of sand and gravel in the subsoil. Also included are areas of soils that have a silty clay loam or silty clay subsoil.

This soil is susceptible to erosion. Runoff is medium. If erosion is controlled, row crops can be grown most of the time. This soil is used for and is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIe–1)

**Rawson loam, 6 to 12 percent slopes, eroded** (RaC2).—This moderately sloping soil occupies breaks around drainageways and knolls of the glacial till plains and areas around lakebeds. Its profile is similar to the one described as representative for the series, except that the surface layer is thinner and lighter colored and depth to the underlying material ranges from 24 to 30 inches.

Erosion is a hazard on this soil. Runoff is medium. If conservation practices are applied, this soil can be used for row crops and is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIIe–1)

## Rensselaer Series

The Rensselaer series consists of deep, poorly drained, medium-textured soils. These soils are in depressions of the uplands and outwash plains. They formed under swamp grasses and mixed hardwoods in medium-textured

and moderately coarse textured material that was deposited by water in shallow lakes and stream backwater areas.

In a representative profile, the surface layer is very dark gray silt loam about 14 inches thick. The subsoil is about 26 inches thick. The upper part is olive-gray, firm clay loam that contains light olive-brown mottles. The lower part is light olive-brown, friable loamy very fine sand that contains olive-gray mottles. The underlying material is olive-gray, friable, stratified fine sand and coarse silt.

Rensselaer soils have a high available moisture capacity and high organic-matter content. They have moderately slow permeability and slow runoff. Wetness is a limitation. Drained areas are suited to most crops commonly grown in the county.

Representative profile of Rensselaer silt loam in a cultivated field, 300 feet south and 220 feet west of the northeast corner of the SE¼NE¼ sec. 34, T. 35 N., R. 5 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) when dry; moderate, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary.

A1—9 to 14 inches, very dark gray (10YR 3/1) silt loam; weak, fine, subangular blocky structure; friable; neutral; clear, smooth boundary.

B21tg—14 to 20 inches, olive-gray (5Y 5/2) clay loam; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; moderate, fine and medium, angular blocky structure; firm; neutral; thin, dark-gray (10YR 4/1) clay films on most peds; few yellowish-brown (10YR 5/8) iron stains; clear, wavy boundary.

B22tg—20 to 29 inches, olive-gray (5Y 5/2) light clay loam; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, discontinuous, dark-gray (10YR 4/1) clay films on some peds; few yellowish-brown (10YR 5/8) iron stains; neutral; abrupt, irregular boundary.

B3—29 to 40 inches, light olive-brown (2.5Y 5/4) loamy very fine sand; common, medium, distinct, olive-gray (5Y 5/2) mottles; weak, medium and coarse, subangular blocky structure; friable; neutral; clear, irregular boundary.

Cg—40 to 60 inches, olive-gray (5Y 5/2), stratified fine sand and coarse silt; common, medium, distinct, olive (5Y 5/4) mottles; massive; friable; mildly alkaline; calcareous.

The solum ranges from 36 to 50 inches in thickness. The A horizon ranges from very dark brown to very dark gray or very dark grayish brown. The B2 horizon is dominantly clay loam but ranges from loam and sandy clay loam to silty clay loam. The C horizon, over short distances, varies in thickness and sequence of layers of fine sand and silt.

Rensselaer soils are associated with the Brookston, Sebewa, and Pewamo soils. They are underlain by sand and silt, whereas Brookston soils are underlain by loam glacial till, and Sebewa soils are underlain by sand and gravel. Rensselaer soils are finer textured throughout the profile than Pewamo soils.

**Rensselaer silt loam** (0 to 2 percent slopes) (Re).—This soil occupies depressional areas of the uplands and outwash plains.

Included in mapping are small areas of Whitaker and Sebewa soils. Also included are areas that contain thin strata of gravel, sand, and clay in the lower part of the subsoil and in the underlying material.

Wetness is a limitation for this soil. If wetness is controlled, this soil is suited to all cultivated crops commonly grown in the county. Most areas are used for corn, soybeans, and wheat. (Capability unt IIw–1)

## Riddles Series

The Riddles series consists of deep, well-drained, moderately coarse textured and medium-textured soils. These soils are nearly level to steep and are on uplands. They formed under mixed hardwoods in glacial drift over medium-textured glacial till.

In a representative profile, the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is about 6 inches of brown, friable sandy loam. The subsoil is about 50 inches of dark-brown, brown, and dark yellowish-brown, firm clay loam and sandy clay loam. The underlying material, to a depth of about 70 inches, is brown, friable loam.

Riddles soils have a medium or high available moisture capacity and low or moderate organic-matter content. They have moderate permeability and slow to rapid runoff. Erosion is a hazard on the sloping soils. Riddles soils are suited to crops commonly grown in the county.

Representative profile of Riddles sandy loam, 2 to 6 percent slopes, in a cultivated field, 250 feet north and 20 feet east of the southwest corner of the NW¼NW¼ sec. 20, T. 36 N., R. 7 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam, brown (10YR 4/3) when dry; weak, medium, granular structure; friable; about 2 percent gravel; neutral; abrupt, smooth boundary.

A2—8 to 14 inches, brown (10YR 5/3) sandy loam; weak, medium and thick, platy structure breaking to weak, medium, subangular blocky; friable; neutral; clear, smooth boundary.

B1—14 to 17 inches, yellowish-brown (10YR 5/4) loam; weak, medium, subangular blocky structure; friable to slightly firm; about 5 percent gravel; neutral; clear, smooth boundary.

B21t—17 to 28 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; thin clay films of reddish brown (5YR 4/4) on most peds; about 10 percent gravel; medium acid; gradual, wavy boundary.

IIB22t—28 to 50 inches, brown (7.5YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm; thin clay films of dark brown (7.5YR 4/4) on most peds; medium acid; gradual, wavy boundary.

IIB3—50 to 64 inches, dark yellowish-brown (10YR 4/4) light clay loam; weak, medium, subangular blocky structure; friable to slightly firm; few iron and manganese concretions; few strong-brown (7.5YR 5/8) iron stains; mainly slightly acid but neutral in the lower part; clear, wavy boundary.

IIC—64 to 72 inches, brown (10YR 5/3) loam till; massive; friable; mildly alkaline; calcareous.

The solum ranges from 42 to 72 inches in thickness. The A horizon ranges from sandy loam to loam in texture, and the Ap horizon ranges from dark brown to dark grayish brown in color. The B horizon has textures of loam, clay loam, and sandy clay loam. The C horizon ranges from loam to light clay loam. In some areas there are pockets and strata of sandy and gravelly material in the B horizon and C horizon.

The Riddles soils are associated with the Miami, Rawson, and Metea soils. They have a thicker B horizon and are more deeply leached than Miami soils. They have a coarser textured C horizon than Rawson soils. Riddles soils are finer textured in the upper part of the B horizon and are more deeply leached than Metea soils.

**Riddles sandy loam, 0 to 2 percent slopes** (RsA).—This nearly level soil occupies ridgetops and broad flats of the uplands.

Included in mapping are small areas of steeper soils that have a surface layer that is thicker than that of nor-

mal Riddles soils. Also included are some small areas of Crosby loam in drainageways.

Droughtiness is a limitation for this soil during extended dry periods. Runoff is slow. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIs-3)

**Riddles sandy loam, 2 to 6 percent slopes** (RsB).—This gently sloping soil is on knolls and breaks along drainageways and depressions of the uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Crosby loam. Also included are some areas of Miami sandy loam and areas where the surface layer is only moderately thick.

This soil is susceptible to erosion. Runoff is medium. Row crops can be grown most of the time if conservation practices are used to control erosion. This soil is used for and is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIe–5)

**Riddles sandy loam, 6 to 12 percent slopes** (RsC).—This moderately sloping soil occupies knolls and breaks along drainageways and depressions in the uplands. Its profile is similar to that described as representative for the series, except that in some areas the surface layer is lighter colored.

Included in mapping are small areas of soils that have a very thick surface layer.

This soil is susceptible to erosion. Runoff is medium. If proper conservation practices are applied, this soil can be used frequently for row crops. Most areas are suited to and used for such crops as corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIIe–5)

**Riddles sandy loam, 12 to 18 percent slopes, eroded** (RsD2).—This strongly sloping soil is on breaks and knolls along depressions and drainageways of the uplands. Its profile is similar to that described as representative for the series, except that the surface layer is lighter colored and thinner.

Included in mapping are small areas that are only slightly eroded and where nearly all the original surface layer remains. Also included are small areas of soils having slopes of more than 18 percent.

Erosion is a hazard on this soil. Runoff is rapid. This soil is suited to grasses, forage legumes, and woodland. (Capability unit IVe–5)

**Riddles sandy loam, 18 to 25 percent slopes, eroded** (RsE2).—This moderately steep soil is around depressions and drainageways. The profile is similar to that described as representative for the series, except that the surface layer is thinner and lighter in color.

Included in mapping are some areas of soils having slopes of more than 25 percent. Also included are some areas, particularly those in woodland, that are not eroded.

Erosion is a serious hazard on this soil. Surface runoff is rapid. This soil is suited to hay, pasture, or woodland. (Capability unit VIe–1)

**Riddles loam, 0 to 2 percent slopes** (RtA).—This nearly level soil occupies flats on the uplands. Its profile is similar to that described as representative for the series, except that the surface layer is loam and the upper part of the subsoil is clay loam.

Included in mapping are small areas of Crosby soils and Miami soils.

This soil can be used for row crops most of the time. It is used for and is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit I–1)

**Riddles loam, 2 to 6 percent slopes, eroded** (RtB2).—This gently sloping soil is on knolls and breaks along depressions and drainageways of the uplands. The profile is similar to that described as representative for the series, except that the surface layer is loam and is about 3 inches thinner.

Included in mapping are small areas that are not eroded and that have a thick surface layer. Small areas of Crosby and Miami soils also are included.

Erosion is a hazard on this soil. Runoff is slow or medium. If adequate conservation practices are used to control erosion, row crops can be grown most of the time. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIe–1)

**Riddles loam, 6 to 12 percent slopes, eroded** (RtC2).—This moderately sloping soil occupies knolls and breaks along drainageways of the uplands. The profile is similar to that described as representative for the series, except that the surface layer is loam and is thinner. The plow layer consists of a mixture of the original surface layer and some of the brownish subsoil.

Included in mapping are small areas that are not eroded and that have a thick surface layer. Also included are small areas of Miami loam and small areas that are severely eroded.

Erosion is a hazard on this soil. Runoff is medium. This soil can be used for row crops if the proper conservation practices are applied. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. (Capability unit IIIe–1)

## Sebewa Series

The Sebewa series consists of poorly drained, medium-textured soils in broad, depressional areas of outwash plains along main drainageways. These soils formed under mixed hardwood forest in loamy outwash. They are moderately deep over loose sand and gravel.

In a representative profile, the surface layer is black and very dark gray loam about 12 inches thick. The subsoil is gray and grayish-brown firm clay loam that is about 24 inches thick and contains yellowish-brown mottles. The underlying material is gray, loose sand and gravel.

Sebewa soils have moderate available moisture capacity and are high in organic-matter content. Permeability is moderately slow, and runoff is slow. Wetness is a limitation, but drained areas are suited to most crops commonly grown in the county.

Representative profile of Sebewa loam in a cultivated field, 50 feet south and 400 feet east of the northwest corner of sec. 30, T. 36 N., R. 7 E.:

Ap—0 to 7 inches, black (10YR 2/1) loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A1—7 to 12 inches, very dark gray (10YR 3/1) loam; moderate, medium and coarse, granular structure; friable; slightly acid; clear, smooth boundary.

B21tg—12 to 25 inches, gray (10YR 5/1) clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; mod-

erate, medium, subangular blocky structure; firm; thin, dark-gray (10YR 4/1) clay films on most ped faces; slightly acid; clear, wavy boundary.

B22tg—25 to 36 inches, grayish-brown (2.5Y 5/2) clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular structure; firm; thin, dark-gray (10YR 4/1) clay films on many ped faces; slightly acid; abrupt, wavy boundary.

IICg—36 to 60 inches, gray (10YR 6/1) coarse sand and gravel; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 24 to 40 inches in thickness. The A horizon ranges from black to very dark brown or very dark gray in color and from sandy loam to loam or silt loam in texture. The B horizon ranges from gravelly clay loam to clay loam. The C horizon is coarse sand and gravel; the amount of gravel is variable.

Sebewa soils are associated with Gilford, Maumee, and Rensselaer soils. They have a finer textured B horizon than Gilford soils. They have a finer textured solum and contain more gravel in the C horizon than Maumee soils. Sebewa soils contain more gravel and less silt in the C horizon than Rensselaer soils.

**Sebewa loam** (0 to 2 percent slopes) (Se).—This soil occupies broad, depressional areas of outwash plains along main drainageways.

Included in mapping are small areas of Homer loam and Rensselaer silt loam. In some of the included areas, the underlying material contains thin strata of loam, silt loam, or clay loam.

Wetness is a limitation for this soil. If wetness is controlled, this soil is suited to most of the crops common in the county. Most areas are used for corn, soybeans, and wheat. (Capability unit IIw–4)

## Shoals Series

The Shoals series consists of deep, somewhat poorly drained, medium-textured soils on bottom lands. These soils formed under mixed hardwoods in medium-textured and coarse-textured alluvial material that washed from the uplands or outwash areas and was deposited by streams.

In a representative profile, the surface layer is about 9 inches of dark-brown heavy loam. The subsoil is about 21 inches of grayish-brown, friable silt loam that contains dark-brown or yellowish-brown mottles. The underlying material extends to a depth of 60 inches. It is gray fine sandy loam in the upper part and light brownish-gray, stratified silt loam, loam, and fine sandy loam in the lower part.

Shoals soils have a high available moisture capacity and low organic-matter content. These soils have moderate permeability and slow surface runoff. Wetness is a limitation, and seasonal flooding is a hazard. If wetness is controlled, these soils are suited to corn and soybeans. They can also be used for pasture and hay crops.

Representative profile of Shoals loam in a cultivated field, 500 feet west and 150 feet north of the southeast corner of the SW¼SE¼ sec. 15, T. 36 N., R. 4 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) heavy loam, light brownish gray (10YR 6/2) when dry; weak, medium and coarse, granular structure; friable; neutral; abrupt, smooth boundary.

B21g—9 to 17 inches, grayish-brown (10YR 5/2) coarse silt loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, granular structure; friable; few manganese concretions; neutral; clear, smooth boundary.

B22g—17 to 30 inches, grayish-brown (10YR 5/2) silt loam; many, coarse, distinct, dark-brown (10YR 4/3) mottles; weak, medium and coarse, granular structure; friable; few manganese concretions; neutral; clear, smooth boundary.

C1g—30 to 48 inches, gray (10YR 6/1) fine sandy loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; very weak, medium, granular structure or massive; mainly neutral but mildly alkaline in lower part; clear, wavy boundary.

C2g—48 to 60 inches, light brownish-gray (10YR 6/2), stratified silt loam, loam, and fine sandy loam; common, coarse, distinct, yellowish-brown (10YR 5/4) mottles; structureless; friable; some layers of fine sand 6 to 12 inches thick; mildly alkaline; calcareous.

The solum ranges from 24 to 40 inches in thickness. The A horizon is dark brown or very dark grayish brown. The B horizon ranges from gray to grayish brown or brown and is loam, silt loam, or fine sandy loam in texture. The C horizon has stratified layers that range from loam to silt loam and sandy loam.

Shoals, Wallkill, and Washtenaw soils all formed in alluvium. Shoals soils are underlain by coarse and moderately coarse alluvial materials, whereas Wallkill soils are underlain by a buried organic soil and Washtenaw soils are underlain by a buried, poorly drained, dark-colored, depressional soil.

**Shoals loam** (0 to 2 percent slopes) (Sh).—This soil occupies bottom land along streams.

Included in mapping are small areas of Alluvial land loamy in slightly higher positions. Also included are some areas that have a surface layer of silt loam. Near some lakebed areas, the material below a depth of 2 to 3 feet is silty clay loam or silty clay. In some areas the underlying material is mostly sand and gravel.

Wetness is a limitation, and flooding is a hazard on this soil. If wetness is controlled, this soil is suited to many crops commonly grown in the county. Crops that are carried over from one growing season to the next are subject to damage by flooding. These soils are also suited to pasture or hay. (Capability unit IIw–7)

## Tawas Series

The Tawas series consists of deep, black, very poorly drained organic soils. These soils are in deep, depressional areas of the outwash plains and bottom lands. They formed under swamp vegetation in deposits of partially decomposed organic material over sandy mineral material.

In a representative profile, the surface layer is black muck about 13 inches thick. Below the surface layer is about 11 inches of very dark gray, friable muck that contains partially decomposed woody fragments. The underlying material is gray, loose sand.

Tawas soils have a high available moisture capacity and very high organic-matter content. The organic matter has moderately rapid permeability, and the underlying sand has very rapid permeability. Runoff is slow. These soils are suited to row crops if wetness is controlled.

Representative profile of Tawas muck in a cultivated field, 200 feet north and 150 feet east of the southwest corner of the SE¼ sec. 30, T. 38 N., R 6 E.:

Oa1—0 to 13 inches, black (10YR 2/1) muck; weak, fine and medium, granular structure; friable; neutral; clear, wavy boundary.

Oa2—13 to 24 inches, very dark gray (10YR 3/1) muck; massive; friable; many, dark-brown (10YR 3/3), partially decomposed wood fragments; thin strata and

pockets of light-gray (10YR 7/1) sand; neutral; abrupt, wavy boundary.

IICg—24 to 60 inches, gray (10YR 5/1) sand; common, medium, distinct, light yellowish-brown (10YR 6/4) mottles; single grain; loose; 2 percent fine gravel; mildly alkaline.

The organic deposits range from 12 to 42 inches in thickness. The Oa1 horizon is typically black but ranges to very dark brown in places. The content of partially decomposed woody fragments in the lower organic horizons is variable and ranges from few to many. The IIC horizon is loamy sand to sand.

Tawas soils are associated with Linwood, Edwards, and Carlisle soils. They are underlain at a depth of 12 to 42 inches by sandy mineral material, whereas Linwood soils are underlain by loamy material and Edwards soils are underlain by marl. Tawas soils have more shallow deposits of organic material than Carlisle soils.

**Tawas muck** (0 to 2 percent slopes) (Ta).—This soil occupies undrained depressions. Its profile is similar to that described as representative for the series, except that the mucky surface layer is thinner and the subsurface layer contains more brownish, partially decomposed peat fragments. These areas are covered with shallow water or the water table is near the surface most of the year.

Included in mapping are small areas of Carlisle muck. In some places the organic material below the surface layer is nearly all peat.

Wetness is a severe limitation for this soil. Except for those in pasture, most areas of this soil serve as habitat for wetland wildlife or provide cover for other wildlife. (Capability unit Vw–2)

**Tawas muck, drained** (0 to 2 percent slopes) (Td).—This soil is in depressions of the outwash plains and bottom lands. It has the profile described as representative for the series.

Included in mapping are small areas of Carlisle muck where the organic materials are more than 42 inches deep. Some areas have iron nodules throughout the organic material. There are fibrous, peaty organic materials a few inches under the surface in some areas. In some areas the lower organic horizon contains thin strata of sand.

Wetness is a severe limitation for this soil. In areas where the soil is dry and bare of vegetation, soil blowing is a hazard. Most areas are used for corn and soybeans. Row crops can be grown each year if wetness is controlled. This soil also is suited to truck crops. (Capability unit IVw–3)

## Tedrow Series

The Tedrow series consists of deep, somewhat poorly drained, coarse-textured soils. These soils are nearly level and occupy areas of the sandy outwash plains. They formed under mixed hardwoods in sandy outwash.

A representative profile has a dark-brown loamy sand surface layer about 9 inches thick. The subsurface layer is about 11 inches of brown, very friable loamy sand that contains yellowish-brown and light brownish-gray mottles. The subsoil is about 15 inches of light brownish-gray, very friable loamy sand that contains yellowish-brown mottles. The underlying material, to a depth of 60 inches, is grayish-brown, loose sand.

Tedrow soils have a low available moisture capacity and low organic-matter content. They have very rapid permeability and slow runoff. Droughtiness is a limitation for these soils. These soils are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture.

Representative profile of Tedrow loamy sand in a cultivated field, 50 feet west and 40 feet south of the northeast corner of the SE¼NE¼ sec. 15, T. 38 N., R. 7 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) loamy sand, light brownish gray (10YR 6/2) when dry; weak, medium and coarse, granular structure; friable; neutral; abrupt, smooth boundary.

A2—9 to 20 inches, brown (10YR 5/3) loamy sand; common, medium, distinct, yellowish-brown (10YR 5/6) and light brownish-gray (10YR 6/2) mottles; very weak, medium, granular structure; very friable; slightly acid; clear, smooth boundary.

B2—20 to 35 inches, light brownish-gray (10YR 6/2) loamy sand; many, medium, prominent, yellowish-brown (10YR 5/6) mottles; weak, medium and coarse, granular structure; very friable; slightly acid; clear, wavy boundary.

C—35 to 60 inches, grayish-brown (10YR 5/2) sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; neutral.

The solum ranges from 30 to 50 inches in thickness. The Ap horizon ranges from dark gray to very dark grayish brown or dark brown in color.

The Tedrow soils are associated with the Homer and Brady soils. They have a coarser textured solum than Homer or Brady soils.

**Tedrow loamy sand** (0 to 2 percent slopes) (Te).—This soil is on outwash plains.

Included in mapping are small areas of Plainfield fine sand at slightly higher elevations. Also included are some areas where the surface layer is fine sand.

Wetness is a limitation. If adequately drained, this soil is suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. During prolonged dry periods, the soil is droughty. If it is tile drained, special blinding is needed around the tile to keep the sand from entering. (Capability unit IVw–4)

## Tyner Series

The Tyner series consists of deep, somewhat excessively drained, coarse-textured soils. These soils are nearly level to moderately sloping and occupy outwash plains along the main streams and in the uplands. They formed under mixed hardwoods in sandy outwash material.

In a representative profile, the surface layer is dark-brown loamy sand about 8 inches thick. The subsurface layer is brown, friable loamy sand about 4 inches thick. The subsoil is about 38 inches thick. The upper 6 inches is dark yellowish-brown, friable loamy sand, the next 22 inches is dark-brown, very friable loamy sand, and the lower 10 inches is yellowish-brown, loose loamy sand. The underlying material is yellowish-brown, loose fine sand.

Tyner soils have a low available moisture capacity and low organic-matter content. They have rapid permeability and slow or medium runoff. Droughtiness is a limitation for these soils, and erosion is a hazard in the moderately sloping areas. These soils are suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture.

Representative profile of Tyner loamy sand, 0 to 2 percent slopes, in a cultivated field, 200 feet east and 50 feet

north of the southwest corner of the NW¼ sec. 15, T. 38 N., R. 4 E.:

Ap—0 to 8 inches, dark-brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) when dry; weak, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) loamy sand; very weak, medium, granular structure; friable; medium acid; clear, smooth boundary.

B21—12 to 18 inches, dark yellowish-brown (10YR 4/4) heavy loamy sand; weak, medium, subangular blocky structure; friable; few fine fragments of shale; strongly acid; clear, wavy boundary.

B22—18 to 40 inches, dark-brown (7.5YR 4/4) loamy sand; very weak, medium, granular structure; very friable; about 10 percent fine gravel; strongly acid; gradual, wavy boundary.

B3—40 to 50 inches, yellowish-brown (10YR 5/6) light loamy sand; slightly coherent to single grain; loose; few, discontinuous, dark yellowish-brown (10YR 4/4) color lenses; strongly acid; gradual, irregular boundary.

C—50 to 60 inches, yellowish-brown (10YR 5/4) fine sand; single grain; loose; some minute shale fragments; medium acid.

The solum ranges from 36 to 60 inches in thickness. The Ap horizon ranges from very dark grayish brown to dark grayish brown or dark brown in color. The B22 horizon is mainly dark brown but ranges to dark yellowish brown or yellowish brown. The B3 horizon is chiefly light loamy sand but ranges to sand.

Tyner soils are associated with Oshtemo, Chelsea, and Plainfield soils. They have a coarser textured B horizon than Oshtemo soils. The B horizon of Tyner soils is thicker than that of Chelsea soils and is generally continuous loamy sand rather than bands of loamy fine sand. Tyner soils have a finer textured solum than Plainfield soils.

**Tyner loamy sand, 0 to 2 percent slopes** (TyA).—This soil occupies outwash plains near the main streams and in the uplands. It has the profile described as representative for the series.

Included in mapping are small areas of soils having slopes of more than 2 percent. Also included are small areas of Oshtemo loamy sand.

Droughtiness is a limitation for this soil. Runoff is slow. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay and pasture. If irrigated, this soil is suited to all crops commonly grown in the county, including special crops. (Capability unit IIIs–1)

**Tyner loamy sand, 2 to 6 percent slopes** (TyB).—This gently sloping soil is on ridges and slope breaks in the outwash plains near the main streams and is in areas of the uplands.

Included in mapping are small areas of soils that have slopes of more than 6 percent, as well as small areas of Oshtemo loamy sand. Also included are a few areas in the uplands that are underlain by loam glacial till at a depth of 42 to 60 inches or more.

Droughtiness is a limitation for this soil. Runoff is slow. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay or pasture. If irrigated, this soil is suited to all crops commonly grown in the county, including special crops. (Capability unit IIIs–1)

**Tyner loamy sand, 6 to 12 percent slopes** (TyC).—This moderately sloping soil is on breaks near drainageways in the outwash plains and in areas of the uplands. Its profile is similar to the one described as representative for the series, except that the surface layer is thinner and lighter colored.

Included in mapping are small areas of soils that have slopes of more than 12 percent. Also included are small areas of Oshtemo loamy sand.

Erosion is a hazard on this soil, and droughtiness is a limitation. If proper conservation practices are applied, this soil can be used frequently for row crops. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay and pasture. This soil is suited to small grain, permanent pasture, and trees. (Capability unit IIIe–12)

## Volinia Series

The Volinia series consists of deep, well-drained, medium-textured soils that formed in loamy outwash under prairie vegetation. These soils are nearly level and occupy areas of the outwash plain.

In a representative profile, the surface layer is about 15 inches of very dark brown and very dark grayish-brown loam. The subsoil is about 33 inches thick. The upper 15 inches is dark-brown, firm sandy clay loam, and the lower 18 inches is dark yellowish-brown, loose loamy sand. The underlying material, to a depth of 60 inches, is light yellowish-brown, loose sand and gravel.

Volinia soils have a moderate available moisture capacity. They have moderate permeability and slow runoff. Use of these soils is limited by droughtiness. They are suited to all crops commonly grown in the county.

Representative profile of Volinia loam in a cultivated field, 150 feet east and 200 feet south of the northwest corner of the SE¼ sec. 15, T. 36 N., R. 6 E.:

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; friable; slightly acid; clear, smooth boundary.

A1—8 to 12 inches, very dark grayish-brown (10YR 3/2) loam; moderate, medium, granular structure; friable; slightly acid; clear, smooth boundary.

A3—12 to 15 inches, dark-brown (10YR 3/3) heavy loam; weak, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B2—15 to 30 inches, dark-brown (7.5YR 4/4) sandy clay loam with about 10 percent gravel; moderate, medium, subangular blocky structure; firm; thin, dark-brown (10YR 3/3) clay films on many peds; medium acid; clear, wavy boundary.

B3—30 to 48 inches, dark yellowish-brown (10YR 4/4) loamy sand with 10 percent gravel; massive; nearly loose; mainly strongly acid but becoming slightly acid in the lower 6 inches; clear, irregular boundary.

IIC—48 to 60 inches, light yellowish-brown (10YR 6/4) sand and gravel; single grain; loose; mildly alkaline; calcareous.

The solum ranges from 40 to 60 inches in thickness. The Ap horizon ranges from black to very dark brown or very dark grayish brown in color. The B2 horizon is sandy loam or gravelly clay loam in texture. The B3 horizon ranges from loamy sand to sand in texture, and some profiles have wavy, discontinuous lenses of sandy loam ½ to 1½ inches thick. The IIC horizon varies considerably in the proportion of sand to gravel.

Volinia soils are associated with Dickinson and Dowagiac soils. They occur on the same landscape and have the same dark color as Dickinson soils, but they have a finer textured B horizon than Dickinson soils. In addition, they are well drained, whereas Dickinson soils are somewhat excessively drained. They have a darker colored A horizon than Dowagiac soils.

**Volinia loam** (0 to 2 percent slopes) (Vo).—This soil is on outwash plains.

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Included in mapping are areas of soils that have a sandy loam surface layer and soils that have slopes of more than 2 percent.

Use of this soil is limited by droughtiness. Most areas are used for and are suited to corn, soybeans, and wheat. The soil also is suited to pasture and trees. (Capability unit IIs–2)

## Wallkill Series

The Wallkill series consists of deep, very poorly drained, medium-textured soils. These soils occupy deep, depressional areas of the uplands and outwash plains. They formed in medium-textured, alluvial material that washed from the surrounding slopes and was deposited over organic soil.

In a representative profile, the surface layer is about 9 inches of very dark gray silt loam. The next layer, to a depth of about 21 inches, is very dark gray, friable heavy silt loam. The underlying material is black, friable muck.

Wallkill soils have a high available moisture capacity and high organic-matter content. They have moderate permeability and slow surface runoff. Use of these soils is seriously limited by wetness. Drained areas are suited to most crops commonly grown in the county. Undrained areas are used for permanent pasture or have a variable cover of shrubs and trees that provide wildlife habitat.

Representative profile of Wallkill silt loam in a cultivated field, 200 feet west and 150 feet north of the southeast corner of sec. 13, T. 35 N., R. 5 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silt loam, gray (10YR 5/7) when dry; weak, fine, granular structure; friable; many roots; neutral; clear, smooth boundary.

C—9 to 21 inches, very dark gray (10YR 3/1) heavy silt loam; weak, medium, subangular blocky structure; friable; many roots; neutral; abrupt, wavy boundary.

IIOa1—21 to 30 inches, black (10YR 2/1) muck; very weak, medium, granular structure; friable; some roots; neutral; clear, wavy boundary.

IIOa2—30 to 60 inches, black (10YR 2/1) muck and many partially decomposed woody fragments; structureless (massive); friable; slightly acid.

The thickness of the recently deposited material ranges from 10 to 40 inches, but the dominant thickness ranges from 18 to 30 inches. The Ap horizon and the C horizon range from very dark gray to dark brown and dark gray or dark grayish brown in color. In some places the C horizon is mottled with gray and yellowish brown. The organic horizon is muck that contains variable amounts of partially decomposed organic material.

Wallkill, Shoals, and Washtenaw soils all formed in alluvium. Wallkill soils are underlain by a buried organic soil, whereas Shoals soils are underlain by deep alluvial material and Washtenaw soils are underlain by buried mineral soils.

**Wallkill silt loam** (0 to 2 percent slopes) (Wa).—This soil occupies deep depressions that formerly were marshes or shallow lakes on uplands and outwash plains.

Included in mapping are areas of soils that have a loam or silty clay loam surface layer and small areas where the alluvial material is less than 10 inches thick.

Wetness is the major limitation for this soil. Most areas are used for corn, soybeans, and small grain. If drained, this soil is suited to these crops. Undrained areas provide wildlife habitat. (Capability unit IIw–7)

## Washtenaw Series

The Washtenaw series consists of deep, poorly drained, medium-textured soils. These soils are nearly level and occur in depressional areas on moraines, till plains, or outwash plains. They formed under mixed hardwoods in 20 to 40 inches of alluvium that was washed from adjacent soils and recently deposited over a developed soil.

In a representative profile, the surface layer is about 10 inches of dark yellowish-brown silt loam. The next layer, to a depth of about 24 inches, is grayish-brown, friable silt loam. The next layer is about 32 inches thick. In sequence from the top, the upper 10 inches is very dark grayish-brown, firm silt loam. The next 8 inches is grayish-brown, firm silty clay loam that contains yellowish-brown mottles, and the lower 14 inches is light brownish-gray, firm clay loam that contains yellowish-brown mottles. The underlying material, to a depth of 64 inches, is yellowish-brown, friable loam glacial till.

Washtenaw soils have a high available moisture capacity and moderate organic-matter content. They have slow permeability and slow surface runoff. Wetness is a serious limitation, but drained areas are suited to most crops commonly grown in the county. Undrained areas are used for permanent pasture or have a variable cover of shrubs and trees that provide wildlife habitat.

Representative profile of Washtenaw silt loam in a cultivated field, 200 feet east and 5 feet south of the center of sec. 12, T. 36 N., R. 5 E.:

Ap—0 to 10 inches, dark yellowish-brown (10YR 3/4) silt loam, light brownish-gray (10YR 6/2) when dry; weak, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary.

C1—10 to 24 inches, grayish-brown (10YR 5/2) silt loam; common, medium, faint, yellowish-brown (10YR 5/6) mottles; weak, medium, granular structure; friable; slightly acid; clear, wavy boundary.

IIA1b—24 to 34 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

IIB21tgb—34 to 42 inches, grayish-brown (2.5YR 5/2) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky and subangular blocky structure; firm; few iron-manganese concretions; slightly acid; gradual, wavy boundary.

IIB22tgb—42 to 56 inches, light brownish-gray (2.5Y 6/2) heavy clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; firm; thin clay films on some peds; slightly acid; clear, wavy boundary.

IIC2—56 to 64 inches, yellowish-brown (10YR 5/4) loam; many, coarse, distinct, grayish-brown (10YR 5/2) mottles; massive; friable; mildly alkaline, calcareous.

The alluvial horizon ranges from 20 to 40 inches in thickness and is grayish brown, dark gray, gray, or dark yellowish brown. The texture is dominantly silt loam but in some places is loam. The buried A horizon ranges from very dark grayish brown to very dark brown or black and is silt loam, loam, silty clay loam, or clay loam. The buried B horizon is mainly silty clay loam or clay loam in texture but in some places ranges to loam. The underlying buried C horizon ranges from till to outwash material.

The Washtenaw, Wallkill, and Shoals soils all formed in alluvium. The Washtenaw soils are underlain by buried mineral soils. The Wallkill soils are underlain by buried organic soils, and the Shoals soils are underlain by deep alluvial material.

**Washtenaw silt loam** (0 to 2 percent slopes) (Wh).—This soil occupies depressional areas in moraines, till plains, and outwash plains.

Included in mapping are small areas of Shoals silt loam where the alluvial material is deeper than 36 inches. Also included are small areas where the alluvial material is less than 15 inches thick. In some areas the surface layer is loam or sandy loam.

Wetness is the major limitation for this soil. Most areas are used for corn, soybeans, and small grain. If drained, this soil is suited to these crops. Undrained areas provide wildlife habitat. (Capability unit IIw–1)

## Whitaker Series

The Whitaker series consists of deep, somewhat poorly drained, medium-textured soils. These soils are nearly level and occupy broad lakebed areas. They formed under mixed hardwoods in medium-textured sediments that settled out of slow-moving water in shallow lakes and stream backwater areas.

In a representative profile, the surface layer is about 9 inches of dark-brown loam and about 3 inches of grayish-brown loam that contains yellowish-brown mottles. The subsoil is about 31 inches thick. The upper part is grayish-brown, firm sandy clay loam that contains yellowish-brown mottles. The next 14 inches is yellowish-brown, firm silty clay loam that contains grayish-brown mottles, and the lower 7 inches is light brownish-gray, friable clay loam with light olive-brown mottles. The underlying material is grayish-brown, stratified fine sand and silt and contains light-gray mottles.

Whitaker soils have a high available moisture capacity and moderate organic-matter content. They have moderate permeability and slow surface runoff. Wetness is a limitation. Drained areas are suited to most crops commonly grown in the county.

Representative profile of Whitaker loam in a cultivated field, 500 feet north and 400 feet east of the southwest corner of the NW¼ sec. 35, T. 35 N., R. 5 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) loam, light brownish gray (10YR 6/2) when dry; weak, medium and coarse, granular structure; friable; neutral; abrupt, smooth boundary.

A2—9 to 12 inches, grayish-brown (2.5Y 5/2) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium and coarse, granular structure; friable; neutral; clear, smooth boundary.

B21tg—12 to 22 inches, grayish-brown (2.5Y 5.2) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, grayish-brown (10YR 5/2) clay films on some peds; few iron and manganese concretions; slightly acid; gradual, smooth boundary.

B22t—22 to 36 inches, yellowish-brown (10YR 5/6) silty clay loam; many, coarse, distinct, grayish-brown (2.5Y 5/2) mottles; moderate, medium, subangular blocky structure and angular blocky structure; firm; thin, grayish-brown (10YR 5/2) clay films on most peds; few reddish-brown (5YR 4/4) iron stains; slightly acid; clear, wavy boundary.

B3—36 to 43 inches, light brownish-gray (2.5Y 6/2) clay loam; few, fine, distinct, light olive-brown (2.5Y 5/6) mottles; massive; friable; neutral; clear, wavy boundary.

IIC—43 to 60 inches, grayish-brown (2.5Y 5/2), stratified fine sand and silt; few, fine, distinct, light-gray (2.5Y 7/2) mottles; massive; friable; calcareous.

The solum ranges from 36 to 60 inches in thickness. The Ap horizon is dark brown or dark grayish brown in color. The A horizon is dominantly loam in texture but ranges from silt loam to sandy loam. The B2 horizon ranges from loam to silty clay loam in different layers. The C horizon varies in sequence and texture of the silt and sand over short distances.

The Whitaker soils are associated with the Del Rey and Homer soils. They are underlain by stratified, coarse-textured and medium-textured materials, but Del Rey soils are underlain by stratified, medium-textured or moderately fine textured lakebed materials, and Homer soils are underlain by stratified sand and gravel.

**Whitaker loam** (0 to 2 percent slopes) (Wk).—This soil is in broad lakebed areas.

Included in mapping are areas of soils that have slopes of more than 2 percent. Also included are some areas where the surface layer is silt loam or sandy loam. Small areas of Rensselaer loam in drainageways also are included.

Wetness is a limitation for this soil. Most areas are used for corn, soybeans, small grain, and grasses and legumes for hay and pasture. If adequately drained, this soil is suited to these crops. It can also be used for permanent pasture and for trees that are tolerant of excessive wetness. (Capability unit IIw–2)

# *Use and Management of the Soils*

This section has six main parts. The first part pertains to cropland and explains the management by capability groups of soils used by the Soil Conservation Service. A description is given for each capability unit, followed by a discussion on levels of management and a table on predicted yields of principal crops. The second part consists of test data and interpretive data that are used for engineering purposes. The third deals with the use of soils in town and country planning. The fourth consists of a discussion on woodland, followed by a section on shrubs. The fifth part discusses use of soils for wildlife habitat. The last part is on use of soils for recreation.

These sections do not suggest specific management for individual soils. Detailed suggestions can be obtained from the local representative of the Soil Conservation Service or from the Elkhart County Cooperative Extension Service.

## Use and Management of Soils for Crops

About two-thirds of Elkhart County is used for cultivated crops and permanent pasture. The main cultivated crops are corn, soybeans, and small grain. The principal forage crops are clover, alfalfa, bromegrass, bluegrass, orchardgrass, and timothy. Some areas are used for special crops, such as fruit, vegetables, berries, and ornamental trees and shrubs.

Most of the sloping soils in crops will erode unless practices are used to protect the soil. Such practices as contour farming, plow planting, stripcropping, diversion terraces, grassed waterways, proper use of crop residues, and grass-legume plantings in rotation will help control erosion and conserve moisture. Some soils require protection from wind blowing if they are row cropped. If properly located and managed, vegetative windbreaks provide adequate protection.

Unless adequately drained, some areas of cropland are too wet for profitable yields. Drainage is accomplished

by tile systems, by surface ditches, or by a combination of both. Tile outlet ditches are needed in some places.

Some soils in the county are irrigated. This practice is especially beneficial on soils that are droughty. The practice of irrigating high-value crops is increasing every year.

The amount of fertilizer and lime needed depends on the results of the soil tests, the crops to be grown, and past cropping history.

### *Capability grouping*

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming *(6)*. It is a practical classification based on the limitations of the soils, the risk of damage when they are used for ordinary field crops or sown pastures, and the way they respond to treatment. The classification does not apply to horticultural crops or other crops that have their own special requirements for economical production. The soils are classified according to degree and kind of permanent limitations, 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 the soils are grouped at three levels, the capability class, the subclass, and the 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. The classes are 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 habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation without major reclamation and limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation without major reclamation and restrict their use largely to range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plant production without major reclamation and restrict their use to recreation, wildlife habitat, water supply, or 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 that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States but not in Elkhart 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 the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, 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–4 or IIIe–6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages, the capability units in Elkhart County are described and suggestions for the use and management of the soils are given. These units are not numbered consecutively, because not all of the units in the statewide system are represented in this county. The names of the soil series represented are mentioned in the description of each unit, but this does not mean that all the soils in a given series are in the unit. The capability classification of each soil in the county is given in the "Guide to Mapping Units" at the back of this survey.

#### CAPABILITY UNIT I–1

This unit consists of deep, nearly level, well-drained soils of the Rawson and Riddles series. These soils have a loam surface layer and a sandy clay loam or clay loam subsoil.

The organic-matter content is low or moderate, available moisture capacity is high, and permeability is moderate or slow. Maintaining and improving tilth and organic-matter content are the principal needs.

These soils are suited to corn, soybeans, small grain, and alfalfa. They are also suitable for pasture, trees, and special crops. Many kinds of cropping systems, including continuous production of row crops, can be used.

Use of crop residue, winter cover crops, and green-manure crops helps to maintain a desirable organic-matter content and good tilth.

#### CAPABILITY UNIT I–2

Only Alluvial land, loamy, is in this unit. The soils are deep, nearly level, and moderately well drained and well drained. They have a sandy loam or loam surface layer and a sandy loam, loam, or silt loam subsoil.

The organic-matter content is moderate, available moisture capacity is moderate to high, and permeability is moderate. These soils are neutral in reaction and are well supplied with plant nutrients received naturally by flooding. Occasional flooding occurs during winter and spring.

These soils are suited to corn, soybeans, and pasture. Wheat ordinarily is not grown, because of flooding. Row crops generally are grown year after year.

Use of crop residue helps to maintain a desirable organic-matter content. Lime generally is not needed on these soils.

#### CAPABILITY UNIT IIe-1

This unit consists of deep, gently sloping, well-drained soils of the Miami, Rawson, and Riddles series. These soils have a loam surface layer and a sandy clay loam, clay loam, or silty clay loam subsoil.

Soils in this unit have low or moderate organic-matter content, high available moisture capacity, and moderate or moderately slow permeability. The major management needs are control of erosion and the maintenance and improvement of organic-matter content and tilth.

These soils are suited to the common crops of the county. Corn, soybeans, small grain, and alfalfa are the principal crops grown. The soils also are suited to pasture, trees, and special crops.

Use of crop residue, winter cover crops, minimum tillage, and grass-legume mixtures helps to control erosion and to maintain good tilth. Grassed waterways, diversion terraces, and contour cultivation (fig. 12) also help to control soil loss. Many different cropping combinations are suitable for these soils.

#### CAPABILITY UNIT IIe-5

The only soil in this unit, Riddles sandy loam, 2 to 6 percent slopes, is deep, gently sloping, and well drained. The surface layer is about 12 to 15 inches of sandy loam, and the subsoil is friable loam and firm sandy clay loam and clay loam.

This soil is low in organic-matter content. It has good tilth and is easy to cultivate. The available moisture capacity is moderate, and the permeability is moderate. The major limitations to management are the erosion hazard, droughtiness, and the unfavorable organic-matter content.

This soil is suited to all crops commonly grown in the county. The main crops are corn, soybeans, small grain, grasses, and legumes. The soils also are suited to special crops, including berries and nursery stock. They are suitable for irrigation, but the gentle slopes make irrigation less feasible than on level soils.

Use of crop residue, minimum tillage practices, winter cover crops, and grass-legume mixtures will help to control erosion, maintain good tilth, and improve soil fertility. Grassed waterways, diversions, terraces, and contouring can be used to control further soil loss. Many combinations of cropping systems are suited to these soils including intensively cultivated crops.

*Figure 12.*—**Contour cropping and rotation pasture on Miami loam, 2 to 6 percent slopes, eroded.**

#### CAPABILITY UNIT IIe-12

This unit consists of deep, gently sloping, somewhat poorly drained soils of the Blount, Crosby, and Haskins series. These soils have a loam or silt loam surface layer and a clay loam, silty clay loam, or clay subsoil.

These soils are low in organic-matter content and have a high available moisture capacity. The Blount and Crosby soils have slow permeability, and the Haskins soil is moderately permeable in the upper part and slowly permeable in the lower part.

The major needs of management are controlling erosion and wetness, maintaining good tilth, and regularly adding organic matter. Blount and Crosby soils form clods more readily than the Haskins soil.

Use of crop residue, winter cover crops, green-manure crops, and minimum tillage helps to control erosion and maintain a desirable organic-matter content. It also helps to improve soil tilth. Grassed waterways (fig. 13) permit the transporting of surface water across these soils without creating gullies or intensifying siltation. Although contouring is helpful in controlling erosion, it commonly increases wetness by retarding surface runoff. Adequate drainage is needed if these soils are to be used for corn, soybeans, small grains, alfalfa, and other commonly grown crops. Many combinations of cropping systems are suited to these soils, including intensely cultivated crops.

#### CAPABILITY UNIT IIs-2

This unit consists of deep, nearly level, well-drained soils of the Dowagiac and Volinia series. These soils have a surface layer of loam and a subsoil that is sandy clay loam in the upper part and loamy sand in the lower part.

These soils are high in organic-matter content. They have a moderate available moisture capacity and moderate permeability. The main limitations are droughtiness and soil blowing.

These soils are suited to all crops commonly grown in the county. During extremely dry years, however, some crops are affected by drought. These soils are well suited to irrigation (fig. 14). They are also suited to special crops.

Use of crop residue, cover crops, and minimum tillage helps to control soil blowing.

#### CAPABILITY UNIT IIs-3

Riddles sandy loam, 0 to 2 percent slopes, the only soil in this unit, is deep, nearly level, and well drained. The surface layer is sandy loam, and the subsoil is loam, sandy clay loam, and clay loam.

This soil is low in organic-matter content and has a moderate available moisture capacity and moderate permeability. The main limitations are droughtiness and unfavorable organic-matter content.

This soil is suited to all crops commonly grown in the county. The main crops are corn, soybeans, and small grain. It also is suited to special crops, including berries and nursery stock. Deep-rooted crops are better able to overcome the drought hazard, as the subsoil stores considerable moisture. This soil is suited to irrigation.

Use of crop residue, winter cover crops, and green-manure crops helps to maintain a desirable organic-matter content.

#### CAPABILITY UNIT IIw-1

This unit consists of deep, poorly drained, nearly level soils of the Brookston, Pewamo, Rensselaer, and Washtenaw series. These soils have a surface layer of silt loam or silty clay loam and a subsoil of silt loam, clay loam, silty clay loam, or clay.

Soils in this unit have moderate or high organic-matter content, a high available moisture capacity, and slow or moderately slow permeability. During prolonged wet periods, the water table is at or near the surface. Owing to the high clay content and a high content of moisture, these soils are often difficult to work during spring. The main limitations are wetness, surface crusting, compaction, and puddling of the soil.

These soils are suited to most of the crops commonly grown in the county. Corn, soybeans, and wheat are the main crops. Other crops, such as tomatoes, sweet corn, and sugar beets, also can be grown.

*Figure 13.*—A grassed waterway on Crosby loam, 2 to 4 percent slopes.

*Figure 14.*—Irrigating corn with a gun sprinkler on Volinia loam.

The tilth of these soils greatly influences their productivity. Working the plow layer when wet makes it puddled and cloddy. Adequate drainage can be provided for most areas of these soils by installing a complete tile system. In some places random tile lines are beneficial. Surface drains are sometimes needed to remove accumulated surface water from ponded areas. Where feasible, diversion terraces are useful in intercepting runoff from the uplands.

Use of minimum tillage and crop residue helps to prevent surface crusting and improve soil tilth. To reduce puddling, avoid working these soils when they are wet. These soils are suited to many combinations of cropping systems, including the continuous production of row crops.

#### CAPABILITY UNIT IIw–2

This unit consists of deep, nearly level, somewhat poorly drained soils of the Blount, Crosby, Del Rey, Haskins, and Whitaker series. These soils have a surface layer of loam or silt loam and a subsoil of sandy clay loam, clay loam, silty clay loam, or clay.

These soils have low or medium organic-matter content, a high available moisture capacity, and moderate to slow permeability. If the plow layer is worked when wet, it becomes puddled and cloddy. Pasturing by livestock when the soils are too wet commonly results in detrimental compaction of the surface layer. The major management requirements are control of wetness, regular additions of organic matter, maintenance of good tilth, and prevention of surface crusting.

If adequately drained, these soils are suited to corn, soybeans, small grain, alfalfa, clover, and grasses. They also are suited to tomatoes and sugar beets. These soils are suitable for many different cropping systems, including continuous production of row crops.

Use of crop residue and winter cover crops helps to maintain the organic-matter content, improve tilth, and prevent crusting. Minimum tillage also helps to reduce crusting and puddling of the surface layer.

#### CAPABILITY UNIT IIw–4

This unit consists of deep, nearly level, poorly drained and very poorly drained soils of the Gilford and Sebewa series. These soils have a surface layer of sandy loam or loam and a subsoil of sandy loam, sandy clay loam, or clay loam.

Soils in this unit have high organic-matter content, a moderate available moisture capacity, and moderately rapid or moderately slow permeability. During prolonged wet periods, the water table is at or near the surface. The main limitation is wetness.

These soils are suited to most of the crops commonly grown in the county. Corn and soybeans are the main crops grown. The soils also are suited to such special crops as onions, cabbage, carrots, sweet corn, and tomatoes.

Use of tile or open-ditch drainage is effective in lowering the water table and removing excess water. If tile is laid in the gravelly and sandy substratum, special blinding or filters help to keep the sand from clogging the tile. Overdrainage can make these soils droughty. These soils are suited to many combinations of cropping systems, including continuous production of row crops.

#### CAPABILITY UNIT IIw–6

Homer loam, the only soil in this unit, is deep, nearly level, and somewhat poorly drained. This soil has a surface layer of loam and a subsoil of sandy loam and sandy clay loam.

This soil has a moderate organic-matter content, moderate available moisture capacity, and moderately slow permeability. The main limitation is wetness. Maintaining good tilth and regularly returning organic matter are needed in the use and management of this soil.

This soil is suited to corn, soybeans, small grain, and grasses and legumes. It is suited to many different cropping systems, including the continuous production of row crops.

A suitable drainage system must be established and maintained for economical and maximum production on this soil. If tile drainage is used, special blinding or filter material is needed to keep the sand from filling the tile. Use of open ditches is effective in lowering the water table.

Minimum tillage and the use of crop residue aid in maintaining and improving soil tilth and organic-matter content. If working the soils is delayed when they are too wet, large clods are less likely to form.

#### CAPABILITY UNIT IIw–7

This unit consists of deep, nearly level soils of the Shoals and Wallkill series. Shoals soils are somewhat poorly drained, and Wallkill soils are very poorly drained. These soils have a surface layer of loam and silt loam and a subsoil of silt loam. Wallkill soils are underlain by organic material at a depth of 15 to 36 inches.

Shoals soils have a low organic-matter content and moderate available moisture capacity. Wallkill soils have a high organic-matter content and high available moisture capacity. All the soils have moderate permeability. The main limitation is wetness. The soils are subject to ponding or overflowing during winter and spring. In some areas protection from runoff from the adjacent uplands is needed.

Soils of this unit are suited to corn and soybeans. Some areas that are difficult to drain are used mainly for permanent pasture.

#### CAPABILITY UNIT IIw–10

Linwood muck is the only soil in this unit. It is a level, moderately deep, very poorly drained soil. The muck layer consists of decomposed plant remains. The underlying material is sandy loam, loam, or clay loam.

This soil has a very high organic-matter content and high available moisture capacity. The permeability is moderately rapid in the organic material and moderately rapid or slow in the underlying material. The main limitations are wetness and the risk of soil blowing.

This soil is suited to corn and soybeans. It also is suited to such special crops as onions, potatoes, carrots, and grass sod for lawns.

If this soil is to be properly managed, a good drainage system is needed. Use of tile and open outlet ditches is common. Practices that control the level of the water table generally are effective in reducing the rate of oxidation of the organic matter.

If the surface of this soil is dry and unprotected, soil blowing may occur at any time of year. Use of field wind-

breaks, cover crops, and plant residues helps to reduce blowing of the fine organic particles.

#### CAPABILITY UNIT IIw–11

Aubbeenaubbee sandy loam is the only soil in this unit. It is a deep, nearly level, somewhat poorly drained soil. The surface layer and upper part of the subsoil are sandy loam, the lower part of the subsoil is sandy clay loam, and the underlying material is loam.

This soil has a low organic-matter content and moderate available moisture capacity. The permeability is moderately rapid in the upper part and moderate in the lower part. The main management needs are control of wetness and the regular return of organic matter.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. During extended dry periods, shallow-rooted crops are subject to damage from drought.

A suitable drainage system needs to be established and maintained for maximum efficiency in the use and management of this soil. If tile drainage is used, special filters are needed to prevent the sand from seeping into and filling the tile lines. Proper location of tile lines to intercept underground seepage is vital to establishment of adequate drainage. This soil is suited to many combinations of cropping systems, including continuous cultivation.

#### CAPABILITY UNIT IIIe–1

This unit consists of deep, well-drained, moderately sloping soils of the Miami, Rawson, and Riddles series. The surface layer is loam, and the subsoil is sandy clay loam, clay loam, or silty clay loam.

The soils in this unit have a low organic-matter content, high available moisture capacity, and moderate to moderately slow permeability. The main needs in managing the soils are control of erosion and the regular return of organic matter.

These soils are suited to all crops commonly grown in the county. The main crops are corn, small grain, and grasses and legumes. In addition, some soybeans are grown. These soils also are suited to the production of valuable timber trees, such as walnut, cherry, and yellow-poplar.

Conservation practices, including contouring, stripcropping, and using grassed waterways and diversion terraces, help to control runoff and erosion. If such practices are not used, row crops should be limited in the rotation and close-growing crops or grasses and legumes for forage should be grown most of the time. Green-manure crops help to maintain and increase the organic-matter content and improve soil tilth. Use of winter cover crops and crop residue helps to control runoff and erosion.

#### CAPABILITY UNIT IIIe–5

Only Riddles sandy loam, 6 to 12 percent slopes, is in this unit. It is a deep, moderately sloping, well-drained soil. The surface layer is sandy loam, and the subsoil is sandy clay loam.

This soil has a low organic-matter content, moderate available moisture capacity, and moderate permeability. The main management needs are control of erosion and the regular return of organic matter.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. It also is suited to fruits, berries, nursery stock, and most species of trees, including walnut and yellow poplar.

Use of crop residue, winter cover crops, and such conservation practices as stripcropping, terracing, and grassed waterways helps to control runoff and erosion.

#### CAPABILITY UNIT IIIe–12

This unit consists of deep, moderately sloping, excessively drained soils of the Chelsea and Tyner series. These soils have a surface layer of sand or loamy sand and a subsoil of sand or loamy sand. They have a low organic-matter content, low or very low available moisture capacity, and rapid or very rapid permeability. The main management limitations are the risk of erosion, droughtiness, and the unfavorable organic-matter content.

Soils in this unit are used for all crops common in the county, but because moisture is limited, they are better suited to crops that mature early in the season, such as small grain or grass-legume meadow, than they are to most other crops. They also are suited to Christmas trees and wildlife habitat.

Contour farming and stripcropping, as well as use of crop residue and winter cover crops, help to control runoff and erosion. Lime and fertilizer are needed in adequate amounts for economical crop production.

#### CAPABILITY UNIT IIIe–13

This unit consists of deep, gently sloping and moderately sloping, well-drained and somewhat excessively drained soils of the Fox, Metea, and Oshtemo series. These soils have a surface layer of loamy sand and sandy loam and a subsoil of sandy loam or sandy clay loam.

The soils in this unit have a low organic-matter content, low to moderate available moisture capacity, and rapid to moderate permeability. The main limitations are the risk of erosion, droughtiness, and the lack of organic matter.

These soils are suited to most of the crops commonly grown in the county. The main crops are corn, small grain, and grasses and legumes. They also are suitable for orchards (fig. 15), woodland, and wildlife habitat. They are better suited to small grain and deep-rooted legumes than to most row crops.

Use of crop residue, barnyard manure, and green-manure crops provides a regular supply of organic matter. Contour farming, stripcropping, and grassed waterways aid in reducing soil loss.

#### CAPABILITY UNIT IIIs–1

This unit consists of deep, nearly level and gently sloping, excessively drained and somewhat excessively drained soils of the Chelsea and Tyner series. The Chelsea soils have a sand surface layer and subsoil, and the Tyner soils have a loamy sand surface layer and subsoil.

Soils in this unit have a low organic-matter content, low or very low available moisture capacity, and very rapid permeability. The main limitations are droughtiness, unfavorable organic-matter content, and risk of soil blowing.

These soils are suited to all crops commonly grown in the county. However, they are better suited to early maturing crops than to most other crops. They have

*Figure 15.*—**Apple orchard on Metea loamy fine sand, 6 to 12 percent slopes, in capability unit IIIe–13.**

severe limitations for crops that require large amounts of water. They are also suited to truck and other special crops, such as nursery stock, melons, berries, and flower bulbs. Crops respond well to applications of supplemental water.

Use of crop residue and cover crops helps to improve and maintain the organic-matter content and to reduce soil blowing. Irrigation, which tends to keep the soil moist during extremely dry periods, also reduces the hazards of soil blowing.

#### CAPABILITY UNIT IIIs–2

This unit consists of deep, nearly level and gently sloping, moderately well drained to somewhat excessively drained soils of the Bronson, Dickinson, Fox, Metea, and Oshtemo series. These soils have a surface layer of loamy sand or sandy loam and a subsoil of loamy sand, sandy loam, or sandy clay loam. They have a low organic-matter content, except for the Dickinson soil, which has a high organic-matter content. All the soils have a low to moderate available moisture capacity and moderately rapid to moderate permeability. The main limitations are droughtiness, risk of soil blowing, and the unfavorable organic-matter content.

These soils are suited to all crops commonly grown in the county, but crops are affected by droughtiness. The soils are better suited to early maturing crops, such as small grain, than they are to most other crops. They are suited to irrigation and, with adequate moisture, such special crops as berries, fruits, truck crops, and nursery stock do well.

Use of crop residue, cover crops, and minimum tillage practices aids in the control of soil blowing and regularly supplies organic matter. Field windbreaks also are beneficial in the control of soil blowing.

#### CAPABILITY UNIT IIIw–1

The only soil in this unit is Maumee loamy fine sand. It is a deep, nearly level, very poorly drained soil. It has a surface layer of loamy fine sand and a subsoil of loamy sand and sand.

This soil has a high organic-matter content, low available moisture capacity, and rapid permeability. Early in spring and late in winter, the water table is at or near the surface. The main limitation is wetness. Some soil blowing occurs during seasons when there is no vegetative cover and the surface layer is dry.

This soil is suited to most crops commonly grown in the county. The main crops are corn and soybeans. Small grain and grasses and legumes also are grown. Other suitable crops are mint, cabbage, onions, carrots, and tomatoes.

This soil requires adequate drainage for maximum production. If tile drainage is used, special blinding or filters are needed to prevent the sand from entering the tile lines. Open ditches also are effective in draining this soil. It can easily be overdrained and become droughty. Measures that control the level of the water table are effective in regulating the degree of drainage. Use of cover crops, crop residue, and field windbreaks is helpful in reducing soil blowing. This soil is suitable for many different cropping systems, including continuous row cropping.

#### CAPABILITY UNIT IIIw–4

Brady sandy loam, the only soil in this unit, is deep, nearly level, and somewhat poorly drained. The surface layer and subsoil consist of sandy loam.

This soil has a moderate organic-matter content, low available moisture capacity, and moderately rapid permeability. The main limitations are wetness and the organic-matter content.

This soil is suited to most crops commonly grown in the county. The main crops are corn and soybeans. Some small grain and grasses and legumes also are grown.

Tile drainage or open-ditch drainage effectively lowers the water table and removes excess water. If tile drainage is used, special blinding or filters are needed to prevent the tile lines from becoming clogged with sand. This soil can be overdrained and become droughty.

Use of crop residue and cover crops supplies regular additions of organic matter. This soil is suited to many combinations of cropping systems, including the continuous production of row crops.

#### CAPABILITY UNIT IIIw–8

The only soil in this unit is Carlisle muck, drained. It is deep, nearly level, and poorly drained. The organic-matter content is very high, the available moisture capacity is high, and permeability is moderately rapid. The main limitations are wetness and risk of soil blowing.

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This soil is suited to corn and soybeans. It also is suited to such special crops as onions, potatoes, sweet corn, carrots, and grass sod for lawns.

Adequate drainage is essential in the management of this soil. Both open ditch drainage and tile drainage are common methods used for drainage. In some areas outlets are not available for drainage systems and pumping may be desirable. Here, habitat for wetland wildlife is easily created.

Soil blowing can occur during any season of the year if the surface of the soil is dry and unprotected. Field windbreaks (fig. 16) of certain species of shrubs and trees, the use of cover crops, and artificially wetting the surface soil all help to reduce soil blowing.

#### CAPABILITY UNIT IVe-1

This unit consists of deep, well-drained, moderately sloping and strongly sloping soils of the Miami series. These soils are eroded or severely eroded. The surface layer is loam or clay loam, and the subsoil is clay loam or silty clay loam.

These soils have a low organic-matter content, high available moisture capacity, and moderate to moderately slow permeability. Runoff is rapid. During extremely dry seasons, moisture can be limiting on the Miami clay loam.

The clay loam surface layer is difficult to work. It is tough and sticky when wet and extremely hard when dry. This soil is best worked under ideal moisture conditions. The main management needs are the control of runoff (fig. 17) and erosion and the improvement of soil tilth.

Establishing and maintaining grassed waterways and using contour farming help to control erosion on the soils in this unit. Use of crop residue and winter cover crops supplies regular additions of organic matter, reduces runoff, and improves soil tilth. Crops grown on the severely eroded soil respond well to applications of barnyard manure.

These soils are well suited to cropping systems having rotations in which row crops are grown only occasionally. The severely eroded soil is well suited to hay or pasture.

*Figure 16.*—**Windbreaks of green willow on Carlisle muck.**

*Figure 17.*—**Good legume hay on Miami clay loam, 6 to 12 percent slopes, severely eroded.**

Areas on which long rotations or permanent vegetation are used provide good habitat for open-land wildlife. Soils in this unit also are well suited to trees.

#### CAPABILITY UNIT IVe-5

The only soil in this unit is Riddles sandy loam, 12 to 18 percent slopes. This is a deep, strongly sloping, well-drained soil. The surface layer is sandy loam, and the subsoil is sandy clay loam or clay loam.

This soil has a low organic-matter content, moderate to high available moisture capacity, and moderate permeability. The main management needs are the control of runoff and erosion and the regular return of organic matter.

This soil is poorly suited to cultivated crops because of slope and the hazard of erosion. It is better suited to small grain and to grasses and legumes for forage, and it should be used only occasionally for cultivated crops. It is suited to woodland and produces high-quality timber. Good wildlife habitat can readily be developed on this soil.

Such conservation practices as grassed waterways, contour farming, and minimum tillage help to control surface runoff and erosion. Without use of conservation practices, permanent vegetation helps to minimize surface runoff and erosion.

#### CAPABILITY UNIT IVe-13

The only soil in this unit is Oshtemo loamy sand, 12 to 18 percent slopes. It is a deep, strongly sloping, somewhat excessively drained soil. The surface layer is loamy sand, and the subsoil is sandy loam and loamy sand.

This soil has a low organic-matter content, low available moisture capacity, and moderately rapid permeability. The main management needs are the control of runoff, erosion, and droughtiness and the regular return of organic matter.

This soil is well suited to small grain and to grasses and legumes for forage. Cropping systems in which row crops are grown only occasionally are preferred. The soil is suited to many kinds of trees and shrubs.

Contour farming and stripcropping, as well as the use of crop residue and winter cover crops, help to control erosion and runoff.

#### CAPABILITY UNIT IVs–1

This unit consists of deep, nearly level and gently sloping, moderately well drained and excessively drained soils of the Brems and Plainfield series. The surface layer is fine sand or loamy fine sand, and the subsoil is medium sand.

These soils have a low organic-matter content, very low available moisture capacity, and rapid or very rapid permeability. The main limitations are droughtiness, the low organic-matter content, and the risk of soil blowing.

These soils are well suited to crops that mature early in the season. Although they are used for all crops commonly grown in the county, they have severe limitations for crops that require large amounts of water, such as corn. They are suited to Christmas trees and wildlife habitat. Special crops, such as berries, fruits, flower bulbs, and nursery stock, do well under irrigation (fig. 18), along with other high-return cash crops.

A protective vegetative cover, windbreaks in critical areas, and protection from overgrazing help to control soil blowing. Use of crop residue and cover crops helps to improve and maintain the organic-matter content.

#### CAPABILITY UNIT IVw–3

This unit consists of deep, level, very poorly drained organic soils of the Edwards and Tawas series. The organic layers are composed of partially decomposed organic material.

These soils have a very high organic-matter content, high available moisture capacity, and moderately rapid permeability. The main limitations are wetness and the risk of soil blowing.

These soils are suited to all crops commonly grown in the county. The main crops are corn and soybeans. Such special crops as onions, carrots, and potatoes grow well on these soils, and so do pasture plantings.

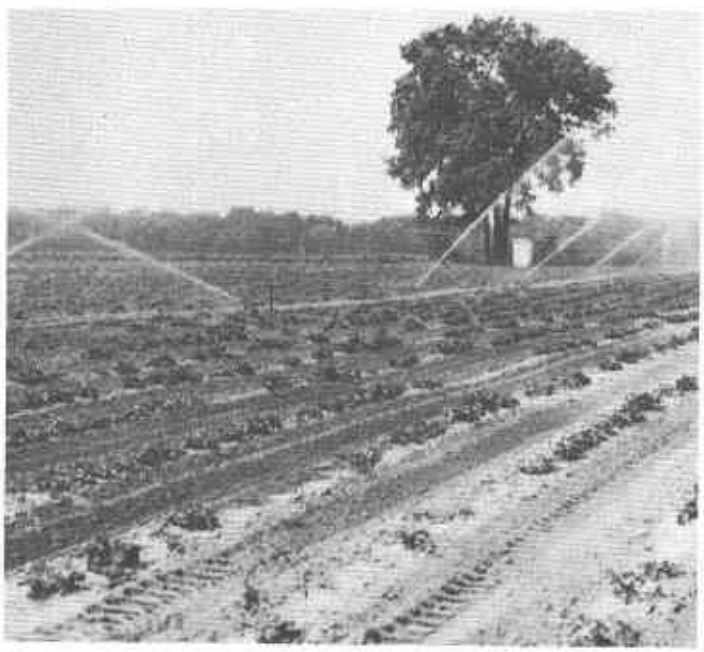

*Figure 18.*—**Strawberries being irrigated on Plainfield fine sand, 0 to 2 percent slopes.**

Adequate drainage is essential in the management of these soils. The Edwards soil is underlain by marl and does not always respond well to tile drainage. Open-ditch drainage is the most feasible method for this soil. The Tawas soil is underlain by sand and responds readily to drainage systems. It is also well suited to practices that control the level of the water table. If tile drainage is used, special blinding or filters are needed to prevent sand from filling the tile. Surface runoff from the uplands commonly needs to be diverted away to help correct the wetness.

Use of cover crops and crop residue helps to control soil blowing early in winter and in spring. Shrub windbreaks are beneficial for this purpose throughout the year.

#### CAPABILITY UNIT IVw–4

The only soil in this unit is Tedrow loamy sand. It is a deep, nearly level, somewhat poorly drained soil. The surface layer and subsoil are loamy sand.

This soil has a low organic-matter content, low available moisture capacity, and rapid permeability. The main limitation is wetness. During prolonged dry periods, plants are damaged by drought and soil blowing may occur.

This soil is suited to small grain and to grasses and legumes. If irrigated, this soil is suited to many kinds of special crops.

A suitable drainage system is needed to remove excess water, especially during the early part of the growing season. If tile drainage is used, it is important to take precautions to prevent the sand from entering the tile. Ditches that control the water table, together with structures to control overdrainage, are beneficial. Use of crop residue, cover crops, and minimum tillage helps to control soil blowing.

#### CAPABILITY UNIT Vw–2

This unit consists of deep, nearly level, very poorly drained to well-drained soils in Alluvial land, mixed, and in the Carlisle and Tawas series. The muck layer of the Tawas and Carlisle soils consists of decomposed plant remains. Soils mapped as Alluvial land, mixed, have a surface layer of silt loam or loam and a subsoil of silt loam, loam, or sandy loam. All the soils in this unit have moderate or high organic-matter content, moderate or high available moisture capacity, and moderate or moderately rapid permeability.

Soils in this unit are not suited to cropping, because they are dissected by many old stream channels and because their soil material and drainage are extremely variable. Many areas are subject to frequent flooding, and some areas are impractical to drain. Other areas border marshes or lakes and have a permanently high water table. Some areas are suited to permanent pasture and adapted woodland species. Other areas provide habitat for wetland wildlife or food and cover for upland wildlife.

#### CAPABILITY UNIT VIe–1

This unit consists of deep, strongly sloping to steep, well-drained soils of the Miami and Riddles series. The surface layer is sandy loam or clay loam, and the subsoil is sandy clay loam, clay loam, or silty clay loam.

These soils have a low organic-matter content, high available moisture capacity, and moderate to moderately

slow permeability. Management needs include control of erosion and runoff and maintenance of a vigorous vegetative cover.

These soils are suited to grasses and legumes for forage. Some areas, where the soils are steep or severely eroded, are better managed as permanent pasture. These soils also are suited to trees and open-land wildlife.

Permanent grasses and legumes can be maintained by controlled grazing and by timely and adequate applications of lime and fertilizer. Renovating permanent pastures on the contour helps to control erosion during the renovation period. Establishing and maintaining grassed waterways also help to control erosion and runoff.

#### CAPABILITY UNIT VIe-3

The only soil in this unit is Oshtemo loamy sand, 18 to 25 percent slopes. This is a deep, steep, somewhat excessively drained soil. It has a surface layer of loamy sand and a subsoil of sandy loam.

This soil has a low organic-matter content, low available moisture capacity, and moderately rapid permeability. The main limitations are the risk of erosion, droughtiness, and the unfavorable organic-matter content.

This soil is suited to grasses, legumes, and trees. It is commonly used for permanent pasture (fig. 19) because of the difficulty of moving farm machinery on it. Small grains are occasionally seeded. Areas on which long rotations or permanent vegetation are used provide good habitat for open-land wildlife.

Use of contour farming, grassed waterways, and minimum tillage helps to control erosion.

#### CAPABILITY UNIT VIs-1

Only Plainfield fine sand, 6 to 12 percent slopes, is in this unit. It is a deep, moderately sloping, excessively drained soil. The surface layer, subsoil, and underlying material are all fine sand.

This soil has low organic-matter content, very low available moisture capacity, and very rapid permeability. The main limitations are droughtiness, low organic-matter content, and risk of soil blowing.

This soil is suited to grasses and legumes for forage and to trees. It is used for corn and soybeans but is poorly suited to them because sufficient moisture is lacking. Small grain is grown in spring, when water is available. Christmas trees and other conifers do well on this soil. Use of crop residue and cover crops helps to provide regular additions of organic matter. A protective vegetative cover, permanent cover in critical areas, and protection from overgrazing help to prevent soil blowing.

#### CAPABILITY UNIT VIIe-3

This unit consists of Borrow pits, Gravel pit, and Made land. These are areas in which the original soils have been so disturbed that they can no longer be identified by soil series. The areas have been leveled or filled with earth or trash. They are made up of sand, silt, clayey material, and trash in almost any proportion.

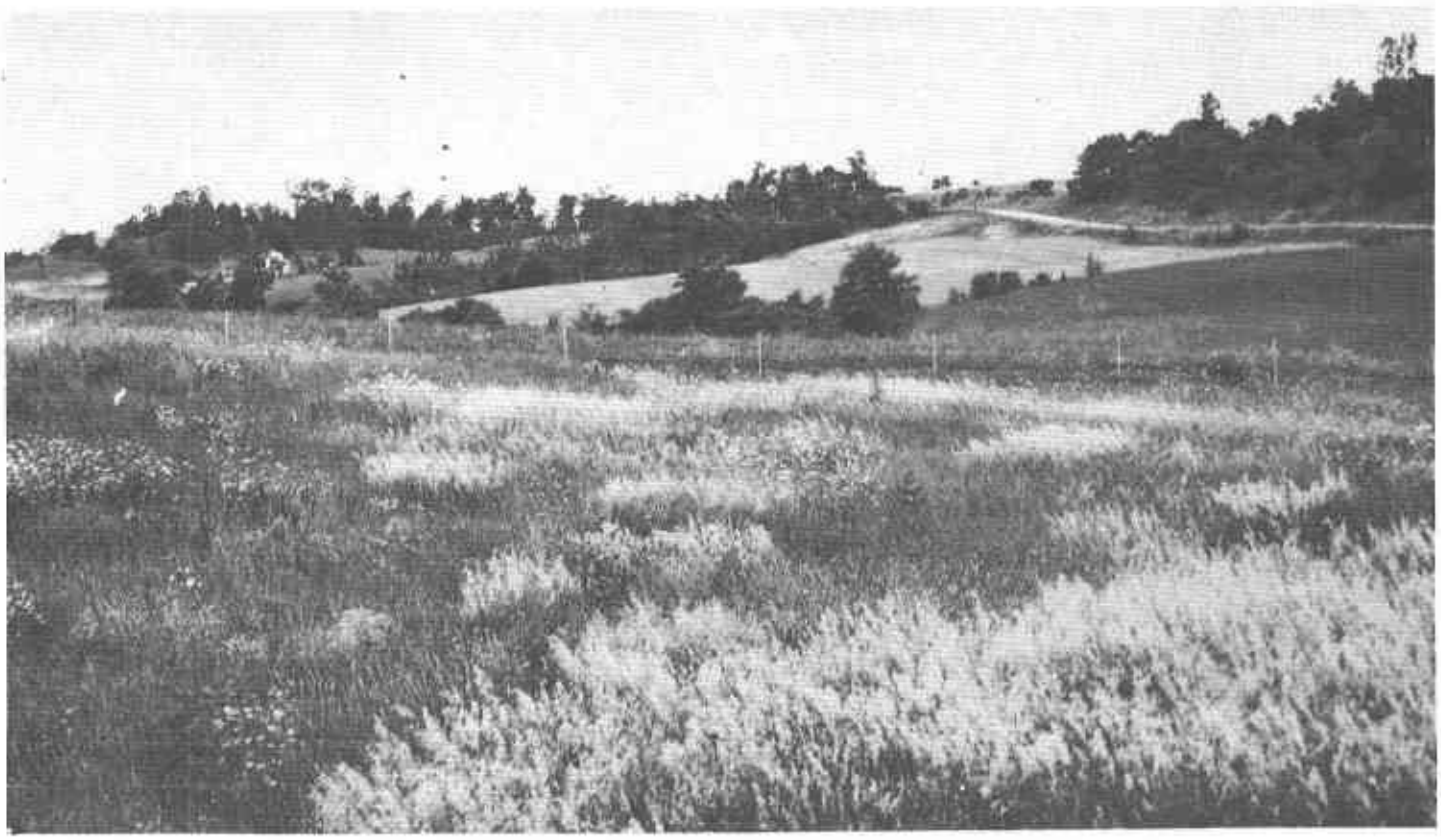

*Figure 19.*—Pasture on Oshtemo loamy sand, 18 to 25 percent slopes.

The suitability of these areas for farm use can only be determined by onsite inspection. Many areas are used for urban development, but suitability for any land use is dependent on the nature of the material.

#### CAPABILITY UNIT VIIIw-1

This unit consists only of Marsh, a land type that is covered by shallow water most of the time. These areas are around edges of deep bodies of water and in undrained depressions. The soil material is muck and peat, silt and clay, or sand and gravel. These areas are dry for short periods of time during most summers. They have little value as cropland, pasture, or woodland.

### *Predicted yields* [3]

Table 2 lists average acre yields of corn, soybeans, wheat, oats, clover and grass, and alfalfa or alfalfa and grass that can be expected on each soil in the county under two levels of management. In columns A are yields to be expected under a common, or medium, level of management. In columns B are yields to be expected under an improved, or high, level of management that some farmers in the county are now practicing.

The yields are predicted averages for a period of 5 to 10 years. They are based on farm records; on interviews with farmers, members of the staff of the Purdue Agricultural Experiment Station, and others familiar with the agriculture of the county; and on direct observations by soil scientists and district conservationists. Considered in making the estimates were the prevailing climate, characteristics of the soils, and the influence of different kinds of management on the soils.

It should be understood that these yield figures may not apply directly to specific tracts of land for any particular year, because the soils vary somewhat from place to place, management practices differ from farm to farm, and weather conditions vary from year to year. Nevertheless, these estimates appear to be as accurate a guide as can be obtained without further detailed and lengthy investigations. They are useful in showing the relative productivity of the soils and how soils respond to improved management.

The management needed to get the yields in columns A consists of (a) using cropping systems that maintain tilth and organic matter, (b) using management practices that reduce erosion sufficiently so that the qualities of the land are not greatly reduced, (c) using moderate applications of fertilizers and lime as determined by soil tests, (d) returning most crop residue to the soil, (e) using conventional plowing and tillage methods, (f) using crop varieties generally adapted to the climate and soils, (g) controlling weeds moderately well by tillage and spraying, and (h) draining wet land sufficiently well for cropping, though in cases yields are somewhat restricted by wetness.

The management needed to get the yields in columns B consists of (a) using cropping systems that maintain tilth and organic matter, (b) using the cultural practices, mechanical practices, or both, that are needed to control erosion, so that the qualities of the land are maintained or improved rather than reduced, (c) maintaining high levels of available phosphate, potassium, and nitrogen as determined frequently by soil tests and according to recommendations by the State Agricultural Experiment Station, (d) liming the soils as indicated by tests and according to recommendations, (e) using crop residues to the fullest extent for protection and improvement of the soil, (f) practicing minimum tillage, (g) using only the best adapted varieties of crops, (h) thoroughly controlling weeds by tillage and spraying, and (i) adequately draining wet soils.

[3] DONALD SMITH, district conservationist, Soil Conservation Service, assisted in preparing this section.

TABLE 2.—*Predicted average acre yields of principal crops under two levels of management*

[In columns A are yields to be expected under common management, and in columns B are yields to be expected under improved management. Absence of data indicates that the crop ordinarily is not grown on the soil or the soil is not suitable for it]

| Soil | Corn | | Soybeans | | Wheat | | Oats | | Clover-grass mixture | | Alfalfa or alfalfa-grass mixture | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | A | B | A | B | A | B | A | B | A | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Tons* | *Tons* | *Tons* | *Tons* |
| Alluvial land, loamy | 80 | 110 | 30 | 45 | | | 60 | 75 | 2.0 | 3.0 | | |
| Alluvial land, mixed | | | | | | | | | | | | |
| Aubbeenaubbee sandy loam | 65 | 85 | 18 | 24 | 25 | 30 | 55 | 60 | 1.2 | 1.7 | 2.0 | 3.0 |
| Blount silt loam, 0 to 2 percent slopes | 85 | 110 | 30 | 40 | 35 | 45 | 55 | 75 | 2.0 | 3.0 | 3.0 | 4.0 |
| Blount silt loam, 2 to 4 percent slopes, eroded | 75 | 100 | 30 | 35 | 30 | 40 | 55 | 75 | 2.0 | 3.0 | 3.0 | 4.0 |
| Borrow pits | | | | | | | | | | | | |
| Brady sandy loam | 70 | 85 | 23 | 26 | 25 | 35 | 50 | 60 | 2.0 | 3.0 | 2.5 | 3.2 |
| Brems loamy fine sand | 40 | 60 | 14 | 18 | 16 | 25 | 30 | 40 | 1.0 | 1.2 | 2.0 | 2.5 |
| Bronson sandy loam | 60 | 80 | 22 | 28 | 25 | 30 | 50 | 60 | 1.2 | 1.5 | 3.0 | 3.5 |
| Brookston silt loam | 100 | 140 | 35 | 45 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 4.0 |
| Carlisle muck | | | | | | | | | | | | |
| Carlisle muck, drained | 100 | 130 | 30 | 40 | | | | | | | | |
| Chelsea fine sand, 0 to 2 percent slopes | 40 | 70 | 15 | 20 | 20 | 30 | 40 | 60 | 1.0 | 1.5 | 2.0 | 3.0 |
| Chelsea fine sand, 2 to 6 percent slopes | 40 | 70 | 15 | 20 | 20 | 30 | 40 | 60 | 1.0 | 1.5 | 2.0 | 3.0 |
| Chelsea fine sand, 6 to 12 percent slopes | 30 | 65 | 14 | 18 | 20 | 30 | 40 | 60 | 1.0 | 1.5 | 1.7 | 2.5 |

TABLE 2.—*Predicted average acre yields of principal crops under two levels of management*—Continued

| Soil | Corn | | Soybeans | | Wheat | | Oats | | Clover-grass mixture | | Alfalfa or alfalfa-grass mixture | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | A | B | A | B | A | B | A | B | A | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Tons* | *Tons* | *Tons* | *Tons* |
| Crosby loam, 0 to 2 percent slopes | 90 | 110 | 30 | 40 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 4.0 |
| Crosby loam, 2 to 4 percent slopes | 85 | 100 | 30 | 35 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 4.0 |
| Del Rey silt loam | 75 | 95 | 25 | 35 | 30 | 40 | 60 | 80 | 1.7 | 2.5 | 3.0 | 4.0 |
| Dickinson sandy loam | 60 | 75 | 20 | 25 | 25 | 30 | 60 | 70 | 1.5 | 1.7 | 3.0 | 3.5 |
| Dowagiac loam | 70 | 90 | 22 | 30 | 30 | 35 | 60 | 70 | 1.5 | 1.7 | 3.0 | 3.5 |
| Edwards muck | 75 | 90 | | | | | | | | | | |
| Fox sandy loam, 0 to 2 percent slopes | 70 | 85 | 25 | 30 | 30 | 35 | 60 | 70 | 1.5 | 2.2 | 3.0 | 4.0 |
| Fox sandy loam, 2 to 6 percent slopes | 70 | 85 | 25 | 30 | 30 | 35 | 60 | 70 | 1.5 | 2.2 | 3.0 | 4.0 |
| Fox sandy loam, 6 to 12 percent slopes, eroded | 60 | 75 | 20 | 25 | 28 | 32 | 60 | 70 | 1.5 | 2.2 | 3.0 | 3.5 |
| Gilford sandy loam | 80 | 100 | 25 | 35 | 35 | 40 | 60 | 80 | 1.5 | 2.5 | 2.5 | 3.0 |
| Gilford mucky sandy loam | 80 | 100 | 25 | 35 | | 30 | 40 | 60 | 1.5 | 2.5 | 2.5 | 3.0 |
| Gravel pit | | | | | | | | | | | | |
| Haskins loam, 0 to 2 percent slopes | 90 | 110 | 30 | 40 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 4.0 |
| Haskins loam, 2 to 4 percent slopes | 85 | 100 | 30 | 35 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 4.0 |
| Homer loam | 65 | 85 | 25 | 30 | 30 | 35 | 60 | 70 | 1.5 | 2.2 | 3.0 | 3.5 |
| Linwood muck | 100 | 130 | 25 | 30 | | | | | | | | |
| Made land | | | | | | | | | | | | |
| Marsh | | | | | | | | | | | | |
| Maumee loamy fine sand | 75 | 90 | 28 | 30 | 30 | 35 | 55 | 70 | 2.0 | 2.5 | | |
| Metea loamy fine sand, 0 to 6 percent slopes | 65 | 80 | 25 | 30 | 30 | 35 | 60 | 70 | 1.5 | 1.7 | 2.5 | 3.5 |
| Metea loamy fine sand, 6 to 12 percent slopes | 50 | 65 | 15 | 20 | 20 | 25 | 45 | 55 | 1.5 | 1.7 | 2.0 | 3.0 |
| Miami loam, 2 to 6 percent slopes, eroded | 85 | 110 | 30 | 35 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 5.0 |
| Miami loam, 6 to 12 percent slopes, eroded | 70 | 85 | 25 | 30 | 30 | 40 | 50 | 70 | 1.5 | 2.2 | 2.5 | 3.5 |
| Miami loam, 12 to 18 percent slopes, eroded | 40 | 55 | 20 | 22 | 25 | 30 | 50 | 60 | 1.5 | 2.0 | 2.5 | 3.0 |
| Miami clay loam, 6 to 12 percent slopes, severely eroded | 60 | 75 | 25 | 30 | 25 | 33 | 50 | 65 | 1.2 | 1.7 | 2.5 | 3.0 |
| Miami clay loam, 12 to 18 percent slopes, severely eroded | 35 | 45 | 15 | 20 | 25 | 30 | 45 | 60 | 1.2 | 1.7 | 2.0 | 2.7 |
| Oshtemo loamy sand, 0 to 2 percent slopes | 60 | 75 | 20 | 24 | 25 | 30 | 50 | 60 | 1.2 | 1.5 | 2.5 | 3.0 |
| Oshtemo loamy sand, 2 to 6 percent slopes | 55 | 75 | 20 | 25 | 25 | 30 | 45 | 50 | 1.2 | 1.5 | 2.5 | 3.0 |
| Oshtemo loamy sand, 6 to 12 percent slopes | 50 | 70 | 18 | 22 | 25 | 30 | 45 | 50 | 1.2 | 1.5 | 2.2 | 2.5 |
| Oshtemo loamy sand, 12 to 18 percent slopes | 45 | 65 | 15 | 20 | 25 | 28 | 45 | 50 | 1.2 | 1.5 | 2.0 | 2.2 |
| Oshtemo loamy sand, 18 to 25 percent slopes | | | | | 20 | 25 | 30 | 40 | 1.0 | 1.5 | 1.5 | 2.0 |
| Pewamo silty clay loam | 95 | 120 | 35 | 40 | 35 | 40 | 70 | 80 | 2.0 | 3.0 | 3.0 | 4.0 |
| Plainfield fine sand, 0 to 2 percent slopes | 40 | 60 | 15 | 20 | 15 | 20 | 30 | 40 | .7 | 1.0 | 1.7 | 2.0 |
| Plainfield fine sand, 2 to 6 percent slopes | 40 | 60 | 15 | 20 | 15 | 20 | 30 | 40 | .7 | 1.0 | 1.7 | 2.0 |
| Plainfield fine sand, 6 to 12 percent slopes | 35 | 50 | 15 | 18 | 15 | 20 | 30 | 40 | .7 | 1.0 | 1.7 | 2.0 |
| Rawson loam, 0 to 2 percent slopes | 85 | 110 | 30 | 40 | 35 | 45 | 60 | 80 | 2.0 | 3.0 | 3.0 | 5.0 |
| Rawson loam, 2 to 6 percent slopes | 80 | 95 | 28 | 36 | 35 | 40 | 55 | 75 | 2.0 | 3.0 | 3.0 | 4.0 |
| Rawson loam, 6 to 12 percent slopes, eroded | 70 | 85 | 25 | 30 | 30 | 38 | 50 | 70 | 1.5 | 2.2 | 2.5 | 3.5 |
| Rensselaer silt loam | 85 | 110 | 35 | 40 | 30 | 40 | 60 | 80 | 1.5 | 2.0 | 3.0 | 4.0 |
| Riddles sandy loam, 0 to 2 percent slopes | 80 | 100 | 28 | 35 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 5.0 |
| Riddles sandy loam, 2 to 6 percent slopes | 75 | 90 | 25 | 33 | 30 | 40 | 60 | 80 | 1.7 | 2.5 | 3.0 | 4.0 |
| Riddles sandy loam, 6 to 12 percent slopes | 70 | 85 | 25 | 30 | 30 | 40 | 50 | 70 | 1.5 | 2.5 | 2.5 | 3.5 |
| Riddles sandy loam, 12 to 18 percent slopes, eroded | 40 | 60 | 18 | 22 | 25 | 30 | 50 | 60 | 1.5 | 2.0 | 2.5 | 3.0 |
| Riddles sandy loam, 18 to 25 percent slopes, eroded | 40 | 55 | 18 | 20 | 22 | 28 | 45 | 55 | 1.5 | 2.0 | 2.2 | 2.7 |
| Riddles loam, 0 to 2 percent slopes | 95 | 130 | 30 | 45 | 40 | 50 | 65 | 85 | 2.0 | 3.0 | 3.0 | 5.0 |
| Riddles loam, 2 to 6 percent slopes, eroded | 85 | 110 | 30 | 35 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 5.0 |
| Riddles loam, 6 to 12 percent slopes, eroded | 70 | 85 | 25 | 30 | 30 | 40 | 50 | 70 | 1.5 | 2.2 | 2.5 | 3.5 |
| Sebewa loam | 85 | 110 | 35 | 40 | 35 | 40 | 60 | 80 | 1.5 | 2.0 | 3.0 | 4.0 |
| Shoals loam | 70 | 90 | 25 | 35 | | | 30 | 45 | 1.5 | 2.0 | | |
| Tawas muck | | | | | | | | | | | | |
| Tawas muck, drained | 70 | 90 | 25 | 35 | | | | | | | | |
| Tedrow loamy sand | 40 | 60 | 15 | 20 | 15 | 20 | 30 | 40 | .7 | 1.0 | 1.7 | 2.0 |
| Tyner loamy sand, 0 to 2 percent slopes | 45 | 70 | 18 | 22 | 20 | 30 | 40 | 60 | 1.0 | 1.5 | 2.0 | 3.0 |
| Tyner loamy sand, 2 to 6 percent slopes | 45 | 70 | 18 | 22 | 20 | 30 | 40 | 60 | 1.0 | 1.5 | 2.0 | 3.0 |
| Tyner loamy sand, 6 to 12 percent slopes | 45 | 70 | 18 | 22 | 20 | 30 | 40 | 60 | 1.0 | 1.5 | 2.0 | 2.5 |
| Volinia loam | 70 | 90 | 22 | 30 | 30 | 35 | 60 | 70 | 1.5 | 1.7 | 3.0 | 3.5 |
| Wallkill silt loam | 90 | 120 | 30 | 40 | | | | | | | | |
| Washtenaw silt loam | 90 | 120 | 30 | 40 | 30 | 40 | 60 | 80 | 1.5 | 2.0 | 3.0 | 4.0 |
| Whitaker loam | 90 | 110 | 30 | 40 | 30 | 40 | 60 | 80 | 2.0 | 3.0 | 3.0 | 4.0 |

## Engineering Uses of the Soils [4]

Soils are of special interest to professional engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the properties important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and pH. Depth to water table and depth to bedrock also are important, and topographic position of the soils may be significant.

The information in this survey can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway and airport locations and in planning detailed soil surveys of the selected locations.
3. Assist in designing drainage systems, farm ponds, diversion terraces, and other structures for soil and water conservation.
4. Locate possible sources of sand and gravel.
5. Correlate performance of structures with soil mapping units and, thus, develop information that can be useful in designing and maintaining new structures.
6. Determine the suitability of soil units for cross-country movements of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. They do not eliminate the need for sampling and testing at the site of specific engineering works where heavy loads are to be supported or where the excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Tables 3, 4, and 5 provide soils data useful in engineering. Only the data in table 3 are from actual laboratory tests. The estimates in tables 4 and 5 are based on a comparison of soils with those tested. At many construction sites, major variations in the soil may be present within the depth of the proposed excavations, and several soils may occur within a short distance. Specific laboratory data on engineering properties of the soil should be determined for the soil at the site before any engineering work is planned in detail.

[4] PETER FORSYTHE, assistant State conservation engineer, Soil Conservation Service, assisted in preparing this section.

Some of the terms used by the soil scientists may be unfamiliar to the engineer. Some words, for example soil, clay, silt, sand, aggregate, and granular, have special meanings in soil science. These terms and others are defined in the Glossary at the back of this survey.

Information useful in engineering can be obtained from the soil map. It will often be necessary, however, to refer to other parts of the survey. By using the information in the soil map, the soil profile descriptions, and the tables in this section, the engineer can plan a detailed investigation of the soil at the construction site.

### *Engineering classification systems*

Two systems for classification of soils are in general use among engineers. Most highway engineers classify soil material according to the system used by the American Association of State Highway Officials (AASHO) *(1)*. Other engineers prefer to use the Unified soil classification system. Both classification systems are used in this survey in tables 3 and 4 and are briefly described here.

AASHO Classification System.—In this system, all soil materials are classified in seven principal groups, based on mechanical analysis and plasticity test data. The groups range from A–1 (gravelly soils of high bearing capacity, the best soils for subgrades) to A–7 (clay soils having low strength when wet, the poorest soils for subgrades). Highly organic soils, such as peat and muck, are not included in this classification, as their use as a construction material or foundation material should be avoided.

Within each of the principal groups, the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The group index number for several of the soils of Elkhart County is shown, in parentheses following the soil group symbol, in the next to last column in table 3. The estimated AASHO classification for all of the soils of the county is given in table 4.

Unified Classification System—Some engineers prefer to use the Unified soil classification system *(7)*. This system is based on identification of soils according to their texture and plasticity and their performance as engineering construction materials. In the Unified system, soil materials are identified as coarse grained (eight classes), fine grained (six classes), or highly organic. The classification of the tested soils according to the Unified system is given in table 3, and the estimated classification of all the soils is given in table 4.

### *Engineering test data*

Table 3 presents test data from three soil series of Elkhart County taken from seven locations. Only selected layers of each soil were sampled. The test results have been used as a general guide in estimating the engineering properties of the soils of the county.

Mechanical analyses were made by a combination of the sieve and hydrometer methods. The liquid limit and plasticity index were determined. The results of these tests and the classification of each sample according to both the AASHO and the Unified systems are given in table 4.

TABLE 3.—*Engineering*

[Tests performed by Purdue University, in cooperation with the Indiana State Highway Commission and the Bureau of

| Soil name and location | Parent material | SCS report No. S–63 Ind–20 | Depth from surface | Moisture-density [1] | | Mechanical analysis [2] | |
|---|---|---|---|---|---|---|---|
| | | | | Maximum dry density | Optimum moisture | Percentage passing sieve— | |
| | | | | | | 1 inch | ¾ inch |
| | | | *Inches* | *Pounds per cubic foot* | *Percent* | | |
| Gilford sandy loam: | | | | | | | |
| SE¼SW¼ sec. 32, T. 38 N., R. 6 E. (Modal). | Sandy outwash. | 9–1 | 0–8 | 102 | 20 | ------ | 100 |
| | | 9–2 | 11–28 | 119 | 11 | ------ | 100 |
| | | 9–3 | 28–42 | 121 | 11 | ------ | 100 |
| NW¼SW¼ sec. 6, T. 36 N., R. 6 E. (Finer textured than modal). | Sandy outwash. | 8–1 | 0–11 | 95 | 24 | ------ | ------ |
| | | 8–2 | 16–27 | 113 | 15 | ------ | ------ |
| | | 8–3 | 27–37 | 110 | 11 | ------ | ------ |
| Oshtemo loamy sand: | | | | | | | |
| NE. corner of sec. 32, T. 38 N., R. 6 E. (Modal). | Sandy outwash. | 5–1 | 0–10 | 126 | 10 | ------ | 100 |
| | | 5–2 | 19–29 | 126 | 10 | 100 | 94 |
| | | 5–3 | 48–58 | 128 | 10 | 100 | 96 |
| NE. corner of sec. 15, T. 38 N., R. 4 E. (Finer textured than modal). | Sandy outwash. | 1–1 | 0–10 | 121 | 12 | ------ | ------ |
| | | 1–2 | 16–30 | 122 | 10 | ------ | ------ |
| | | 1–3 | 30–45 | 105 | 13 | ------ | ------ |
| SW. corner of sec. 29, T. 38 N., R. 6 E. (Coarser textured than modal). | Sandy outwash. | 4–1 | 0–9 | 124 | 10 | ------ | 100 |
| | | 4–2 | 18–31 | 122 | 10 | ------ | 100 |
| | | 4–3 | 58–70 | 123 | 8 | 100 | 98 |
| Volinia loam: | | | | | | | |
| SE¼NW¼ sec. 25, T. 36 N., R. 6 E. (Modal). | Gravelly and sandy outwash. | 7–1 | 0–9 | 111 | 16 | ------ | ------ |
| | | 7–2 | 15–28 | 124 | 12 | ------ | 100 |
| | | 7–3 | 48–58 | 118 | 14 | ------ | 100 |
| SE¼SW¼ sec. 22, T. 36 N., R. 6 E. (Coarser textured than modal). | Gravelly and sandy outwash. | 6–1 | 0–9 | 102 | 20 | ------ | ------ |
| | | 6–2 | 15–26 | 116 | 13 | 100 | 94 |
| | | 6–3 | 42–54 | 134 | 9 | ------ | 100 |

[1] Based on AASHO Designation T 99, Methods A and D (*1*).

[2] Mechanical analyses according to AASHO Designation T 88–57 (*1*). Results by this procedure frequently may 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 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 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 of soils.

*test data*

Public Roads, in accordance with standard methods of the American Association of State Highway Officials (AASHO)(1)]

| Mechanical analysis [2] | | | | | | | | | Liquid limit | Plasticity index | Classification | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage passing sieve—Continued | | | | | Percentage smaller than— | | | | | | AASHO [3] | Unified [4] |
| 3/8 inch | 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. | | | | |
| | | | | | | | | | *Percent* | | | |
| 97 | 94 | 89 | 67 | 29 | 26 | 18 | 11 | 8 | 38 | 7 | A–2–4(0) | [6] SM |
| 93 | 86 | 77 | 58 | 22 | 19 | 17 | 12 | 8 | 22 | 6 | A–2–4(0) | SM–SC |
| 96 | 92 | 82 | 18 | 8 | 7 | 6 | 4 | 3 | (5) | (5) | A–1–b(0) | SP–SM |
| 100 | 99 | 97 | 73 | 28 | 27 | 23 | 14 | 9 | 45 | 9 | A–2–5(0) | [6] SM |
| 100 | 99 | 95 | 66 | 26 | 25 | 22 | 18 | 15 | 22 | 4 | A–2–4–(0) | SM–SC |
| 100 | 99 | 97 | 58 | 10 | 9 | 8 | 8 | 7 | (5) | (5) | A–3(0) | SP–SM |
| 98 | 95 | 90 | 64 | 22 | 21 | 18 | 11 | 9 | (5) | (5) | A–2–4(0) | SM |
| 90 | 78 | 63 | 24 | 15 | 14 | 13 | 11 | 7 | 23 | 4 | A–1–b(0) | SM–SC |
| 69 | 47 | 31 | 7 | 4 | 3 | 2 | 2 | 1 | (5) | (5) | A–1–a(0) | GW |
| 100 | 99 | 98 | 74 | 27 | 26 | 19 | 11 | 8 | 21 | (5) | A–2–4(0) | SM |
| 100 | 99 | 96 | 66 | 19 | 18 | 18 | 17 | 15 | 19 | 4 | A–2–4(0) | SM–SC |
| 100 | 99 | 98 | 69 | 10 | 8 | 8 | 8 | 7 | (5) | (5) | A–3(0) | SP–SM |
| 97 | 95 | 90 | 66 | 23 | 22 | 21 | 12 | 8 | 20 | 3 | A–2–6(0) | SC |
| 92 | 80 | 66 | 43 | 10 | 9 | 9 | 8 | 8 | (5) | (5) | A–1–b(0) | SW–SM |
| 91 | 83 | 64 | 8 | 4 | 3 | 3 | 2 | 2 | (5) | (5) | A–1–b(0) | SP |
| 100 | 99 | 98 | 70 | 44 | 42 | 32 | 18 | 14 | 29 | 9 | A–4(2) | SC |
| 96 | 90 | 79 | 49 | 21 | 20 | 20 | 16 | 14 | 24 | 6 | A–1–b(0) | SM–SC |
| 98 | 94 | 87 | 67 | 7 | 6 | 6 | 6 | 6 | (5) | (5) | A–3(0) | SP–SM |
| 100 | 99 | 97 | 83 | 49 | 48 | 40 | 23 | 16 | 34 | 15 | A–6(5) | [6] SC |
| 84 | 74 | 61 | 33 | 14 | 13 | 13 | 11 | 9 | 31 | 10 | A–2–4(0) | SC |
| 90 | 74 | 48 | 6 | 3 | 2 | 2 | 1 | 1 | (5) | (5) | A–1–a(0) | SW |

[3] Based on AASHO Designation M 145–49.

[4] Based on the Unified Soil Classification System (7). SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of A-line are to be given a borderline classification. Examples are SM–SC and SP–SM.

[5] Nonplastic.

[6] Surface layer is organic and shows more than 5 percent less by weight on ignition.

TABLE 4.—*Estimated soil properties*

[Depth to bedrock is not included in this table, because all soils in Elkhart County are so

| Soil series and map symbols | Depth to seasonal high water table | Depth from surface | Classification | | |
|---|---|---|---|---|---|
| | | | USDA texture | Unified | AASHO |
| | *Feet* | *Inches* | | | |
| Alluvial land: Ad, Am. Properties variable. Onsite investigation necessary. | | | | | |
| Aubbeenaubbee: Au | 2–3 | 0–26 | Sandy loam | SM | A–2 |
| | | 26–34 | Sandy clay loam | CL | A–6 |
| | | 34–60 | Loam | ML or CL | A–4 or A–6 |
| Blount: BlA, BlB2 | 1–3 | 0–11 | Silt loam | ML or CL | A–4 |
| | | 11–23 | Silty clay loam | CL | A–6 |
| | | 23–33 | Silty clay | CL or CH | A–6 or A–7 |
| | | 33–60 | Silty clay loam | CL | A–6 |
| Borrow pits: Bp. Properties variable. Onsite investigation necessary. | | | | | |
| Brady: Br | 1–3 | 0–31 | Sandy loam | SM | A–2 |
| | | 31–50 | Loamy sand | SM | A–1 |
| | | 50–60 | Sand | SP or SM | A–3 |
| Brems: Bu | 2–3 | 0–9 | Loamy fine sand | SM | A–2 |
| | | 9–60 | Sand | SP | A–1 |
| Bronson: Bv | 3–6 | 0–42 | Sandy loam | SM | A–2 |
| | | 42–46 | Sandy clay loam | CL | A–6 |
| | | 46–60 | Gravel and sand | GP | A–1 |
| Brookston: Bw | 0–1 | 0–9 | Silt loam | ML | A–4 |
| | | 9–46 | Clay loam | CL | A–6 |
| | | 46–60 | Loam | CL | A–4 or A–6 |
| Carlisle: Ca, Cd | 0–1 | 0–22 | Muck | Pt | |
| | | 22–60 | Muck or peat | Pt | |
| Chelsea: ChA, ChB, ChC | >6 | 0–68 | Fine sand | SP–SM | A–3 |
| Crosby: CrA, CrB | 1–3 | 0–13 | Loam | ML | A–4 |
| | | 13–34 | Clay loam | CL or CH | A–6 or A–7 |
| | | 34–60 | Light clay loam | ML or CL | A–4 or A–6 |
| Del Rey: De | 1–3 | 0–9 | Silt loam | ML or CL | A–4 or A–6 |
| | | 9–38 | Silty clay loam or silty clay. | CL | A–6 |
| | | 38–60 | Silt loam | ML or CL | A–4 or A–6 |
| Dickinson: Dk | >6 | 0–30 | Sandy loam | SM | A–2 |
| | | 30–40 | Loamy sand | SM | A–1–b |
| | | 40–60 | Sand | SP–SM | A–3 |
| | | 60–66 | Gravel and sand | GP | A–1 |
| Dowagiac: Do | >6 | 0–13 | Loam | ML | A–4 |
| | | 13–36 | Sandy clay loam | SC | A–6 |
| | | 36–52 | Loamy sand | SM | A–1 |
| | | 52–72 | Gravel and sand | GP | A–1 |
| Edwards: Ed | 0–1 | 0–26 | Muck | Pt | |
| | | 26–60 | Marl | | |
| Fox: FoA, FoB, FoC2 | >6 | 0–13 | Sandy loam | SM | A–2 |
| | | 13–36 | Sandy clay loam | SC or CL | A–6 |
| | | 36–60 | Gravel and sand | GW | A–1–b |

See footnotes at end of table.

*significant to engineering*

deep that bedrock does not affect use. The sign > means more than; the sign < means less than]

| Percentage passing sieve— | | | Permeability | Available moisture capacity | Reaction | Frost-heave potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|
| No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | *Inches per hour* | *Inches per inch of soil* | *pH value* | | |
| 90–100 | 80–90 | 25–35 | 2.00–6.30 | 0.10–0.14 | 6.1–6.5 | High | Low. |
| 95–100 | 95–100 | 70–80 | 0.20–2.00 | 0.14–0.16 | 5.6–6.0 | Moderate | Moderate. |
| 95–100 | 85–95 | 50–60 | 0.63–2.00 | 0.14–0.16 | 7.4–7.8 | Moderate | Low. |
| 95–100 | 90–100 | 85–95 | 0.63–2.00 | 0.18–0.23 | 6.1–6.5 | High | Low. |
| 95–100 | 90–100 | 80–90 | 0.20–0.63 | 0.19–0.21 | 5.6–6.0 | Moderate | Moderate to high. |
| 95–100 | 90–100 | 80–90 | 0.06–0.20 | 0.15–0.18 | 5.1–5.5 | Moderate | High. |
| 95–100 | 90–100 | 80–90 | 0.20–0.63 | 0.16–0.18 | 7.4–7.8 | Moderate | Moderate. |
| 80–90 | 60–70 | 20–30 | 2.00–6.30 | 0.10–0.14 | 6.1–6.5 | Moderate | Low. |
| 95–100 | 40–50 | 10–20 | 6.30–20.0 | 0.06–0.07 | 6.6–7.3 | Moderate | Low. |
| 90–100 | 60–70 | 5–10 | >20.0 | <0.06 | 7.4–7.8 | Low | Low. |
| 100 | 50–75 | 15–30 | 6.30–20.00 | <0.05 | 5.6–6.0 | Low | Low. |
| 100 | 40–65 | 5–10 | 6.30–20.00 | <0.05 | 5.6–6.0 | Low | Low. |
| 80–90 | 60–70 | 20–30 | 2.00–6.30 | 0.10–0.12 | 5.6–6.0 | Moderate | Low. |
| 90–95 | 80–85 | 50–60 | 2.00–6.30 | 0.14–0.18 | 5.6–6.0 | Moderate | Moderate. |
| 30–50 | 15–25 | 5–15 | >20.0 | <0.05 | 7.4–7.8 | Low | Low. |
| 95–100 | 95–100 | 80–85 | 0.63–2.00 | 0.18–0.23 | 6.6–7.3 | High | Low. |
| 95–100 | 90–100 | 75–85 | 0.06–0.20 | 0.16–0.18 | 6.6–7.3 | Moderate | Moderate. |
| 95–100 | 80–90 | 60–70 | 0.63–2.00 | 0.14–0.18 | 7.4–7.8 | Moderate | Low. |
| (1) | (1) | (1) | 2.00–6.30 | >0.24 | 6.1–6.5 | High | High. |
| (1) | (1) | (1) | 2.00–6.30 | >0.24 | 6.6–7.3 | High | High. |
| 95–100 | 80–90 | 0–10 | >20.0 | <0.05 | 5.6–6.0 | Low | Low. |
| 95–100 | 90–100 | 85–95 | 0.63–2.00 | 0.14–0.18 | 6.1–6.5 | Moderate | Low. |
| 95–100 | 95–100 | 75–85 | 0.06–0.20 | 0.16–0.18 | 5.6–6.0 | Moderate | Moderate. |
| 95–100 | 80–90 | 60–70 | 0.20–0.63 | 0.16–0.18 | 7.4–7.8 | High | Low. |
| 95–100 | 95–100 | 80–85 | 0.63–2.00 | 0.18–0.23 | 5.6–6.0 | High | Moderate. |
| 95–100 | 90–100 | 80–90 | 0.06–0.20 | 0.19–0.21 | 5.1–5.5 | Moderate | Moderate. |
| 95–100 | 95–100 | 80–85 | 0.63–2.00 | 0.18–0.23 | 7.4–7.8 | High | Moderate. |
| 80–90 | 60–70 | 20–30 | 2.00–6.30 | 0.10–0.14 | 5.1–5.5 | Moderate | Low. |
| 95–100 | 40–50 | 10–20 | 6.30–20.0 | 0.06–0.08 | 5.1–5.5 | Moderate | Low. |
| 90–100 | 60–70 | 0–10 | >20.0 | <0.06 | 5.1–7.3 | Low | Low. |
| 75–85 | 70–80 | 0–10 | >20.0 | <0.06 | 7.4–7.8 | Low | Low. |
| 95–100 | 80–90 | 60–70 | 0.63–2.00 | 0.14–0.18 | 5.1–5.5 | Low | Low. |
| 95–100 | 80–85 | 40–50 | 0.63–2.00 | 0.14–0.18 | 5.1–5.5 | Moderate | Moderate. |
| 95–100 | 40–50 | 10–20 | 6.30–20.0 | 0.06–0.08 | 5.1–5.5 | Low | Low. |
| 75–85 | 40–50 | 10–20 | >20.0 | <0.06 | 7.4–7.8 | Low | Low. |
| (1) | (1) | (1) | 2.00–6.30 | >0.24 | 6.1–6.5 | High | High. |
| (2) | (2) | (2) | (3) | (3) | 7.4–7.8 | Moderate | Moderate. |
| 80–90 | 60–70 | 20–30 | 2.00–6.30 | 0.10–0.14 | 5.6–6.0 | Low | Low. |
| 95–100 | 80–90 | 45–55 | 0.63–2.00 | 0.14–0.18 | 5.6–6.0 | Moderate | Moderate. |
| 60–70 | 30–40 | 0–5 | >20.0 | <0.06 | 7.4–7.8 | Low | Low. |

TABLE 4.—*Estimated soil properties*

| Soil series and map symbols | Depth to seasonal high water table | Depth from surface | Classification | | |
|---|---|---|---|---|---|
| | | | USDA texture | Unified | AASHO |
| | *Feet* | *Inches* | | | |
| **Gilford:** | | | | | |
| Gf | 0–1 | 0–28 | Sandy loam | SM or ML | A–2 or A–4 |
| | | 28–31 | Sandy clay loam | SC | A–6 |
| | | 31–38 | Loamy sand | SM | A–2–4 |
| | | 38–60 | Sand | SP–SM | A–2 |
| Gm | 0–1 | 0–7 | Muck | Pt | ---------- |
| | | 7–28 | Sandy loam | SM or ML | A–4 |
| | | 28–31 | Sandy clay loam | SC | A–6 |
| | | 31–38 | Loamy sand | SM | A–2–4 |
| | | 38–60 | Sand | SP–SM | A–2 |
| **Gravel pit:** Gp. Properties variable. Onsite investigation necessary. | | | | | |
| **Haskins:** HaA, HaB | 1–3 | 0–10 | Loam | ML | A–4 |
| | | 10–20 | Clay loam | CL | A–6 |
| | | 20–30 | Sandy clay loam | CL | A–6 |
| | | 30–39 | Silty clay | CL or CH | A–6 or A–7–6 |
| | | 39–60 | Silty clay loam | CL | A–6 |
| **Homer:** Ho | 1–3 | 0–14 | Loam | ML | A–4 |
| | | 14–31 | Sandy clay loam | SC or CL | A–6 |
| | | 31–60 | Gravel and sand | GP | A–1 |
| **Linwood:** Lm | 0–1 | 0–22 | Muck | Pt | ---------- |
| | | 22–60 | Sandy loam to silty clay loam. | (3) | (3) |
| **Made land:** Ma. Properties variable. Onsite investigation necessary. | | | | | |
| **Marsh:** Mh. Properties variable. Onsite investigation necessary. | | | | | |
| **Maumee:** Mm | 0–1 | 0–36 | Loamy fine sand | SM | A–2 |
| | | 36–60 | Sand | SP–SM | A–3 |
| **Metea:** MnB, MnC | >6 | 0–25 | Loamy sand | SM | A–2 |
| | | 25–32 | Sandy clay loam | CL | A–6 |
| | | 32–52 | Loam | ML | A–4 |
| **Miami:** | | | | | |
| MoB2, MoC2, MoD2 | >6 | 0–13 | Loam | ML | A–4 |
| | | 13–39 | Clay loam | CL | A–6 |
| | | 39–60 | Loam or clay loam | ML | A–4 |
| MrC3, MrD3 | >6 | 0–7 | Clay loam | CL | A–6 |
| | | 7–39 | Clay loam | CL | A–6 |
| | | 39–60 | Loam or clay loam | CL | A–6 |
| **Oshtemo:** OsA, OsB, OsC, OsD, OsE | >6 | 0–14 | Loamy sand | SM or SC | A–2 |
| | | 14–29 | Sandy loam | SM | A–1 or A–2 |
| | | 29–48 | Loamy sand | SM | A–2 |
| | | 48–60 | Gravel and sand | GW or GP | A–1 |
| **Pewamo:** Pe | 0–1 | 0–13 | Silty clay loam | CL | A–6 |
| | | 13–39 | Silty clay | CH | A–7 |
| | | 39–60 | Silty clay loam | CL | A–6 |
| **Plainfield:** PlA, PlB, PlC | 6 | 0–60 | Fine sand | SP–SM | A–3 |

See footnotes at end of table.

*significant to engineering*—Continued

| Percentage passing sieve— | | | Permeability | Available moisture capacity | Reaction | Frost-heave potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|
| No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | *Inches per hour* | *Inches per inch of soil* | *pH value* | | |
| 95–100 | 70–80 | 45–55 | 2. 00–6. 30 | 0. 10–0. 14 | 6. 6–7. 3 | High | Low. |
| 95–100 | 80–85 | 40–50 | 2. 00–6. 30 | 0. 14–0. 18 | 6. 6–7. 3 | Moderate | Moderate. |
| 95–100 | 45–55 | 10–20 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 6–7. 3 | Moderate | Low. |
| 95–100 | 50–60 | 5–10 | >20. 0 | <0. 06 | 6. 6–7. 3 | Moderate | Low. |
| (1) | (1) | (1) | 2. 00–6. 30 | >0. 24 | 6. 1–6. 5 | High | High. |
| 95–100 | 70–80 | 45–55 | 2. 00–6. 30 | 0. 10–0. 14 | 6. 6–7. 3 | High | Low. |
| 95–100 | 80–85 | 40–50 | 2. 00–6. 30 | 0. 14–0. 18 | 6. 6–7. 3 | Moderate | Moderate. |
| 95–100 | 45–55 | 10–20 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 6–7. 3 | Moderate | Low. |
| 95–100 | 50–60 | 5–10 | >20. 0 | <0. 06 | 6. 6–7. 3 | Moderate | Low. |
| 95–100 | 80–90 | 60–70 | 0. 63–2. 00 | 0. 14–0. 18 | 5. 6–6. 0 | High | Low. |
| 95–100 | 95–100 | 75–85 | 0. 20–0. 63 | 0. 16–0. 18 | 5. 6–6. 0 | Moderate | Moderate. |
| 90–95 | 80–85 | 55–65 | 0. 63–2. 00 | 0. 14–0. 18 | 5. 1–5. 5 | High | Moderate. |
| 95–100 | 95–100 | 75–85 | 0. 06–0. 20 | 0. 19–0. 21 | 6. 6–7. 3 | Moderate | High. |
| 95–100 | 90–100 | 80–90 | 0. 20–0. 63 | 0. 19–0. 21 | 7. 4–7. 8 | Moderate | High. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 14–0. 18 | 5. 6–6. 0 | Moderate | Low. |
| 95–100 | 80–90 | 45–55 | 0. 20–0. 63 | 0. 14–0. 18 | 5. 6–6. 0 | Moderate | Moderate. |
| 60–70 | 30–40 | 0–5 | >20. 0 | <0. 06 | 7. 4–7. 8 | Low | Low. |
| (1) | (1) | (1) | 2. 00–6. 30 | 0. 24–0. 28 | 6. 6–7. 3 | High | High. |
| 90–100 | 80–100 | (3) | 0. 63–2. 00 | 0. 10–0. 21 | 6. 6–7. 8 | Moderate | Moderate. |
| 95–100 | 80–90 | 20–30 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 1–6. 5 | High | Low. |
| 95–100 | 70–80 | 5–10 | >20–0 | <0. 06 | 7. 4–7. 8 | Low | Low. |
| 95–100 | 45–55 | 15–25 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 1–6. 5 | Low | Low. |
| 90–95 | 80–85 | 55–65 | 0. 63–2. 00 | 0. 10–0. 18 | 6. 1–6. 5 | Moderate | Moderate. |
| 95–100 | 85–95 | 50–60 | 0. 63–2. 00 | 0. 14–0. 18 | 7. 4–7. 8 | Moderate | Low. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 14–0. 18 | 5. 6–6. 0 | Moderate | Low. |
| 95–100 | 95–100 | 75–85 | 0. 20–2. 00 | 0. 16–0. 18 | 5. 6–6. 0 | Moderate | Moderate. |
| 95–100 | 80–90 | 60–70 | 0. 20–2. 00 | 0. 14–0. 18 | 7. 4–7. 8 | Moderate | Low. |
| 95–100 | 95–100 | 70–80 | 0. 20–2. 00 | 0. 16–0. 18 | 6. 1–6. 5 | Moderate | Moderate. |
| 95–100 | 95–100 | 75–85 | 0. 20–2. 00 | 0. 16–0. 18 | 6. 1–6. 5 | Moderate | Moderate. |
| 95–100 | 80–90 | 60–70 | 0. 20–2. 00 | 0. 14–0. 18 | 7. 4–7. 8 | Moderate | Low. |
| 90–100 | 60–70 | 20–30 | 6. 30–20. 0 | 0. 06–0. 08 | 5. 6–6. 0 | Low | Low. |
| 80–90 | 60–70 | 20–30 | 2. 00–6. 30 | 0. 10–0. 14 | 5. 6–6. 0 | Moderate | Low. |
| 90–100 | 40–50 | 10–20 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 1–6. 5 | Low | Low. |
| 20–40 | 10–20 | 0–10 | >20. 0 | <0. 08 | 7. 4–7. 8 | Low | Low. |
| 95–100 | 90–100 | 80–90 | 0. 20–0. 63 | 0. 19–0. 21 | 6. 1–6. 5 | Moderate | Moderate. |
| 95–100 | 90–100 | 80–90 | 0. 06–0. 20 | 0. 15–0. 18 | 6. 6–7. 3 | Low | High. |
| 95–100 | 90–100 | 80–90 | 0. 20–0. 63 | 0. 19–0. 21 | 7. 4–7. 8 | Moderate | Moderate. |
| 95–100 | 80–90 | 0–10 | >20. 0 | <0. 06 | 5. 1–5. 5 | Low | Low. |

TABLE 4.—*Estimated soil properties*

| Soil series and map symbols | Depth to seasonal high water table | Depth from surface | Classification | | |
|---|---|---|---|---|---|
| | | | USDA texture | Unified | AASHO |
| | *Feet* | *Inches* | | | |
| Rawson: RaA, RaB, RaC2 | 6 | 0–13 | Loam | ML | A–4 |
| | | 13–34 | Clay loam | CL | A–6 |
| | | 34–60 | Clay loam | CL | A–6 |
| Rensselaer: Re | 0–1 | 0–14 | Silt loam | ML or CL | A–4 |
| | | 14–29 | Clay loam | CL | A–6 |
| | | 29–40 | Loamy sand | SM | A–2–4 |
| | | 40–60 | Stratified sand and silt | ML | A–4 |
| Riddles: RsA, RsB, RsC, RsD2, RsE2, RtA, RtB2, RtC2. | 6 | 0–17 | Sandy loam or loam | ML | A–4 |
| | | 17–64 | Sandy clay loam or clay loam. | CL | A–6 |
| | | 64–72 | Loam | ML or CL | A–4 or A–6 |
| Sebewa: Se | 0–1 | 0–12 | Loam | ML | A–4 |
| | | 12–36 | Clay loam | CL | A–6 |
| | | 36–60 | Gravel and sand | GP | A–1 |
| Shoals: Sh | 1–3 | 0–30 | Loam and silt loam | ML | A–4 |
| | | 30–48 | Sandy loam | SM | A–2–4 |
| | | 48–60 | Stratified loam, silt loam, and sandy loam. | ML | A–4 |
| Tawas: Ta, Td | 0–1 | 0–24 | Muck | Pt | |
| | | 24–60 | Sand | SM | A–1–b |
| Tedrow: Te | 1–3 | 0–35 | Loamy sand | SM | A–2 |
| | | 35–60 | Sand | SP–SM | A–3 |
| Tyner: TyA, TyB, TyC | >6 | 0–50 | Loamy sand | SM | A–2 |
| | | 50–60 | Sand | SP–SM | A–3 |
| Volinia: Vo | >6 | 0–15 | Loam | ML or SC | A–4 |
| | | 15–30 | Sandy clay loam | CL or SC | A–6 |
| | | 30–48 | Loamy sand | SM | A–1 |
| | | 48–60 | Gravel and sand | SW, SP, GP, or SM | A–1 or A–3 |
| Wallkill: Wa | 0–1 | 0–21 | Silt loam | ML | A–4 |
| | | 21–60 | Muck | Pt | |
| Washtenaw: Wh | 0–1 | 0–34 | Silt loam | ML | A–4 |
| | | 34–56 | Silty clay loam or clay loam. | CL | A–6 |
| | | 56–64 | Loam | ML | A–4 |
| Whitaker: Wk | 1–3 | 0–12 | Loam | ML | A–4 |
| | | 12–22 | Sandy clay loam | CL | A–6 |
| | | 22–43 | Silty clay loam or clay loam. | CL | A–6 |
| | | 43–60 | Stratified silt and sand | ML | A–4 |

[1] Organic material.
[2] Marl.

*significant to engineering*—Continued

| Percentage passing sieve— | | | Permeability | Available moisture capacity | Reaction | Frost-heave potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|
| No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | | | | | |
| | | | *Inches per hour* | *Inches per inch of soil* | *pH value* | | |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 14–0. 18 | 5. 1–6. 5 | Moderate | Low. |
| 95–100 | 95–100 | 75–85 | 0. 06–0. 20 | 0. 16–0. 18 | 5. 6–6. 0 | Moderate | Moderate. |
| 95–100 | 95–100 | 75–85 | 0. 20–0. 63 | 0. 16–0. 18 | 7. 4–7. 8 | Moderate | Moderate. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 18–0. 23 | 6. 6–7. 3 | High | Low. |
| 95–100 | 95–100 | 75–85 | 0. 20–0. 63 | 0. 16–0. 18 | 6. 6–7. 3 | Moderate | Moderate. |
| 95–100 | 45–55 | 15–25 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 6–7. 3 | Moderate | Low. |
| 95–100 | 85–95 | 60–90 | 2. 00–6. 30 | 0. 10–0. 14 | 7. 4–7. 8 | High | Low. |
| 95–100 | 75–85 | 50–60 | 0. 63–6. 30 | 0. 12–0. 18 | 6. 1–6. 3 | Moderate | Low. |
| 95–100 | 95–100 | 75–85 | 0. 63–2. 00 | 0. 14–0. 18 | 5. 6–6. 0 | Moderate | Moderate. |
| 95–100 | 80–90 | 60–70 | 0. 63–2. 00 | 0. 14–0. 18 | 7. 4–7. 8 | Moderate | Low. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 14–0. 18 | 6. 1–6. 5 | High | Low. |
| 95–100 | 95–100 | 75–85 | 0. 20–0. 63 | 0. 16–0. 18 | 6. 1–6. 5 | Moderate | Moderate. |
| 75–85 | 70–80 | 0–10 | >20. 0 | <0. 06 | 7. 4–7. 8 | Low | Low. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 14–0. 23 | 6. 6–7. 3 | High | Low. |
| 80–90 | 60–70 | 20–30 | 2. 00–6. 30 | 0. 10–0. 14 | 6. 6–7. 3 | Moderate | Low. |
| 90–100 | 85–95 | 80–90 | 0. 63–2. 00 | 0. 10–0. 23 | 7. 4–7. 8 | High | Low. |
| (1) | (1) | (1) | 2. 00–6. 30 | 0. 24–0. 28 | 6. 6–7. 3 | High | High. |
| 95–100 | 40–50 | 15–25 | >20. 0 | <0. 06 | 7. 4–7. 8 | Low | Low. |
| 95–100 | 80–90 | 10–20 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 1–6. 5 | Low | Low. |
| 90–100 | 60–70 | 0–10 | >20. 0 | <0. 06 | 6. 6–7. 3 | Low | Low. |
| 95–100 | 80–90 | 10–20 | 6. 30–20. 0 | 0. 06–0. 08 | 6. 1–6. 5 | Low | Low. |
| 80–90 | 70–80 | 0–10 | >20. 0 | <0. 06 | 5. 6–6. 0 | Low | Low. |
| 95–100 | 90–100 | 45–70 | 0. 63. 2. 00 | 0. 14–0. 18 | 6. 1–6. 5 | Moderate | Low. |
| 90–95 | 80–85 | 45–65 | 0. 63–2. 00 | 0. 14–0. 18 | 5. 6–6. 0 | Moderate | Moderate. |
| 95–100 | 40–50 | 10–20 | 6. 30–20. 0 | 0. 06–0. 08 | 5. 6–6. 0 | Low | Low. |
| 75–85 | 40–50 | 0–5 | >20. 0 | <0. 06 | 7. 4–7. 8 | Low | Low. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 18–0. 23 | 6. 6–7. 3 | High | Low. |
| (1) | (1) | (1) | 2. 00–6. 30 | 0. 24–0. 28 | 6. 6–7. 3 | High | High. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 18–0. 23 | 6. 1–6. 5 | High | Low. |
| 95–100 | 90–100 | 80–90 | 0. 06–0. 20 | 0. 19–0. 21 | 6. 1–6. 5 | Moderate | Moderate. |
| 95–100 | 90–100 | 85–95 | 0. 63–2. 00 | 0. 14–0. 18 | 7. 4–7. 8 | High | Low. |
| 95–100 | 80–90 | 60–70 | 0. 63–2. 00 | 0. 14–0. 18 | 6. 1–6. 5 | High | Low. |
| 90–95 | 80–85 | 50–60 | 0. 63–2. 00 | 0. 14–0. 18 | 6. 1–6. 5 | Moderate | Moderate. |
| 95–100 | 90–100 | 75–90 | 0. 63–2. 00 | 0. 19–0. 21 | 6. 1–6. 5 | Moderate | Moderate. |
| 95–100 | 80–90 | 65–95 | 2. 00–6. 30 | 0. 10–0. 14 | 7. 4–7. 8 | High | Low. |

[1] Variable.

TABLE 5.—*Interpretations of*

| Soil series and map symbols | Suitability of soils as a source of— | | |
|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill |
| Alluvial land: Ad, Am. Properties variable. Onsite investigation necessary. | | | |
| Aubbeenaubbee: Au | Fair: sandy loam | Not suitable | Good in upper 2 to 3 feet. Fair to poor in substratum: fair stability. |
| Blount: BlA, BlB2 | Good: thin in moderately eroded areas. Poor in subsoil: silty clay loam. | Not suitable | Poor to fair: moderate to high volume change; difficult to work when wet; medium to high compressibility. |
| Borrow pits: Bp. Properties variable. Onsite investigation necessary. | | | |
| Brady: Br | Fair: sandy loam | Good | Good |
| Brems: Bu | Poor: loamy fine sand and fine sand. | Good for sand; unsuitable for gravel. | Good |
| Bronson: Bv | Fair: sandy loam | Good | Good |
| Brookston: Bw | Good: high water table. Poor in subsoil: clay loam. | Not suitable | Poor: moderate volume change; difficult to work when wet; medium to high compressibility; high water table. |
| Carlisle: Ca, Cd | Poor: oxidizes rapidly; high water table. | Not suitable | Not suitable: organic material. |
| Chelsea: ChA, ChB, ChC | Poor: sand | Good for sand; not suitable for gravel. | Good |

*engineering properties*

| Soil features affecting use for— | | | | |
|---|---|---|---|---|
| Road and highway location | Drainage systems | Ponds and reservoir sites | Dikes, levees, and embankments | Waterways |
| Seasonal high water table, subject to lateral seepage; high susceptibility to frost action. | Somewhat poorly drained; sandy overburden requires special attention. | Seasonal high water table; rapid seepage in subsoil; slow seepage in substratum. | Fair stability; fair compaction; slow permeability when compacted. | Lateral seepage; seasonal high water table; moderate fertility. |
| Seasonal high water table; moderate to high susceptibility to frost action; moderate to high volume change; clayey. | Somewhat poorly drained; slow permeability. | Seasonal high water table; slow seepage. | Fair to good stability; fair to good compaction; moderate to high shrink-swell potential; slow or very slow permeability when compacted. | Seasonal high water table; moderate fertility. |
| Seasonal high water table; low volume change; moderate susceptibility to frost action. | Somewhat poorly drained; moderately rapid permeability. | Seasonal high water table; moderate seepage in subsoil; very rapid seepage in substratum. | Fair stability; fair compaction characteristics; moderate permeability when compacted; rapid permeability in substratum when compacted. | Seasonal high water table; low available moisture capacity; moderate to low fertility. |
| Loose sand may interfere with traction; vegetation difficult to establish. | Moderately well drained | Rapid seepage | Fair stability; fair compaction characteristics; moderately rapid permeability when compacted. | Very low available moisture capacity; low fertility. |
| Easy to work; moderate susceptibility to frost action. | Moderately well drained | Moderate seepage rate in subsoil; very rapid seepage in substratum. | Fair stability; fair compaction characteristics; moderate permeability when compacted; rapid permeability in substratum when compacted. | Low available moisture capacity; moderate to low fertility. |
| Seasonal high water table, moderate to high susceptibility to frost action. | Poorly drained; slow permeability; subject to surface ponding. | Seasonal high water table; slow seepage. | Fair stability; fair compaction characteristics; slow permeability when compacted; moderate shrink-swell potential. | Seasonal high water table; high fertility. |
| High water table; unstable; organic material. | Very poorly drained; moderately rapid permeability; subject to subsidence; poor availability of outlets. | High water table; moderately rapid seepage; poor stability. | Organic material | High water table; high fertility. |
| Easy to work; some cuts and fill; loose sand may interfere with traction. | Excessively drained | Very rapid seepage | Fair stability; fair compaction characteristics; moderately rapid permeability when compacted. | Difficult to vegetate; very low available moisture capacity; low fertility. |

TABLE 5.—*Interpretations of*

| Soil series and map symbols | Suitability of soils as a source of— | | |
|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill |
| Crosby: CrA, CrB | Good: thin in moderately eroded areas. Poor in subsoil: clay loam. | Not suitable | Poor to fair: moderate volume change; difficult to work when wet; moderate compressibility. |
| Del Rey: De | Good. Poor in subsoil: silty clay loam. | Not suitable | Poor to fair: moderate volume change; difficult to work when wet; moderate compressibility. |
| Dickinson: Dk | Good: sandy loam, but high organic-matter content. | Good | Good |
| Dowagiac: Do | Good | Good | Good |
| Edwards: Ed | Poor: oxidizes rapidly; high water table. | Not suitable | Not suitable: organic material. |
| Fox: FoA, FoB, FoC2 | Good | Good | Fair to poor: moderate volume change; medium compressibility. Good in substratum. |
| Gilford: Gf, Gm | Good: sandy loam, but high organic-matter content; high water table. | Good: high water table; poorly graded sand and gravel. | Good: seasonal high water table. |
| Gravel pit: Gp. Properties variable. Onsite investigation necessary. | | | |
| Haskins: HaA, HaB | Good | Not suitable | Poor to fair: moderate volume change; difficult to work when wet; moderate compressibility. |

*engineering properties*—Continued

| Soil features affecting use for— | | | | |
|---|---|---|---|---|
| Road and highway location | Drainage systems | Ponds and reservoir sites | Dikes, levees, and embankments | Waterways |
| Seasonal high water table; moderate to high susceptibility to frost action. | Somewhat poorly drained; slow permeability. | Seasonal high water table; slow seepage. | Fair to good stability; fair to good compaction characteristics; slow permeability when compacted. | Seasonal high water table; moderate fertility. |
| Seasonal high water table; moderate to high susceptibility to frost action. | Somewhat poorly drained; slow permeability. | Seasonal high water table; slow seepage. | Fair to good stability; fair to good compaction characteristics; slow permeability when compacted; moderate shrink-swell potential. | Seasonal high water table; moderate fertility. |
| Easy to work; high organic-matter content in surface layer. | Somewhat excessively drained. | Rapid seepage in surface layer and subsoil; very rapid seepage in substratum. | Fair stability; fair compaction characteristics; moderate permeability when compacted; rapid permeability in substratum when compacted. | Low available moisture capacity; moderate to low fertility. |
| Easy to work; high organic-matter content in surface layer. | Well drained | Rapid seepage; moderate seepage in subsoil; very rapid seepage in substratum. | Fair stability; fair compaction characteristics; moderate permeability when compacted; rapid permeability in substratum when compacted. | Moderate available moisture capacity; moderate fertility. |
| High water table; periodic ponding; unstable material. | Very poorly drained; moderately rapid permeability; subject to subsidence; variable permeability in substratum. | High water table; slow seepage in substratum. | Organic material; poor stability; poor compaction characteristics; fair to poor stability and compaction characteristics and variable permeability in substratum. | High water table; moderate to high fertility. |
| Some cuts and fills | Well drained | Slow seepage in subsoil; very rapid seepage in substratum. | Fair to good stability; fair to good compaction characteristics; slow permeability when compacted; rapid permeability in substratum when compacted. | Slopes subject to excessive runoff; moderate fertility. |
| Seasonal high water table; relatively high organic-matter content in surface layer; high susceptibility to frost action. | Very poorly drained; moderately rapid permeability in subsoil; very rapid permeability in substratum; loose material requires special attention. | Seasonal high water table; rapid seepage. | Fair stability; fair compaction characteristics; moderate permeability when compacted; rapid permeability in substratum when compacted. | Seasonal high water table; moderate fertility. |
| Seasonal high water table; moderate to high susceptibility to frost action. | Somewhat poorly drained; slow permeability. | Seasonal high water table; slow seepage. | Fair stability; fair to good compaction characteristics; slow permeability when compacted; moderate shrink-swell potential. | Seasonal high water table; moderate fertility. |

TABLE 5.—*Interpretations of*

| Soil series and map symbols | Suitability of soils as a source of— | | |
|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill |
| Homer: Ho | Good | Good | Poor to fair: moderate volume change; difficult to work when wet. Good in substratum. |
| Linwood: Lm | Poor: oxidizes rapidly; high water table. | Not suitable | Not suitable: organic material. Poor to fair in substratum: moderate volume change; difficult to work when wet. |
| Made land: Ma. Properties variable. Onsite investigation necessary. | | | |
| Marsh: Mh. Properties variable. Onsite investigation necessary. | | | |
| Maumee: Mm | Fair: loamy fine sand; high water table. | Good: high water table; poorly graded sand and gravel. | Good: seasonal high water table. |
| Metea: MnB, MnC | Fair: loamy sand | Not suitable | Good. Poor to fair in substratum: moderate volume change. |
| Miami: MoB2, MoC2, MoD2, MrC3, MrD3 | Poor: thin in moderately eroded areas; subsoil is clay loam. | Not suitable | Fair to poor: moderate volume change; difficult to work when wet. |
| Oshtemo: OsA, OsB, OsC, OsD, OsE | Poor: sandy | Good | Good |

*engineering properties*—Continued

| Soil features affecting use for— | | | | |
|---|---|---|---|---|
| Road and highway location | Drainage systems | Ponds and reservoir sites | Dikes, levees, and embankments | Waterways |
| Seasonal high water table; moderate susceptibility to frost action. | Somewhat poorly drained; sandy substratum requires special attention; moderately slow permeability. | Seasonal high water table; slow seepage in subsoil; rapid seepage in substratum. | Fair stability; fair to good compaction characteristics; slow permeability when compacted; rapid permeability in substratum when compacted. | Seasonal high water table; moderate fertility. |
| High water table and surface ponding; organic soil; unstable. | Very poorly drained; muck is subject to subsidence; poor availability of outlets. | High water table; moderately rapid seepage; slow seepage in substratum. | Organic material; poor stability; poor compaction characteristics; substratum has fair stability, fair to good compaction characteristics, and slow permeability when compacted. | High water table; high fertility. |
| Seasonal high water table; relatively high organic-matter content in surface layer; high susceptibility to frost action. | Very poorly drained; rapid permeability; sandy soil requires special attention. | High water table; rapid seepage. | Fair to poor stability; fair to poor compaction characteristics; moderate permeability when compacted. | Seasonal high water table; moderate fertility. |
| Cuts and fills | Well drained | Rapid seepage in subsoil; slow seepage in substratum. | Fair stability; fair compaction characteristics; moderate permeability when compacted; substratum has fair to good compaction characteristics and slow permeability when compacted. | Moderate available moisture capacity; moderate fertility. |
| Cuts and fills common | Well drained | Slow seepage | Fair to good stability; fair to good compaction characteristics; slow permeability when compacted. | Slopes subject to excessive runoff; moderate fertility. |
| Easy to work; cuts and fills in sloping areas. | Somewhat excessively drained. | Rapid seepage in subsoil; very rapid seepage in substratum. | Fair stability; fair compaction characteristics; moderate permeability when compacted; rapid permeability in substratum when compacted. | Low available moisture capacity; moderate to low fertility. |

TABLE 5.—*Interpretations of*

| Soil series and map symbols | Suitability of soils as a source of— | | |
|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill |
| Pewamo: Pe | Good: high water table. Poor in subsoil: clayey. | Not suitable | Moderate to poor: high volume change; difficult to work when wet; high water table. |
| Plainfield: PlA, PlB, PlC | Poor: fine sand | Good for sand; not suitable for gravel. | Good |
| Rawson: RaA, RaB, RaC2 | Good: thin in moderately eroded areas; subsoil is clay loam. | Not suitable | Fair to poor: moderate volume change; difficult to work when wet; medium compressibility. |
| Rensselaer: Re | Good: high water table. | Poor: limited amount of material | Fair to poor: low to moderate volume change; high water table. |
| Riddles: RsA, RsB, RsC, RsD2, RsE2, RtA, RtB2, RtC2. | Good: thin in moderately eroded areas. | Not suitable | Fair to poor: moderate volume change; difficult to work when wet; fair shear strength. |
| Sebewa: Se | Good: high water table; subsoil is clay loam. | Good | Poor: moderate volume change; difficult to work when wet. Good in substratum: high water table. |
| Shoals: Sh | Good | Not suitable | Poor: medium to high compressibility; low shear strength. |

*engineering properties*—Continued

| Soil features affecting use for— | | | | |
|---|---|---|---|---|
| Road and highway location | Drainage systems | Ponds and reservoir sites | Dikes, levees, and embankments | Waterways |
| High water table; moderate susceptibility to frost action. | Poorly drained; slow permeability. | Seasonal high water table. | Fair stability; fair compaction characteristics; moderate to high shrink-swell potential; slow to very slow permeability when compacted. | Seasonal high water table; high fertility. |
| Loose sand may interfere with traction; cuts and fills on sloping terrain. | Excessively drained | Rapid seepage | Fair stability; fair compaction characteristics; moderately rapid permeability when compacted. | Very low available moisture capacity; low fertility. |
| Common cuts and fills | Well drained | Slow seepage | Fair stability; fair to good compaction characteristics; slow permeability when compacted; moderate shrink-swell potential. | Slopes subject to excessive runoff; moderate fertility. |
| High water table; high susceptibility to frost action. | Poorly drained; seasonal high water table; substratum needs special attention; moderately slow permeability. | Seasonal high water table; slow seepage in subsoil; moderately rapid seepage in substratum. | Fair stability; fair to good compaction characteristics; slow permeability when compacted; substratum has poor stability, fair to poor compaction characteristics, and moderate permeability when compacted. | Seasonal high water table; high fertility. |
| Cuts and fills commonly needed; moderate susceptibility to frost action. | Well drained | A few thin strata of very permeable material; slow seepage in subsoil; moderate seepage in substratum; a few thin strata in substratum may result in more rapid seepage. | Fair to good stability; fair to good compaction characteristics; slow permeability when compacted. | Slopes subject to excessive runoff and erosion; moderate fertility. |
| Seasonal high water table; moderate susceptibility to frost action. | Poorly drained; seasonal high water table; moderately slow permeability. | Seasonal high water table; slow seepage in subsoil; very rapid seepage in substratum. | Fair stability; fair compaction characteristics; slow permeability when compacted; rapid permeability in substratum when compacted. | Seasonal high water table; high fertility. |
| Hazard of flooding | Somewhat poorly drained; hazard of flooding; moderate permeability. | Hazard of flooding | Poor stability; poor to fair compaction characteristics; slow permeability when compacted. | Seasonal high water table; hazard of flooding; high fertility. |

TABLE 5.—*Interpretations of*

| Soil series and map symbols | Suitability of soils as a source of— | | |
|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill |
| Tawas: Ta, Td | Poor: oxidizes rapidly; high water table. | Fair below organic material. | Not suitable: organic material.<br>Fair to good in substratum. |
| Tedrow: Te | Poor: sandy | Good for sand; unsuitable for gravel. | Good |
| Tyner: TyA, TyB, TyC | Poor: sandy | Good | Good |
| Volinia: Vo | Good | Good | Good |
| Wallkill: Wa | Good: high water table. | Not suitable | Poor: poor stability; high compressibility; seasonal high water table. |
| Wasthenaw: Wh | Good: high water table. | Not suitable | Poor: moderate volume change; difficult to work when wet; medium to high compressibility. |
| Whitaker: Wk | Good | Poor: variable; limited amount of material. | Poor: moderate volume change; difficult to work when wet; medium to high compressibility. |

*engineering properties*—Continued

| Soil features affecting use for— | | | | |
|---|---|---|---|---|
| Road and highway location | Drainage systems | Ponds and reservoir sites | Dikes, levees, and embankments | Waterways |
| Seasonal high water table; subject to surface ponding; organic matter; unstable. | Very poorly drained; poor availability of outlets; sandy substratum requires special attention; moderately rapid permeability. | High water table; rapid seepage in substratum. | Organic material; poor stability; poor compaction characteristics; substratum has fair stability, fair to poor compaction characteristics, and moderate to moderately rapid permeability when compacted. | High water table; high fertility. |
| Loose sand may interfere with traction; vegetation difficult to establish. | Somewhat poorly drained; sandy material requires special attention; rapid permeability. | Seasonal high water table; rapid seepage. | Fair stability; fair compaction characteristics; moderately rapid permeability when compacted. | Seasonal high water table; low available moisture capacity; low fertility. |
| Easy to work: some cuts and fills. | Somewhat excessively drained. | Rapid seepage | Fair stability; fair compaction characteristics; moderate permeability when compacted. | Low available moisture capacity; low fertility. |
| Easy to work: high organic-matter content in surface layer. | Well drained | Moderate seepage in subsoil; very rapid seepage in substratum. | Fair to good stability; fair to good compaction characteristics; moderately slow to slow permeability when compacted. | Moderate available moisture capacity; high fertility. |
| High water table; high susceptibility to frost action; underlying muck unstable. | Very poorly drained; subject to subsidence; poor availability of outlets; moderate permeability. | High water table; moderately rapid seepage in substratum. | Poor stability; poor to fair compaction; slow permeability when compacted; substratum is organic material and has poor stability and compaction characteristics. | Seasonal high water table; high fertility. |
| High water table; high susceptibility to frost action. | Poorly drained; slow permeability; subject to surface ponding. | Seasonal high water table; slow seepage. | Fair stability; fair compaction characteristics; slow permeability when compacted. | Seasonal high water table; high fertility. |
| Seasonal high water table; high susceptibility to frost action. | Somewhat poorly drained; seasonal high water table; moderate permeability; unstable substratum. | Moderate seepage in substratum; seasonal high water table; some areas suitable for pit ponds. | Fair stability; fair to good compaction characteristics; slow permeability when compacted; moderate shrink-swell potential. | Seasonal high water table; moderate fertility. |

The names for the various sizes of sand, silt, and clay as used by engineers are not equivalent to the names used by soil scientists. To soil scientists, for example, "clay" refers to mineral grains less than 0.002 millimeter in diameter, whereas engineers frequently define "clay" size as being less than 0.005 millimeter in diameter.

The liquid limit and plastic limit tests on the soil samples measure the effect of water on the consistency of 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 the plastic state to a liquid state if disturbed. The plastic limit is the moisture content at which the soil material passes from a solid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state if disturbed. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Table 3 also presents data on the relationship between the moisture content and the compacted density of the soil. If the soil material is compacted at successively higher moisture contents, assuming that the same amount of force is used in compacting the soil, the density of the compacted material will increase until the "optimum moisture content" is reached. After that, the density decreases with increase in moisture content. The ovendry weight in pounds per cubic foot of soil at the optimum moisture content is the "maximum dry density." Data on the relationship of moisture to density are important in planning earthwork, because generally the soil is most stable if it is compacted to about its maximum dry density when it is at approximately the optimum moisture content.

### *Estimated engineering properties*

Table 4 gives estimates of soil properties that affect engineering significantly. Because actual tests were made only for those soils listed in table 3, it was necessary to estimate the engineering properties for the remainder of the soils. Estimates were based upon a comparison of these soils with those that were sampled and tested and upon experiences gained from working with and observing similarly classified soils in other areas. The estimates are not a substitute for the detailed tests needed at a specific site selected for construction. The information in this table, in general, applies to a depth of 5 feet or less.

A brief explanation of some of the columns in table 4 follows:

Depth to seasonal high water table.—The highest level of free water in the soil at any time during the year.

Depth from surface.—Normally, only the depth for the major horizons is listed. Special horizons are listed if they have engineering properties significantly different from the adjacent horizons.

Percentage passing sieves 10, 40, and 200.—The values in these columns are estimates and are rounded off to the nearest 5 percent. The percentage of material that passes the No. 200 sieve approximates the amount of silt and clay in the soil.

Permeability.—This term refers to movement of water downward through undisturbed soil material. Estimates are based mostly on texture, structure, and consistency.

Available moisture capacity.—The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount of wilting point. In table 4 it is expressed as inches of water per inch of soil.

Frost-heave potential.—Frost action includes heave caused by ice lenses forming in a soil and the subsequent loss of strength as a result of excess moisture during periods of thawing. Three conditions must exist for frost action to become a major consideration: (1) a susceptible soil; (2) a source of water during the freezing period; and (3) a freezing temperature that exists long enough to penetrate the ground.

Shrink-swell potential.—This is the quality of the soil that determines its volume change with a change in moisture content. It is estimated primarily on the basis of the amount and kind of clay in a soil.

### *Engineering interpretations*

In table 5 interpretations of soils for engineering uses are given. The data apply to the representative profile of each soil series, as described in the section "Descriptions of the Soils." Some features of a soil may be a help in one kind of engineering work and a hindrance in another. For example, a highly permeable substratum is a feature that would render a soil undesirable as a site for a farm pond. However, the same soil might be favorable for highway location.

Topsoil.—Refers to soil material, preferably high in organic-matter content, that is used to topdress back slopes, embankments, lawns, gardens, etc. The suitability rating is based mainly on texture and organic-matter content.

Sand and gravel.—The suitability rating applies to the soil material that occurs within a depth of 5 to 7 feet. Sand or sand and gravel occur at variable depths within the same soil series. Test pits are needed to determine the extent and availability of sand or sand and gravel.

Road fill.—The suitability rating is based on performance of soil material when used as borrow for fill. Both the subsoil and substratum are rated if they are contrasting in character.

Road and highway location.—Soil features considered are those that affect overall performance of the soil. The entire profile was evaluated, based on an undisturbed soil without artificial drainage.

Drainage systems.—Features are considered which affect the installation and performance of surface and subsurface drainage practices. Such features are texture, permeability, topography, seasonal water table, and restricting layers.

Ponds and reservoir sites.—The primary concern are features of the undisturbed soil that affect the seepage rate (permeability).

Dikes, levees, and embankments.—The features considered are those that affect the use of disturbed soil material for constructing embankments to impound surface water.

Waterways.—Features that affect the establishment, growth, and maintenance of vegetation and the layout and construction of the waterways are considered.

## Town and Country Planning

This section deals with the soil and water problems in the developing urban-fringe areas. The data can be used by the land buyer or home buyer to study and evaluate sites and, therefore, to help avoid making a poor choice. The data also can be used to plan for further investigation in marginal or poorly suited areas. Others can use this information to evaluate environmental conditions for a variety of uses (fig. 20). When sites are viewed on any given day, some surface conditions can be misleading. Depressions can be dry one day and filled with water the next. Soils on bottom land, if viewed during summer, can appear markedly different from the way they do in winter and spring, when they may be covered by floodwater.

In table 6, the soils in Elkhart County are rated for selected uses in town and country planning, and limitations for these uses are given. The ratings are based on soil features and do not include other items that may be important in selecting an area for the purposes stated. A rating of *slight* means that the soil is relatively free of limitations or has limitations that are easy to overcome, a rating of *moderate* indicates that limitations should be recognized, but can be overcome through correct planning, careful design, and good maintenance; a rating of *severe* indicates that limitations are extreme enough to make use questionable and measures required to overcome these limitations generally are not practical. The soil feature giving the highest degree of limitation is used to rate the soil.

In the paragraphs that follow, each town and country planning use is defined and the properties important in rating the limitations for such purposes are given. The information can be used along with table 6, with information in other parts of the survey, as a guide in the use of soils data for town and country planning. Before beginning any construction projects, however, an investigation should be made at the specific location being considered.

Homesites are evaluated for the construction of buildings of three stories or less. Soils are important in the construction and maintenance of building foundations and basements. A properly constructed basement not only supports the building without undue settling or cracking, but also is dry throughout the year. Sound construction techniques should provide for adequate drainage around the foundation or footings to prevent undue settlement and wet basements. Soil characteristics that affect homesites include depth to seasonal water table, slope, stability, compressibility, and hazard of flooding.

*Figure 20.*—**Housing development on an Oshtemo loamy sand.**

Septic tank absorption fields are that part of a septic tank sewage disposal system that provides for the filtration and absorption of septic tank effluent. These systems are used in areas where central sewage is not available. A well-designed system consists of a septic tank for holding and digesting solid wastes, a distribution box for directing effluent into the tile system, and a tile disposal field. Successful operation of the entire system depends upon the ability of the soil to absorb and filter the liquid or effluent passed through the tile system. The presence of soil characteristics that impair adequate absorption and filtering of the effluent can create health hazards, as well as public nuisance situations. Soil characteristics that affect the operation of the absorption field include depth to seasonal high water table, permeability, slope, and hazard of flooding.

Local roads and streets have some kind of all-weather surfacing, commonly asphalt or concrete, and are expected to carry traffic all year. They consist of underlying local soil material, either cut or fill, called road subgrade; the base material of gravel, crushed stone, or lime-stabilized or soil-cement-stabilized soil, called the subbase; and the actual road surface, or pavement. These layers are graded to shed water and have provisions for lateral drainage. With the probable exception of the hardened surface layer, the roads and streets are built mainly from the soil at hand, and cuts and fills are limited, generally to less than 6 feet. Soil characteristics that affect construction of local roads and streets include depth to the seasonal high water table, slope, hazard of flooding, shrink-swell potential, susceptibility to frost heave, and compressibility.

Sewage lagoons are shallow lakes or pondlike structures that are built to hold sewage for the time necessary for bacterial decomposition. A suitable site should provide for an impoundment area and enough soil material to make the dikes. The completed lagoon must be able to hold water with minimum seepage in order to prevent pollution of underground or surface water sources. Soil characteristics that affect sewage lagoons are depth to seasonal high water table, slope, depth to coarse fragments, hazard of flooding, permeability, and organic-matter content.

Sanitary land fills are disposal areas for trash, garbage, and industrial wastes. The soils are rated for the trench method of land-fill construction in which hauling of cover material is unnecessary. A good sanitary land fill should operate without contaminating water supplies, reducing aesthetic land values, or causing health hazards. In addition, it should be usable during all seasons of the year. Areas of land fill that have been adequately compacted and covered can be used for parking areas, parks, recreation areas, and other such purposes. Soil characteristics that affect the operation of a sanitary land fill include depth to seasonal high water table, slope, stoniness, flooding hazard, soil texture, and permeability.

TABLE 6.—*Limitations of the soils for*

| Mapping units | Homesites | Septic tank absorption fields |
|---|---|---|
| Alluvial land, loamy [2] | Severe: hazard of flooding | Severe: hazard of flooding |
| Alluvial land, mixed [2] | Severe: hazard of flooding | Severe: hazard of flooding |
| Aubbeenaubbee sandy loam | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: seasonal high water table |
| Blount silt loam, 0 to 2 percent slopes | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: slow permeability; seasonal high water table. |
| Blount silt loam, 2 to 4 percent slopes, eroded. | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: slow permeability; seasonal high water table. |
| Borrow pits: Properties variable. Onsite investigation necessary. | | |
| Brady sandy loam | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: seasonal high water table; some hazard of polluting shallow wells nearby. |
| Brems loamy fine sand | Moderate: moderately well drained | Slight: some hazard of polluting shallow wells nearby. |
| Bronson sandy loam | Moderate: moderately well drained | Slight: some hazard of polluting shallow wells nearby. |
| Brookston silt loam | Severe: seasonal high water table; poorly drained. | Severe: slow permeability; seasonal high water table. |
| Carlisle muck | Severe: unstable; very high compressibility; very poorly drained. | Severe: unstable; high water table; very poorly drained. |
| Carlisle muck, drained | Severe: unstable; very high compressibility | Severe: unstable; subject to ponding |
| Chelsea fine sand, 0 to 2 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Chelsea fine sand, 2 to 6 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Chelsea fine sand, 6 to 12 percent slopes | Moderate: slopes | Slight to severe: slopes; some hazard of polluting shallow wells nearby. |
| Crosby loam, 0 to 2 percent slopes | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: slow permeability; seasonal high water table. |
| Crosby loam, 2 to 4 percent slopes | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: slow permeability; seasonal high water table. |
| Del Rey silt loam | Moderate for homes without basements, severe for homes with basements; seasonal high water table; somewhat poorly drained. | Severe: slow permeability; seasonal high water table. |
| Dickinson sandy loam | Slight | Slight |

See footnotes at end of table.

*town and country planning*

| Local roads and streets | Sewage lagoons | Sanitary land fill [1] (trench method) |
|---|---|---|
| Severe: hazard of flooding | Severe: hazard of flooding | Severe: hazard of flooding. |
| Severe: hazard of flooding | Severe: hazard of flooding | Severe: hazard of flooding. |
| Severe: seasonal high water table; subject to frost heaving. | Severe: seasonal high water table; moderately rapid permeability in upper 2 to 3 feet. | Moderate: seasonal high water table; somewhat poorly drained. |
| Moderate: seasonal high water table; somewhat poorly drained. | Slight | Moderate: seasonal high water table; somewhat poorly drained; clayey; subject to cracking on drying; sticky when wet. |
| Moderate: seasonal high water table; somewhat poorly drained. | Slight | Moderate: seasonal high water table; somewhat poorly drained; clayey; subject to cracking on drying; sticky when wet. |
| Moderate: seasonal high water table; somewhat poorly drained. | Severe: loose sand and gravel within depth of 5 feet. | Severe: sand and gravel within depth of 5 feet or less; seasonal high water table. |
| Slight | Severe: rapid permeability | Severe: hazard of free leachate flow to ground water; sandy soil subject to blowing. |
| Slight | Severe: loose sand and gravel within depth of 5 feet. | Severe: hazard of free leachate flow to ground water. |
| Severe: seasonal high water table; plastic when wet. | Moderate: seasonal high water table; subject to ponding. | Severe: seasonal high water table; subject to ponding; poorly drained. |
| Severe: unstable; very high compressibility; very poorly drained. | Severe: high water table; organic soil; unstable. | Severe: high water table; organic soil; unstable. |
| Severe: unstable; very high compressibility. | Severe: organic soil; unstable | Severe: organic soil; unstable. |
| Slight | Severe: very rapid permeability | Severe: hazard of free leachate flow to ground water; subject to soil blowing. |
| Slight | Severe: very rapid permeability | Severe: hazard to free leachate flow to ground water; subject to soil blowing. |
| Severe: slopes | Severe: slopes; very rapid permeability | Severe: slopes; hazard of free leachate flow to ground water; subject to soil blowing. |
| Moderate: seasonal high water table; somewhat poorly drained. | Slight | Moderate: seasonal high water table; somewhat poorly drained. |
| Moderate: seasonal high water table; somewhat poorly drained. | Slight | Moderate: seasonal high water table; somewhat poorly drained. |
| Moderate: seasonal high water table; somewhat poorly drained. | Slight | Moderate: seasonal high water table; somewhat poorly drained; clayey materials; subject to cracking upon drying; sticky when wet. |
| Slight | Severe: moderately rapid permeability; loose sand and gravel within depth of 5 feet. | Severe: sand and gravel within depth of 5 feet; hazard of free leachate flow to ground water. |

TABLE 6.—*Limitations of the soils for*

| Mapping units | Homesites | Septic tank absorption fields |
|---|---|---|
| Dowagiac loam | Slight | Slight |
| Edwards muck | Severe: very poorly drained; high water table; unstable. | Severe: high water table; underlying marl has slow permeability. |
| Fox sandy loam, 0 to 2 percent slopes | Slight | Slight |
| Fox sandy loam, 2 to 6 percent slopes | Slight | Slight |
| Fox sandy loam, 6 to 12 percent slopes, eroded. | Moderate: slopes | Slight to severe: slopes; some hazard of polluting shallow wells nearby. |
| Gilford sandy loam | Severe: seasonal high water table; very poorly drained. | Severe: seasonal high water table; very poorly drained. |
| Gilford mucky sandy loam | Severe: seasonal high water table; very poorly drained; organic surface layer. | Severe: seasonal high water table; very poorly drained. |
| Gravel pit: Properties variable. Onsite investigation necessary. | | |
| Haskins loam, 0 to 2 percent slopes | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: seasonal high water table |
| Haskins loam, 2 to 4 percent slopes | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: seasonal high water table |
| Homer loam | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: seasonal high water table; moderately slow permeability. |
| Linwood muck | Severe: high water table; unstable; very poorly drained; high compressibility. | Severe: high water table; very poorly drained; unstable. |
| Made land: Properties variable. Onsite investigation necessary. | | |
| Marsh: Properties variable. Onsite investigation necessary. | | |
| Maumee loamy fine sand | Severe: high water table; very poorly drained. | Severe: high water table; very poorly drained. |
| Metea loamy fine sand, 0 to 6 percent slopes. | Slight | Slight |
| Metea loamy fine sand, 6 to 12 percent slopes. | Moderate: slopes | Moderate: slopes |

See footnotes at end of table.

*town and country planning*—Continued

| Local roads and streets | Sewage lagoons | Sanitary land fill [1] (trench method) |
|---|---|---|
| Slight | Severe: moderate permeability; loose sand and gravel within depth of 5 feet. | Severe: sand and gravel within depth of 5 feet; hazard of free leachate flow to ground water. |
| Severe: high water table; poor stability; difficult to compact. | Severe: high organic-matter content; high water table subject to ponding. | Severe: high water table; subject to ponding. |
| Slight | Severe: less than 4 feet to loose sand and gravel. | Severe: less than 4 feet to loose sand and gravel; hazard of free leachate flow to ground water. |
| Slight | Severe: less than 4 feet to loose sand and gravel. | Severe: less than 4 feet to loose sand and gravel; hazard of free leachate flow to ground water. |
| Severe: slopes | Severe: less than 4 feet to loose sand and gravel. | Severe: less than 4 feet to loose sand and gravel; hazard of free leachate flow to ground water. |
| Severe: seasonal high water table; relatively high organic-matter content. | Severe: moderately rapid permeability; seasonal high water table; less than 4 feet to loose sand and gravel. | Severe: seasonal high water table; less than 4 feet to loose sand and gravel |
| Severe: seasonal high water table; organic surface layer; very poorly drained. | Severe: moderately rapid permeability; seasonal high water table; less than 4 feet to loose sand and gravel. | Severe: seasonal high water table; less than 4 feet to loose sand and gravel. |
| Moderate: seasonal high water table; somewhat poorly drained. | Moderate: moderate permeability in upper 2 to 3 feet; seasonal high water table. | Moderate: seasonal high water table; somewhat poorly drained. |
| Moderate: seasonal high water table; somewhat poorly drained. | Moderate: moderate permeability in upper 2 to 3 feet; seasonal high water table. | Moderate: seasonal high water table; somewhat poorly drained. |
| Moderate: seasonal high water table; somewhat poorly drained. | Severe: less than 4 feet to loose sand and gravel. | Severe: less than 4 feet to loose sand and gravel. |
| Severe: high water table; high compressibility in upper layers; very poorly drained. | Severe: high organic-matter content; very poorly drained; high water table. | Severe: high water table; very poorly drained. |
| Severe: high water table; very poorly drained; relatively high organic-matter content in surface layer. | Severe: rapid permeability; high water table. | Severe: rapid permeability; high water table. |
| Slight | Severe: rapid permeability in upper 2 to 3 feet. | Slight. |
| Moderate: slopes | Severe: slopes; rapid permeability in upper 2 to 3 feet. | Moderate: slopes. |

TABLE 6.—*Limitations of the soils for*

| Mapping units | Homesites | Septic tank absorption fields |
|---|---|---|
| Miami loam, 2 to 6 percent slopes, eroded | Slight | Moderate: moderate to moderately slow permeability. |
| Miami loam, 6 to 12 percent slopes, eroded | Moderate: slopes | Moderate: moderate to moderately slow permeability. |
| Miami loam, 12 to 18 percent slopes, eroded. | Moderate: slopes | Severe: slopes; moderately slow permeability. |
| Miami clay loam, 6 to 12 percent slopes, severely eroded. | Moderate: slopes | Severe: slopes; moderately slow permeability; present surface layer is material from the subsoil. |
| Miami clay loam, 12 to 18 percent slopes, severely eroded. | Moderate: slopes | Severe: slopes; moderately slow permeability; present surface layer is material from the subsoil. |
| Oshtemo loamy sand, 0 to 2 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Oshtemo loamy sand, 2 to 6 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Oshtemo loamy sand, 6 to 12 percent slopes | Moderate: slopes | Slight to severe: slopes; some hazard of polluting shallow wells nearby. |
| Oshtemo loamy sand, 12 to 18 percent slopes. | Moderate: slopes | Severe: slopes; some hazard of polluting shallow wells nearby. |
| Oshtemo loamy sand, 18 to 25 percent slopes. | Severe: slopes | Severe: slopes; some hazard of polluting shallow wells nearby. |
| Pewamo silty clay loam | Severe: seasonal high water table; poorly drained. | Severe: slow permeability; seasonal high water table. |
| Plainfield fine sand, 0 to 2 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Plainfield fine sand, 2 to 6 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Plainfield fine sand, 6 to 12 percent slopes | Slight | Slight to severe: slopes; some hazard of polluting shallow wells nearby. |
| Rawson loam, 0 to 2 percent slopes | Slight | Severe: slow permeability |
| Rawson loam, 2 to 6 percent slopes | Slight | Severe: slow permeability |
| Rawson loam, 6 to 12 percent slopes, eroded | Moderate: slopes | Severe: slopes; slow permeability |
| Rensselaer silt loam | Severe: high water table; poorly drained | Severe: moderately slow permeability; high water table. |
| Riddles sandy loam, 0 to 2 percent slopes | Slight | Slight |
| Riddles sandy loam, 2 to 6 percent slopes | Slight | Slight |
| Riddles sandy loam, 6 to 12 percent slopes | Moderate: slopes | Slight to severe: slopes |
| Riddles sandy loam, 12 to 18 percent slopes, eroded. | Moderate: slopes | Severe: slopes |

See footnotes at end of table.

*town and country planning*—Continued

| Local roads and streets | Sewage lagoons | Sanitary land fill [1] (trench method) |
|---|---|---|
| Moderate: slopes | Moderate: slopes | Slight. |
| Severe: slopes | Moderate: slopes | Moderate: slopes. |
| Severe: slopes | Severe: slopes | Severe: slopes. |
| Severe: slopes | Moderate: slopes | Moderate: slopes. |
| Severe: slopes | Severe: slopes | Severe: slopes. |
| Slight | Severe: loose sand and gravel within depth of 5 feet. | Severe: moderately rapid permeability; loose sand and gravel within depth of 5 feet. |
| Moderate: slopes | Severe: loose sand and gravel within depth of 5 feet. | Severe: moderately rapid permeability; loose sand and gravel within depth of 5 feet. |
| Severe: slopes | Severe: slopes; loose sand and gravel within depth of 5 feet. | Severe: moderately rapid permeability; loose sand and gravel within depth of 5 feet. |
| Severe: slopes | Severe: slopes; loose sand and gravel within depth of 5 feet. | Severe: moderately rapid permeability; loose sand and gravel within depth of 5 feet. |
| Severe: slopes | Severe: slopes; loose sand and gravel within depth of 5 feet. | Severe: moderately rapid permeability; loose sand and gravel within depth of 5 feet; slopes. |
| Severe: seasonal high water table; highly plastic. | Moderate: seasonal high water table; subject to ponding. | Moderate: poorly drained; seasonal high water table; clayey; material difficult to work when wet. |
| Slight | Severe: rapid permeability; very porous, does not hold water. | Severe: rapid permeability; subject to soil blowing. |
| Slight | Severe: rapid permeability; very porous, does not hold water. | Slight. |
| Severe: slopes | Severe: rapid permeability; very porous, does not hold water; slopes. | Severe: slopes; rapid permeability. |
| Slight | Slight | Slight. |
| Moderate: slopes | Moderate: slopes | Slight. |
| Moderate: slopes | Moderate: slopes | Moderate: slopes. |
| Severe: high water table; poorly drained | Severe: high water table; less than 4 feet to silt and sand; does not hold water. | Severe: high water table; less than 4 feet to silt and sand. |
| Slight | Moderate: moderate permeability | Slight. |
| Moderate: slopes | Moderate: slopes; moderate permeability | Slight. |
| Severe: slopes | Moderate: slopes; moderate permeability | Moderate: slopes. |
| Severe: slopes | Severe: slopes; moderate permeability | Severe: slopes. |

TABLE 6.—*Limitations of the soils for*

| Mapping units | Homesites | Septic tank absorption fields |
|---|---|---|
| Riddles sandy loam, 18 to 25 percent slopes, eroded. | Severe: slopes | Severe: slopes |
| Riddles loam, 0 to 2 percent slopes | Slight | Slight |
| Riddles loam, 2 to 6 percent slopes, eroded | Slight | Slight |
| Riddles loam, 6 to 12 percent slopes, eroded | Moderate: slopes | Slight to severe: slopes |
| Sebewa loam | Severe: seasonal high water table; poorly drained. | Severe: moderately slow permeability; seasonal high water table. |
| Shoals loam [2] | Severe: hazard of flooding | Severe: hazard of flooding |
| Tawas muck | Severe: high water table; unstable; very poorly drained; high compressibility. | Severe: high water table; very poorly drained. |
| Tawas muck, drained | Severe: upper 1 to 4 feet is organic material; unstable; high compressibility. | Severe: upper 1 to 4 feet is organic material; unstable. |
| Tedrow loamy sand | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: seasonal high water table; some hazard of polluting shallow wells nearby; rapid permeability. |
| Tyner loamy sand, 0 to 2 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Tyner loamy sand, 2 to 6 percent slopes | Slight | Slight: some hazard of polluting shallow wells nearby. |
| Tyner loamy sand, 6 to 12 percent slopes | Moderate: slopes | Slight to severe: slopes; some hazard of polluting shallow wells nearby. |
| Volinia loam | Slight | Slight |
| Wallkill silt loam | Severe: underlying organic material very unstable; very poorly drained. | Severe: seasonal high water table; underlying organic material very unstable. |
| Washtenaw silt loam | Severe: poorly drained; subject to ponding. | Severe: seasonal high water table; subject to ponding. |
| Whitaker loam | Moderate for homes without basements, severe for homes with basements: seasonal high water table; somewhat poorly drained. | Severe: seasonal high water table |

[1] Onsite studies of the underlying strata, the water table, and the hazards of aquifer pollution and drainage into ground water need to be made for land fills deeper than 5 or 6 feet.

*town and country planning*—Continued

| Local roads and streets | Sewage lagoons | Sanitary land fill [1] (trench method) |
|---|---|---|
| Severe: slopes | Severe: slopes; moderate permeability | Severe: slopes. |
| Slight | Moderate: moderate permeability | Slight. |
| Slight | Moderate: moderate permeability | Slight. |
| Severe: slopes | Moderate: slopes; moderate permeability | Moderate: slopes. |
| Severe: seasonal high water table; poorly drained. | Severe: seasonal high water table; less than 4 feet to loose sand and gravel; does not hold water. | Severe: seasonal high water table; less than 4 feet to loose sand and gravel. |
| Severe: hazard of flooding | Severe: hazard of flooding | Severe: hazard of flooding. |
| Severe: high water table; very poorly drained; unstable; high compressibility. | Severe: high organic-matter content; high water table; subject to ponding. | Severe: high water table; lacks suitable material for cover; underlying sand is rapidly permeable. |
| Severe: upper 1 to 4 feet is organic material; unstable. | Severe: high organic-matter content in upper 1 to 4 feet. | Severe: lacks suitable material for cover; underlying sand is rapidly permeable. |
| Moderate: seasonal high water table; somewhat poorly drained; low compressibility. | Severe: rapid permeability; very porous, does not hold water. | Severe: rapid permeability; seasonal high water table. |
| Slight | Severe: rapid permeability; loose sand and gravel within depth of 5 feet. | Severe: rapid permeability; loose sand and gravel within depth of 5 feet. |
| Slight | Severe: rapid permeability; loose sand and gravel within depth of 5 feet. | Severe: rapid permeability; loose sand and gravel within depth of 5 feet. |
| Severe: slopes | Severe: rapid permeability; loose sand and gravel within depth of 5 feet. | Severe: rapid permeability; loose sand and gravel within depth of 5 feet. |
| Slight | Severe: loose sand and gravel within depth of 5 feet. | Severe: loose sand and gravel within depth of 5 feet. |
| Severe: very poorly drained; underlying organic material very unstable. | Severe: seasonal high water table; subject to ponding; underlain by organic material. | Severe: seasonal high water table; very poorly drained; underlain by organic material. |
| Severe: poorly drained; seasonal high water table. | Moderate: seasonal high water table; subject to ponding. | Severe: seasonal high water table; subject to ponding; poorly drained. |
| Moderate: seasonal high water table; somewhat poorly drained. | Severe: underlying material at depth of 4 to 5 feet has moderately rapid permeability. | Severe: seasonal high water table; somewhat poorly drained; underlying strata have moderately rapid permeability. |

[2] Some degree of flooding nearly every year. Flooding once in 5 to 10 years constitutes a severe limitation.

Because routine soil survey investigations are normally confined to a depth of about 5 or 6 feet and many land-fill operations use trenches as deep as 15 feet, there is a need for a geologic investigation of the area to determine the potential for pollution of ground water, as well as to obtain data for the design of the land fill. This soil survey is a valuable tool in selecting potential sites and for determining where additional investigations appear warranted.

Borrow pits, Gravel pit, Made land, and Marsh are not rated in table 6. The properties of these mapping units are so variable that an onsite investigation is necessary to determine the degree of limitation that exists for town and country planning.

## Use of the Soils for Woodland [5]

Most of the valuable timber-producing areas in Elkhart County have been cleared and are used for farming. The remaining wooded areas are relatively small in size and are scattered throughout the county. The rougher topography of the sandy soils and areas of wet, undrained soils now support most of the remaining tree cover.

If the native vegetation is removed from the sandy and mucky soils and intensive land use is attempted, soil blowing becomes a serious hazard. The retention of native vegetation, or the planting of suitable trees or shrubs, helps to protect these soils from soil blowing.

Windbreaks of trees and shrubs are very suitable for the control of soil blowing. These are long belts of trees or shrubs that protect farmsteads, orchards, feedlots, and crop fields from the force of wind. They slow the speed of the wind and lessen soil blowing to the leeward for a distance equal to about twenty times the heights of plants in the windbreak.

Field windbreaks normally are single-row plantings of trees and shrubs in a north-south direction to give maximum protection from prevailing winds. This type of windbreak should be established on a spacing interval of 40 rods or less, dependent upon the type of crop grown and the erodibility of the soil. On many farms the windbreaks could be planted adjacent to north-south property lines or field divisions or on the leeward side of drainage ditches.

Farmstead windbreaks should have a minimum of three rows of plants and be located on the north and west sides of building areas or feedlots. This type of windbreak is designed to provide wind protection, control snow deposition, add beauty, supply food and cover for wildlife, and supply shelter for livestock.

Suitable plants for use in windbreaks on muck soils are American arborvitae, Norway spruce, white pine, medium purple willow, tall purple willow, amur honeysuckle, and multiflora rose. Suitable plants for use in windbreaks on sandy soils are white pine, red pine, jack pine, forsythia, autumn-olive, and common lilac.

Table 7 lists the soils that are suitable for tree and shrub plantings for landscaping of building sites, recreation areas, homestead windbreaks, screening unsightly sites, general neighborhood beautification, erosion control, and creating wildlife food and cover areas.

Trees and shrubs of different species vary widely in their suitability for different soils and site conditions. The soils are placed in groups based mainly on wetness characteristics and available moisture capacity. Each of the soils in a particular group is similar in suitability for tree and shrub plantings. For more detailed information about the soils in each group, refer to the sections "Descriptions of the Soils" and "Capability Grouping."

In addition to the soils and the trees and shrubs suitable for plantings, table 7 lists some characteristics of the various species. These suggested plants should be considered as making up only a partial list of trees and shrubs that are suitable for the soils in the county. Many of the shrubs listed serve dual purposes.

Borrow pits, Gravel pit, Made land, and Marsh were excluded from table 7. The properties of these mapping units are so variable that an onsite investigation is necessary to determine the suitability of a particular shrub or tree.

## Use of the Soils for Wildlife

The wide range of soil and moisture in Elkhart County provides a high potential for managing the land to increase and maintain various kinds of wildlife.

The principal factor affecting the wildlife species and population in the county is the availability of suitable habitat. Because soil is a vital key in the production of food and cover for wildlife, its suitability for providing these items is discussed in this section. The land types Borrow pits, Gravel pit, Made land, and Marsh are not listed in table 8 (p. 78).

In table 8, each soil in the county is rated *well suited*, *suited*, *poorly suited*, or *unsuited* according to its suitability for three kinds of wildlife. The ratings are based on the suitability of the soils for the habitat elements essential to the birds and mammals that make up each kind of wildlife.

The following paragraphs discuss the kinds of wildlife in the county, list the elements of habitat used in rating the soils, and define the suitability ratings.

Openland wildlife consists of birds and mammals that normally frequent cropland, pastures, and hayland overgrown with herbaceous upland plants and shrubs. Examples of openland wildlife are rabbit, fox, meadowlark, skunk, quail, and pheasant. Elements of wildlife habitat used in rating the soils for openland wildlife are grain and seed crops, grasses and legumes, wild herbaceous upland plants, and hardwood woodland plants.

Woodland wildlife consists of mammals and birds that frequent areas of hardwood and coniferous trees, shrubs, or a combination of this vegetation. Examples of woodland wildlife are squirrel, deer, raccoon, woodchuck, woodpecker, and nuthatch. Elements of wildlife habitat used in rating the soils for this kind of wildlife are grasses and legumes, wild herbaceous upland plants, hardwood woodland plants, and coniferous woodland plants.

Wetland wildlife consists of mammals, birds, and reptiles that frequent wet areas, such as ponds, marshes, and swamps. Examples of wetland wildlife are muskrats,

[5] By JOHN O. HOLWAGER, woodland conservationist, Soil Conservation Service.

ducks, geese, frogs, kingfishers, and heron. Elements of wildlife habitat used in rating soils for this kind of wildlife are wetland food and cover plants, shallow water developments, excavated ponds (fig. 21), and grain and seed crops.

In table 8, the ratings of suitability for each kind of wildlife indicate the soils where habitat can be managed most practically and where wildlife is most likely to live successfully.

A rating of *well suited* means that habitat generally is easily created, improved, and maintained. There are few soil limtations that affect management.

A rating of *suited* indicates that it is feasible to create a habitat on this soil but certain limitations must be corrected. Management practices are required to overcome the deficiencies.

A rating of *poorly suited* indicates that the soils have serious limitations to use that need to be recognized and overcome. Use tends to be questionable because the limitations are difficult to overcome.

A rating of *unsuited* indicates that extreme measures are needed to overcome the soil limitations; use is undesirable or impractical.

Borrow pits, Gravel pit, Made land, and Marsh are excluded from table 8. The properties of these mapping units are so variable that an onsite investigation is necessary to determine the degree of limitation that exists.

## Recreation

Outdoor recreation is already a major part of American life and can be expected to increase greatly by the year 2000. For this reason, it should be an integral element in local land use planning (*2*).

Experience and activity in the open country are an important part of our way of life, not only for inspiration and enjoyment, but also as a source of livelihood. In the past, public lands were considered the major supplier; however, more recently private development has also been recognized as a major supplier of the outdoor recreation that is so in demand.

***Figure 21.*—Excavated pond being developed in Tawas muck for wildlife habitat.**

Competition for rural space grows with an increase in population, a higher standard of living, improved access, and more leisure time. Building sites, highways, farming, and similar uses of soils commonly relegate recreation to those areas that are less desirable for other uses. The wide range of activity and the seasonal aspects of recreation make possible the use of many kinds of soil conditions.

The wooded shorelines along major streams, as well as areas on bottom land cut by meandering streams, lend themselves to recreational and wildlife uses. Some areas would serve as natural outdoor laboratories for educational and scientific purposes.

In table 9 (p. 84) the soils in this county are rated according to their limitations affecting six kinds of recreational facilities. These are cottages and utility buildings; tent and camp trailer sites; picnic areas, parks, and extensive play areas; playgrounds, athletic fields, and intensive play areas; bridle paths and nature and hiking trails; and golf fairways.

The soils are not rated for septic tank filter fields for sewage disposal. See table 6 in the section "Town and Country Planning" for this information.

The ratings used in table 9 are predictions of the behavior of specific kinds of soil. They are based on soil characteristics and do not include other factors that may be important. A rating of *slight* means that there are few or no limitations that affect design or management. A rating of *moderate* means that the facility can be created, improved or maintained, but the limitations need to be recognized and overcome by correct planning, good management, and careful design. A rating of *severe* means that use is questionable, and careful design and above-average management are required.

In the paragraphs that follow, each recreational use is defined and the properties important in rating the limitations for such purposes are given. The information can be used, along with table 9 and with information in other parts of the survey, as a guide in planning the use of the soils for recreation. Before beginning any construction projects, however, an investigation should be made at the site being considered.

Cottages and utility buildings.—These are seasonal or year-round cottages, washrooms and bathrooms, picnic shelters, and service buildings. Properties considered are wetness, hazard of flooding, slope, rockiness, stoniness, and depth to hard bedrock. Also considered are suitability for septic tank filter fields, shrink-swell potential, frost potential, hillside slippage, presence of loose sand, and bearing capacity. Suitability of the soils for supporting vegetation, and whether basements and underground utilities are planned, should be considered in the final evaluation.

Tent and camp trailer sites.—These are areas used for pitching tents, for parking camping trailers, and for the accompanying activities of outdoor living. The sites require little preparation, but they should have areas suitable for unsurfaced parking lots for cars and camping trailers. They should be able to withstand heavy traffic by people, horses, and vehicles. Properties considered are wetness, hazard of flooding, permeability, slope, texture of the surface soil, amount of coarse fragments, stoniness, and rockiness. Suitability of soils for supporting vegetation should be considered in the final evaluation.

TABLE 7.—*Shrub and tree*

[Dashes indicate species not

| Group and map symbols | Plants | Suitable for— | |
|---|---|---|---|
| | | Screen plantings | Ornamental or shade trees |
| Group 1: Bw, Ca, Cd, Ed, Gf, Gm, Lm, Mm, Pe, Re, Se, Ta, Td, Wa, Wh. | American arborvitae | Suitable | Suitable |
| | Black spruce | Suitable | Suitable |
| | European larch | | Suitable |
| | Medium and tall purple willow | Suitable | |
| | Red osier dogwood | Suitable | |
| | Gray dogwood | Suitable | |
| | Silky dogwood | Suitable | |
| | Multiflora rose | Suitable | |
| | Amur honeysuckle | Suitable | Suitable |
| | Winterberry | | |
| | Elderberry | | |
| | White pine | Suitable | Suitable |
| | Norway spruce | Suitable | Suitable |
| Group 2: Am, Au, BlA, BlB2, Br, CrA, CrB, De, HaA, HaB, Ho, Sh, Te, Wk. | White pine | Suitable | Suitable |
| | White spruce | Suitable | Suitable |
| | Norway spruce | Suitable | Suitable |
| | Canadian hemlock | Suitable | Suitable |
| | Sycamore | | Suitable |
| | White birch | | Suitable |
| | Yew (varieties) | Suitable | Suitable |
| | Highbush cranberry | Suitable | Suitable |
| | Autumn-olive | Suitable | |
| | Amur honeysuckle | Suitable | Suitable |
| | Tartarian honeysuckle | Suitable | |
| | Spicebush | | |
| | Mountain-ash | | Suitable |
| Group 3: Ad, Do, FoA, FoB, FoC2, MnB, MnC, MoB2, MoC2, MoD2, MrC3, MrD3, RaA, RaB, RaC2, RsA, RsB, RsC, RsD2, RsE2, RtA, RtB2, RtC2, Vo. | White pine | Suitable | Suitable |
| | Red pine | Suitable | Suitable |
| | Norway spruce | Suitable | Suitable |
| | Northern pin oak | | Suitable |
| | Black gum | | Suitable |
| | Hazelnut (filbert) | Suitable | |
| | Indigobush | Suitable | |
| | Blackhaw viburnum | Suitable | |
| | Staghorn sumac | Suitable | |
| | Serviceberry | | Suitable |
| | Wild plum | Suitable | |
| | Amur honeysuckle | Suitable | Suitable |
| | Manchu cherry | Suitable | Suitable |
| | Nannyberry-viburnum | Suitable | Suitable |
| | Eastern wahoo | Suitable | Suitable |
| | Wayfaring tree | Suitable | Suitable |
| Group 4: Bu, Bv, ChA, ChB, ChC, Dk, OsA, OsB, OsC, OsD, OsE, PlA, PlB, PlC, TyA, TyB, TyC. | Red pine | Suitable | Suitable |
| | Jack pine | Suitable | Suitable |
| | Austrian pine | Suitable | Suitable |
| | White pine | Suitable | Suitable |
| | Silver buffaloberry | Suitable | |
| | Indigobush | Suitable | |
| | American hazlenut | Suitable | |
| | Red-fruited chokeberry | Suitable | |
| | Forsythia | Suitable | |
| | Russian-olive | Suitable | Suitable |
| | Staghorn sumac | Suitable | |
| | Smooth sumac | Suitable | |
| | Fragrant sumac | Suitable | |
| | French tamarix | Suitable | |
| | Wild plum | Suitable | |
| | Sweetfern | | |

*planting guide*

recommended for this use]

| Suitable for—continued | | Height at maturity | Plant tolerant to sun or shade | Remarks |
|---|---|---|---|---|
| Wildlife food and cover | Planting in road cuts and erosion areas | | | |
| | | *Feet* | | |
| | | 20–30 | Sun | Evergreen. |
| | | 50–60 | Both | Evergreen; branches droop. |
| | | 60–90 | Sun | Sheds needles in fall. |
| | | 10–20 | Sun | Establish by cutting. |
| Suitable | | 6–10 | Both | Good border and wildlife food plant. |
| Suitable | Suitable | 4–8 | Sun | Good border and wildlife food plant. |
| Suitable | Suitable | 6–12 | Both | Good border and wildlife food plant. |
| Suitable | Suitable | 6–10 | Sun | May spread into nonmanaged areas. |
| Suitable | | 8–16 | Both | Very attractive; heavy crop of fruit. |
| Suitable | | 6–8 | Both | Red fruit in winter. |
| Suitable | Suitable | 8–10 | Sun | Heavy crop of fruit. |
| | | 100–120 | Sun | Tolerates partial shade; evergreen. |
| | | 60–80 | Both | Short needles; evergreen. |
| | | 100–200 | Sun | Tolerates partial shade; evergreen. |
| | | 60–70 | Both | Excellent specimen tree; evergreen. |
| | | 60–80 | Both | Short needles; evergreen. |
| | | 80–100 | Shade | Very good for shaping into hedges. |
| | Suitable | 90–100 | Sun | Bark attractive in winter. |
| | | 30–40 | Sun | Very good for planting in clumps. |
| | | 10–15 | Both | Responds well to shearing. |
| Suitable | Suitable | 6–10 | Both | Holds red fruit into winter. |
| Suitable | Suitable | 6–10 | Sun | Wildlife food; attracts songbirds. |
| Suitable | Suitable | 8–16 | Both | Wildlife food; attracts songbirds. |
| Suitable | Suitable | 8–12 | Both | Wildlife food; attracts songbirds. |
| Suitable | Suitable | 8–10 | Shade | Spicy odor in leaves and fruit. |
| Suitable | | 20–30 | Sun | Orange to red fruit. |
| | | 100–120 | Sun. | |
| | Suitable | 70–80 | Sun | Evergreen; long needles. |
| | | 60–80 | Both. | |
| Suitable | | 70–80 | Sun | Scarlet color in fall. |
| Suitable | | 50–60 | Both | Red color in fall. |
| Suitable | Suitable | 6–8 | Sun | Produces edible nuts. |
| | Suitable | 8–12 | Both | Good erosion control plant. |
| Suitable | Suitable | 12–16 | Both | White flowers; purple fruit; thicket forming. |
| Suitable | Suitable | 15–20 | Both | Spreads from root suckers. |
| Suitable | | 15–20 | Both | Early white blooms. |
| Suitable | Suitable | 10–15 | Both | Thicket forming. |
| Suitable | | 8–16 | Both. | |
| Suitable | | 10–15 | Sun | Showy specimen shrub. |
| Suitable | | 20–25 | Sun | Showy plant; slow growth. |
| Suitable | | 8–10 | Sun | Scarlet color in fall. |
| Suitable | | 6–12 | Sun | Flowers and fruits heavily. |
| | Suitable | 70–80 | Sun. | |
| | Suitable | 50–60 | Sun | Abundance of cones; evergreen. |
| | Suitable | 50–60 | Sun | Stiff needled; evergreen. |
| | | 100–120 | Sun | Not suitable where erosion is active. |
| Suitable | Suitable | 8–10 | Sun | Silver-colored leaves. |
| | Suitable | 8–12 | Both. | |
| Suitable | Suitable | 6–8 | Sun. | |
| Suitable | Suitable | 6–8 | Sun | Holds fruit well into winter. |
| | Suitable | 8–10 | Sun | Yellow flowers. |
| Suitable | | 15–20 | Sun | Silver leaves. |
| Suitable | Suitable | 10–15 | Sun | Sprouts from roots. |
| Suitable | Suitable | 10–15 | Sun | Retains fruit well. |
| Suitable | Suitable | 4–8 | Sun | Dark-green leaves, red fruit. |
| | Suitable | 8–10 | Sun | Red cover in fall. |
| Suitable | Suitable | 10–15 | Both | Thicket forming. |
| | Suitable | 3–5 | Sun | Spreads by root sprouts. |

TABLE 8.—*Soil limitations for producing habitat for three major kinds of wildlife*

| Soil series and map symbols | Openland wildlife | Woodland wildlife | Wetland wildlife |
|---|---|---|---|
| Alluvial land: Ad, Am | Properties variable. Onsite investigations required. | Properties variable. Onsite investigations required. | Properties variable. Onsite investigations required. |
| Aubbeenaubbee: Au | Well suited | Suited: suitable for planting many kinds of adapted grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants and hardwood woody plants; fast growth of conifers results in rapid canopy closure. | Poorly suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| Blount: BlA, BlB2 | Well suited | Suited: suitable for planting many kinds of adapted species of grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants and hardwood woody plants; fast growth of conifers results in rapid canopy closure. | Suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| Brady: Br | Well suited | Suited: suitable for planting many kinds of adapted species of grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants and hardwood woody plants; fast growth of conifers results in rapid canopy closure. | Suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| Brems: Bu | Poorly suited: available moisture is limited; number of suitable species is restricted; production of food generally is low, and vigor of growth is limited. | Poorly suited: available moisture is limited; number of suitable species is restricted; production of food generally is low, and vigor of growth is limited; slight limitation for conifers; growth is slow, and this delays canopy closure. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water developments or excavated ponds; severe limitation for grain and seed crops. |
| Bronson: Bv | Well suited | Suited: grass and legumes require fertilizer, lime, and renovation for good stands and long life; slight limitation for wild herbaceous upland plants and hardwood woodland plants; vigorous growth of many kinds of plants and food production is dependable; moderate limitation for coniferous woodland plants; some limitation of species. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow-water developments or excavated ponds; moderate hazard for grain and seed crops because soil is somewhat droughty. |
| Brookston: Bw | Poorly suited in natural condition; well suited if adequately drained: number of suitable plant species is restricted; vigor of growth is limited. | Suited: soil conditions limit the number of suitable species; dependability of food production of hardwood woodland plants is somewhat limited; growth and suitable species of conifers are limited. | Well suited. |
| Carlisle: Ca, Cd | Poorly suited: few plant species are suited; vigor of growth is limited. | Suited: soil conditions limit the number of plant species important to wildlife. | Well suited. |

TABLE 8.—*Soil limitations for producing habitat for three major kinds of wildlife*—Continued

| Soil series and map symbols | Openland wildlife | Woodland wildlife | Wetland wildlife |
|---|---|---|---|
| Chelsea: ChA, ChB, ChC | Poorly suited: available moisture is limited; number of suitable species is restricted; production of food generally is low, and vigor of growth is limited. | Poorly suited: available moisture is limited; number of suitable species is restricted; production of food generally is low, and vigor of growth is limited; slight limitation for conifers; growth is slow, delaying canopy closure. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water developments or excavated ponds; severe limitation for grain and seed crops. |
| Crosby: CrA, CrB | Well suited | Suited: suitable for planting many kinds of adapted species of grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants and hardwood woody plants; fast growth of conifers results in rapid canopy closure. | Suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| Del Rey: De | Well suited | Suited: suitable for planting many kinds of adapted species of grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants; fast growth of conifers results in rapid canopy closure. | Suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| Dickinson: Dk | Well suited | Suited: grass and legumes require fertilizer, lime, and renovation for good stands and long life; slight limitation for wild herbaceous upland plants and hardwood woodland plants; vigorous growth of many kinds of plants, and food production is dependable; moderate limitation for coniferous woodland plants; some limitation of suitable species. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water development or excavated ponds; moderate hazard for grain and seed crops because soil is somewhat droughty. |
| Dowagiac: Do | Well suited | Suited: grass and legumes require fertilizer, lime, and renovation for good stands and long life; slight limitation for wild herbaceous upland plants and hardwood woodland plants; vigorous growth of many kinds of plants, and food production is dependable; moderate limitation for coniferous woodland plants; some limitation of suitable species. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water developments or excavated ponds; moderate hazard for grain and seed crops because soil is somewhat droughty. |
| Edwards: Ed | Poorly suited: few plant species are suited; growth vigor is limited. | Suited: soil conditions limit the number of species important to wildlife. | Well suited. |

TABLE 8.—*Soil limitations for producing habitat for three major kinds of wildlife*—Continued

| Soil series and map symbols | Openland wildlife | Woodland wildlife | Wetland wildlife |
|---|---|---|---|
| **Fox:** FoA, FoB, FoC2 | Well suited | Suited: grass and legumes require fertilizer, lime, and renovation for good stands and long life; slight limitation for wild herbaceous upland plants and hardwood woodland plants; vigorous growth of many species of plants, and food production is dependable; moderate limitation for coniferous woodland plants; some limitation of suitable species. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water developments or excavated ponds; moderate hazard for grain and seed crops because soil is somewhat droughty. |
| **Gilford:** Gf, Gm | Poorly suited: the number, kind, and growth vigor of plant species are limited if soil is in natural condition; limitation is slight if soil is adequately drained. | Suited: soil conditions limit the number of suitable species; dependability of food production of hardwood woodland plants is somewhat limited; growth and suitable species of conifers are limited. | Well suited. |
| **Haskins:** HaA, HaB | Well suited | Suited: suitable for many kinds of adapted species of grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants and hardwood woody plants; fast growth of conifers results in rapid canopy closure. | Suited: suitable for a continous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| **Homer:** Ho | Well suited | Suited: suitable for many kinds of adapted species of grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants and hardwood woody plants; fast growth of conifers results in rapid canopy closure. | Suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| **Linwood:** Lm | Poorly suited: few plant species are suited; growth vigor is limited. | Suited: soil conditions limit the number of plant species important to wildlife. | Well suited. |
| **Maumee:** Mm | Poorly suited: number of suitable plant species is restricted; growth vigor is limited. | Suited: soil conditions limit the number of suitable plant species; dependability of food production of hardwood woody plants is somewhat limited; growth and suitable species of conifers are limited. | Well suited. |
| **Metea:** MnB, MnC | Suited: available moisture is somewhat limited; grass and legumes require maintenance for long-term stands. | Suited: grass and legumes require fertilizer, lime, and renovation for good stands and long life; slight limitation for wild herbaceous upland plants and hardwood woody plants; vigorous growth of many species of plants, and food production is dependable; moderate limitation for coniferous woody plants; some limitation of suitable species. | Unsuited: wetland plants do not survive; construction of shallow water developments or excavated ponds is not feasible. |

TABLE 8.—*Soil limitations for producing habitat for three major kinds of wildlife*—Continued

| Soil series and map symbols | Openland wildlife | Woodland wildlife | Wetland wildlife |
|---|---|---|---|
| Miami: MoB2, MoC2, MoD2, MrC3, MrD3. | Well suited where slopes are 2 to 12 percent. Suited where slopes are 12 to 18 percent: hazard of erosion if soil is used for cultivated crops; slight limitations for herbaceous plants or hardwood woody plants. | Well suited where slopes are 2 to 12 percent. Suited where slopes are 12 to 18 percent: hazard of erosion if soil is used for grain and seed crops; slight limitation for coniferous woody plants because of rapid growth and canopy closure. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water developments or excavated ponds; slight limitation for grain and seed crops. |
| Oshtemo: OsA, OsB, OsC, OsD, OsE. | Well suited where slopes are 0 to 12 percent. Suited where slopes are 12 to 25 percent: hazard of erosion if soil is used for cultivated crops; slight limitation for herbaceous plants or hardwood woody plants. | Suited: grass and legumes require fertilizer, lime, and renovation for good stands and long life; slight limitation for herbaceous upland plants and hardwood woody plants; vigorous growth of many kinds of species of plants, and food production is dependable; moderate limitation for coniferous woodland plants; some limitation of suitable species. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water developments or excavated ponds; moderate hazard for grain and seed crops because soil is somewhat droughty. |
| Pewamo: Pe | Poorly suited in natural condition; well suited if adequately drained: number of suitable plant species is restricted; vigor of growth is limited. | Suited: soil conditions limit the number of suitable plant species; dependability of food production of hardwood woody plants is somewhat limited; growth and suitable species of conifers are limited. | Well suited. |
| Plainfield: PlA, PlB, PlC | Poorly suited: available moisture is limited; number of suitable species is restricted; production of food generally is low, and vigor of growth is limited. | Poorly suited: available moisture is limited; number of suitable species is restricted; production of food generally is low, and vigor of growth is limited; slight limitation for conifers; growth is slow, delaying canopy closure. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water development or excavated ponds; severe limitation for grain and seed crops. |
| Rawson: RaA, RaB, RaC2 | Well suited | Well suited | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water development or excavated ponds; slight limitations for grain and seed crops. |
| Rensselaer: Re | Poorly suited in natural condition; well suited if adequately drained: the number, kind, and vigor of growth of plant species are limited. | Suited: soil conditions limit the number of suitable plant species; dependability of food production of hardwood plants is somewhat limited; growth and species of conifers are limited. | Well suited. |
| Riddles: RsA, RsB, RsC, RsD2, RsE2, RtA, RtB2, RtC2. | Well suited where slopes are 0 to 12 percent. Moderate where slopes are 12 to 25 percent: hazard of erosion if soil is used for grain and seed crops or grasses and legumes; slight limitations for herbaceous plants or hardwood woody plants. | Well suited where slopes are 0 to 12 percent. Moderate where slopes are 12 to 25 percent: hazard of erosion if used for grain and seed crops or grasses and legumes; slight limitation for herbaceous plants or hardwood woody plants; severe limitation for coniferous woody plants because of rapid growth and canopy closure. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow water development or excavated ponds; slight limitation for grain and seed crops. |

TABLE 8.—*Soil limitations for producing habitat for three major kinds of wildlife*—Continued

| Soil series and map symbols | Openland wildlife | Woodland wildlife | Wetland wildlife |
|---|---|---|---|
| Sebewa: Se | Poorly suited in natural condition; well suited if adequately drained: the number, kind, and vigor of growth of plant species are limited. | Suited: soil conditions limit the number of suitable plant species; dependability of food production of hardwood plants is somewhat limited; growth and suitable species of conifers are limited. | Well suited. |
| Shoals: Sh | Well suited | Well suited | Suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| Tawas: Ta, Td | Poorly suited: few plant species are suited; growth vigor is limited. | Suited: soil conditions limit the number of suitable plant species. | Well suited. |
| Tedrow: Te | Poorly suited: number of suitable species is restricted; production of food generally is low, and vigor of growth is limited. | Poorly suited: soil conditions limit the number of plant species important for wildlife food production. | Suited: suitable for production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and water supplies are not dependable. |
| Tyner: TyA, TyB, TyC | Poorly suited: available moisture is limited; number of suitable plant species is restricted; production of food generally is low, and vigor of growth is limited. | Poorly suited: available moisture is limited; number of suitable plant species is restricted; production of food generally is low, and vigor of growth is limited; slight limitation for conifers; growth is slow, delaying canopy closure. | Unsuited: wetland plants do not survive; it is not feasible to construct shallow-water developments or excavated ponds; severe limitations for grain and seed crops. |
| Volinia: Vo | Well suited | Well suited | Unsuited: wetland plants do not survive; it is not feasible to construct shallow-water developments or excavated ponds; moderate hazard for grain and seed crops because soil is somewhat droughty. |
| Wallkill: Wa | Poorly suited: few plant species are suited; vigor of growth is limited. | Suited: soil conditions limit the number of suitable plant species. | Well suited. |
| Washtenaw: Wh | Poorly suited in natural conditions; well suited if adequately drained: number of suitable plant species is restricted; growth vigor is limited. | Suited: soil conditions limit the number of suitable plant species; dependability of food production of hardwood woody plants is somewhat limited; growth and suitable species of conifers are limited. | Well suited. |

TABLE 8.—*Soil limitations for producing habitat for three major kinds of wildlife*—Continued

| Soil series and map symbols | Openland wildlife | Woodland wildlife | Wetland wildlife |
|---|---|---|---|
| Whitaker: Wk | Well suited | Suited: suitable for many kinds of adapted species of grasses and legumes; produces a vigorous growth of many kinds of uncultivated herbaceous upland plants and hardwood woody plants; fast growth of conifers results in rapid canopy closure. | Suited: suitable for continuous production of grain and seed crops; moderate limitations in construction of shallow water impoundments; excavated pond sites are somewhat difficult to locate, and satisfactory water supplies are not dependable. |

Picnic areas, parks, and extensive play areas.—These are areas suitable for heavy foot traffic and are used by people for picknicking in a natural outdoor environment. Properties considered are wetness, hazard of flooding, slope, texture of the surface soil, stoniness, and rockiness. The presence of trees or ponds that may affect the desirability of a site is not considered. Suitability of the soils for supporting vegetation should be considered in the final evaluation.

Playgrounds, athletic fields, and intensive play areas.—These are areas developed for playground and athletic fields to be used for organized games, such as baseball, football, tennis, and badminton. They are subject to heavy foot traffic and generally require a level surface, good drainage, and texture and consistence that give a firm surface. It is assumed that good vegetative cover can be established and maintained on areas where needed.

Bridle paths and nature and hiking trails.—These are areas used for trails, cross-country hiking, bridle paths, and other intensive uses that allow for the movement of people. It is assumed that these areas are used as they naturally occur and that little preparation is necessary for this use. The most desirable soils have good trafficability for people and horses. They are well drained, are nearly level to sloping, and have a stable, loamy surface. They are not subject to erosion or cutting out, and they are free of coarse fragments and stones or rock outcrops. Paths and trails should be on, or nearly on, the contour in sloping areas to help control erosion. Paths and trails on variable slopes enhance interest, but they should not be on slopes of more than 15 percent for long distances.

Golf fairways.—Only properties affecting fairways were considered. Soils used for fairways should be well drained, firm, and free of flooding during periods of use. They also should have good trafficability, contain a minimum amount of coarse fragments or stones, and have gently undulating slopes. They should be able to support a good turf and be well suited for growing many kinds of trees and shrubs. Loamy soils are best, but if coarser textured soils are irrigated, they do just as well. Poorly drained mineral soils have severe limitations, but they may be used for pond sites to provide esthetic value or for storing water for turf maintenance. Sandy soils may be designed for sand traps or used as a source of sand for the greens. Greens, traps, and hazards are manmade, generally from disturbed, transported soil material.

# *Formation and Classification of the Soils*

This section consists of two main parts. The first part tells how the factors of soil formation have affected the development of soils in Elkhart County. The second explains the system of soil classification currently used and places each soil series in some of the categories of that system.

## Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of a soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

### *Parent material*

Parent materials from which the soils in Elkhart County were derived are (1) glacial till, (2) glacial outwash, (3) alluvium, (4) windblown sand, and (5) organic material.

TABLE 9.—*Limitations of soils*

| Soil series and map symbols | Cottages and utility buildings | Tent and camp trailer sites |
|---|---|---|
| Alluvial land: Ad | Severe: subject to flooding | Severe: subject to flooding |
| Am | Severe: subject to flooding | Severe: subject to flooding |
| Aubbeenaubbee: Au | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. |
| Blount: BlA, BlB2 | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet; slow to dry after rains. |
| Borrow pits: Bp. Properties variable. Onsite investigation necessary. | | |
| Brady: Br | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. |
| Brems: Bu | Slight | Moderate: loamy sand surface layer; subject to blowing; unstable material; droughty. |
| Bronson: Bv | Slight | Slight |
| Brookston: Bw | Severe: poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Carlisle: Ca, Cd | Severe: very poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. |
| Chelsea: ChA, ChB, ChC | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. | Severe: droughty; loose sand; difficult to maintain vegetative cover. |
| Crosby: CrA, CrB | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet; slow to dry after rains. |
| Del Rey: De | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet; slow to dry after rains. |
| Dickinson: Dk | Slight | Slight |
| Dowagiac: Do | Slight | Slight |
| Edwards: Ed | Severe: very poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. |

*for recreational facilities*

| Picnic areas, parks, and extensive play areas | Playgrounds, athletic fields, and intensive play areas | Bridle paths and nature and hiking trails | Golf fairways |
|---|---|---|---|
| Moderate: may be flooded one or two times during period of intensive use; well drained and moderately well drained. | Severe: subject to flooding | Moderate: subject to flooding | Moderate: subject to flooding; well drained and moderately well drained. |
| Moderate: subject to flooding | Severe: subject to flooding | Moderate: subject to flooding | Moderate: subject to flooding. |
| Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. |
| Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; slow to dry after rains; sticky when wet. | Moderate: somewhat poorly drained; slow to dry after rains. |
| Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. |
| Moderate: loamy sand surface layer; subject to blowing; droughty. | Moderate: loamy sand surface layer; poor trafficability when dry. | Moderate: loamy sand surface layer; poor trafficability when dry. | Moderate: loamy sand surface layer; subject to blowing; droughty. |
| Slight | Slight | Slight | Slight. |
| Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; wet, slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable. | Severe: very poorly drained; very poor trafficability. | Severe: very poorly drained; very poor trafficability. |
| Severe: droughty; difficult to maintain vegetation; sod easily damaged; subject to soil blowing. | Severe: droughty; difficult to maintain vegetation; subject to soil blowing. | Severe: droughty; poor trafficability when dry. | Severe: droughty; difficult to maintain vegetative cover. |
| Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; sticky when wet. | Moderate: somewhat poorly drained; slow to dry after rains. |
| Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; sticky when wet. | Moderate: somewhat poorly drained; slow to dry after rains. |
| Slight | Slight | Slight | Slight. |
| Slight | Slight | Slight | Slight. |
| Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. | Severe: very poorly drained; very poor trafficability. | Severe: very poorly drained; very poor trafficability. |

TABLE 9.—*Limitations of soils*

| Soil series and map symbols | Cottages and utility buildings | Tent and camp trailer sites |
|---|---|---|
| Fox: FoA, FoB, FoC2 | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. |
| Gilford: Gf, Gm | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. |
| Gravel pit: Gp. Properties variable. Onsite investigation necessary. | | |
| Haskins: HaA, HaB | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet; slow to dry after rains. |
| Homer: Ho | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet. |
| Linwood: Lm | Severe: very poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. |
| Made land: Ma. Properties variable. Onsite investigation necessary. | | |
| Marsh: Mh. Properties variable. Onsite investigation necessary. | | |
| Maumee: Mm | Severe: poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: poorly drained; seasonal water table at depth of 0 to 1 foot. |
| Metea: MnB, MnC | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. |
| Miami: MoB2, MoC2, MoD2, MrC3, MrD3 | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. Severe on slopes of more than 12 percent. | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. Severe on slopes of more than 12 percent. |
| Oshtemo: OsA, OsB, OsC, OsD, OsE | Slight on 0 to 6 percent slopes. Moderate on 2 to 12 percent slopes. Severe on slopes of more than 12 percent. | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. Severe on slopes of more than 12 percent. |
| Pewamo: Pe | Severe: poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot. | Severe: poorly drained; subject to ponding; soft when wet; slow to dry after rains. |
| Plainfield: PlA, PlB, PlC | Slight on 0 to 6 percent slopes. Moderate on 6 to 12 percent slopes. | Severe: droughty; loose sand; difficult to maintain vegetative cover. |

*for recreational facilities*—Continued

| Picnic areas, parks, and extensive play areas | Playgrounds, athletic fields, and intensive play areas | Bridle paths and nature and hiking trails | Golf fairways |
|---|---|---|---|
| Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. | Slight on 0 to 2 percent slopes.<br>Moderate on 2 to 6 percent slopes.<br>Severe on 6 to 12 percent slopes. | Slight | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. |
| Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. |
| Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; sticky when wet. | Moderate: somewhat poorly drained; slow to dry after rains. |
| Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; sticky when wet. | Moderate: somewhat poorly drained; slow to dry after rains. |
| Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material | Severe: very poorly drained; subject to ponding; very poor trafficability. | Severe: very poorly drained; subject to ponding; very poor trafficability. |
| Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. | Severe: very poorly drained; seasonal water table at depth of 0 to 1 foot. |
| Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. | Slight on 0 to 2 percent slopes.<br>Moderate on 2 to 6 percent slopes.<br>Severe on slopes of more than 6 percent. | Slight | Slight. |
| Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on slopes of more than 12 percent. | Slight on 0 to 2 percent slopes.<br>Moderate on 2 to 6 percent slopes.<br>Severe on slopes of more than 6 percent. | Slight on 0 to 12 percent slopes.<br>Moderate on 12 to 18 percent slopes. | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on slopes of more than 12 percent. |
| Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on slopes of more than 12 percent. | Slight on 0 to 2 percent slopes.<br>Moderate on 2 to 6 percent slopes.<br>Severe on slopes of more than 6 percent. | Slight on 0 to 12 percent slopes.<br>Moderate on 12 to 25 percent slopes. | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on slopes of more than 12 percent. |
| Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Severe: droughty; difficult to maintain vegetation; sod easily damaged; subject to soil blowing. | Severe: droughty; difficult to maintain vegetation; subject to soil blowing. | Severe: droughty; poor trafficability when dry. | Severe: droughty; difficult to maintain vegetative cover. |

TABLE 9.—*Limitations of soils*

| Soil series and map symbols | Cottages and utility buildings | Tent and camp trailer sites |
|---|---|---|
| Rawson: RaA, RaB, RaC2 | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. |
| Rensselaer: Re | Severe: poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Riddles: RsA, RsB, RsC, RsD2, RsE2, RtA, RtB2, RtC2. | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on 12 to 25 percent slopes. | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on 12 to 25 percent slopes. |
| Sebewa: Se | Severe: poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Shoals: Sh | Severe: somewhat poorly drained; subject to occasional flooding. | Moderate: somewhat poorly drained; may flood 1 or 2 times during intense use period. |
| Tawas: Ta, Td | Severe: very poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. |
| Tedrow: Te | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet.<br>Severe for basements. | Moderate: somewhat poorly drained; unstable material; droughty. |
| Tyner: TyA, TyB, TyC | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. | Moderate: droughty; somewhat difficult to maintain vegetative cover; slopes. |
| Volinia: Vo | Slight | Slight |
| Wallkill: Wa | Severe: very poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot; unstable material. | Severe: very poorly drained; subject to ponding; poor trafficability; slow to dry after rains. |
| Washtenaw: Wh | Severe: poorly drained; subject to ponding; seasonal water table at depth of 0 to 1 foot. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Whitaker: Wk | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet.<br>Severe for basements. | Moderate: somewhat poorly drained; seasonal water table at depth of 1 to 3 feet; slow to dry after rains. |

*for recreational facilities*—Continued

| Picnic areas, parks, and extensive play areas | Playgrounds, athletic fields, and intensive play areas | Bridle paths and nature and hiking trails | Golf fairways |
|---|---|---|---|
| Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. | Slight on 0 to 2 percent slopes.<br>Moderate on 2 to 6 percent slopes.<br>Severe on slopes of more than 6 percent. | Slight | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes. |
| Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on 12 to 25 percent slopes. | Slight on 0 to 2 percent slopes.<br>Moderate on 2 to 6 percent slopes.<br>Severe on 6 to 25 percent slopes. | Slight on 0 to 12 percent slopes.<br>Moderate on 12 to 25 percent slopes. | Slight on 0 to 6 percent slopes.<br>Moderate on 6 to 12 percent slopes.<br>Severe on 12 to 25 percent slopes. |
| Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Moderate: somewhat poorly drained; may flood 1 or 2 times during intense use period. | Moderate: somewhat poorly drained; may flood 1 or 2 times during intense use period. | Moderate: somewhat poorly drained; subject to occasional flooding. | Moderate: somewhat poorly drained; subject to occasional flooding. |
| Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. | Severe: very poorly drained; subject to ponding; very poor trafficability; unstable material. | Severe: very poorly drained; very poor trafficability. | Severe: very poorly drained; very poor trafficability. |
| Moderate: somewhat poorly drained; sod easily damaged; droughty. | Moderate: somewhat poorly drained; sod easily damaged; droughty. | Moderate: somewhat poorly drained; poor trafficability when dry. | Moderate: somewhat poorly drained; droughty. |
| Moderate: droughty; somewhat difficult to maintain vegetative cover; slopes. | Moderate: somewhat excessively drained; droughty; poor trafficability when dry.<br>Severe on slopes of more than 6 percent. | Moderate: somewhat excessively drained; droughty; poor trafficability when dry. | Moderate: somewhat excessively drained; droughty; somewhat difficult to maintain vegetative cover. |
| Slight | Slight | Slight | Slight. |
| Severe: very poorly drained; subject to ponding; poor trafficability; slow to dry after rains. | Severe: very poorly drained; subject to ponding; poor trafficability; slow to dry after rains. | Severe: very poorly drained; subject to ponding; poor trafficability; slow to dry after rains. | Severe: very poorly drained; subject to ponding; slow to dry after rains. |
| Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. | Severe: poorly drained; subject to ponding; slow to dry after rains. |
| Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; slow to dry after rains. | Moderate: somewhat poorly drained; sticky when wet. | Moderate: somewhat poorly drained; slow to dry after rains. |

Glaciation has been important in the development of the soil in Elkhart County. As little as 15,000 years ago, this area was covered by thick glacial ice. The glacial drift varies in thickness, but it is about 300 feet thick in most places. The county is occupied by four main glacial moraines. The New Paris moraine covers a considerable area around New Paris and Foraker and merges with a sandy plain at its northern end. The Topeka moraine begins near Goshen and extends intermittently in a southeasterly direction past Millersburg. The Middlebury moraine begins near Bristol and extends past Middlebury. The LaGrange moraine crosses the extreme northeastern corner of the county.

The soils on uplands of the county formed mainly in loam to light clay loam glacial till, except for an area immediately north of Millersburg. The glacial till is nonsorted material deposited by ice and consists of particles of all sizes, from clay and silt to sand and gravel, with varying amounts of stones and boulders. Riddles and Miami soils are nearly level to moderately steep on ridge tops, knolls, and breaks of the glacial till plain. Crosby soils are nearly level and gently sloping in areas between depressions and small drainageways of the glacial till plain, and Brookston soils are level and in depressional areas on flats of the glacial till plain. The soils in the area north of Millersburg formed in clay loam or silty clay loam glacial till. Blount soils are level and gently sloping in areas between depressions on flats of the glacial till plain, and Pewamo soils are level in depressions on flats of the glacial till plain.

The outwash parent materials in which some soils formed were deposited by large volumes of water that originated from the melting glacial ice. These soils formed in loamy outwash over loose sand and gravel. Hills and ridges of sand and gravel are common west of Middlebury and south of Bristol. Oshtemo soils commonly occupy these areas. A broad, sandy outwash plain is located north of Elkhart and Bristol, and dune topography is evident. These sandy materials have been reworked by the wind in some areas. Plainfield and Tyner soils are common in the sandy areas.

Broad outwash plains occur along the St. Joseph, Elkhart, and Little Elkhart Rivers and along Turkey and Solomon Creeks. The soils in these areas also formed from loamy outwash material over loose sand and gravel. Fox and Oshtemo are common soils in these areas.

On the present-day flood plains, such young soils as those in the Shoals series and Alluvial land, mixed, and Alluvial land, loamy, are forming. These areas receive fresh deposits of alluvium during flood stage.

### *Climate*

Elkhart County has a temperate, humid, continental climate that is essentially uniform over the entire county. The mean annual precipitation is about 34 inches. It is fairly well distributed throughout the year; only slightly greater amounts occur during spring. The monthly mean temperature is about 49° F., and there are wide variations in temperature from summer to winter. More information about the climate is given in the section "General Nature of the County."

Climate influences the soils in the county largely through moderately heavy amounts of precipitation. The rain and melting snow slowly seep down through the soil. This percolating water causes physical and chemical changes; physically, it removes the clay particles from the surface layer and translocates them to the subsoil. This accumulation of clay in the subsoil is characteristic of most soils in the county. Chemically, the percolating water dissolves minerals and moves them through the soil. As a result of this leaching, the free calcium carbonate has been removed from the surface layer and subsoil of most of the soils. Consequently, the soils are medium acid to strongly acid in the surface layer unless they have been limed.

The soils are frozen for 3 to 4 months in winter. During this period, the soil-forming factors are largely dormant, except for some freezing and thawing action.

Climate indirectly influences the formation of soil by stimulating the growth of living organisms, especially vegetation. The climate of Elkhart County is conducive to growth of hardwood forest, which directly influences the formation of soils classified as Alfisols.

### *Plant and animal life*

Plants have been the principal living organisms that influenced the formation of the soils in Elkhart County, but micro-organisms, earthworms, and other forms of life have contributed to their morphology. Bacteria and fungi are micro-organisms that affect the soil. They cause plants to decompose into humus and to be incorporated into the soil. Higher plants, such as trees, legumes, and grasses, use plant nutrients from the lower layers of the soils and return most of the nutrients to the upper layers in the form of leaf and grass litter.

The native vegetation of the county consisted mainly of deciduous hardwood forest, prairie grasses, and water-tolerant grasses and sedges. In addition, there were a few water-tolerant trees.

Soils are affected greatly by the type of vegetation under which they formed. Grasses have a large, fine, fibrous root system and, together with the top growth, add large amounts of organic matter to the soil each year. Therefore, soils formed under grasses have a thick, black to dark-brown surface layer. In contrast, soils formed under forest have a thin, light-colored surface layer because the organic matter was derived principally from leaves deposited mostly on the surface of the soil.

Organisms are important in decomposing the large amount of organic matter that accumulates on the surface each year. The disintegration, decomposition, and incorporation of organic matter into the soil are largely affected by the organisms that live in the soil. The species of organisms in the soil vary with such factors as climate, physical and chemical properties of the soil, and type of vegetation. These organisms influence the type of humus layer, soil profile development, and physio-chemical properties of the soil. An intimate relationship exists between life in the soil and the vegetative cover that the land supports. Consequently, organisms, both plants and animals, have played an important part and contribute to the differences among the soils in the county.

### *Relief*

Variations in the land surface influence the formation of soil by affecting the degree of drainage and erosion. Restricted internal drainage has been the most influential factor. A high water table has restricted the drainage of

soils in depressions and in many of the nearly level areas. Intensive use of these soils is not possible, unless the water table is lowered by establishing a drainage system.

The effect of drainage on the morphology of soil is evident when a comparison is made of soils that formed in similar parent material but under different drainage conditions. For example, the poorly drained Brookston soils formed in loam till in depressional areas and have a thick, very dark gray surface layer and a grayish subsoil mottled with yellowish brown. The Miami soils also formed in loam till, but are gently sloping to steep. They have a dark-brown and brown surface layer and are yellowish brown in the upper part of their subsoil.

Surface drainage has less effect on soil formation than internal drainage. Steep soils that formed in loam till are not so strongly developed as nearly level to moderately sloping soils that formed in the same kind of till. This difference in soil development is the result of (1) rapid normal erosion, (2) the reduced percolation of water through the soil, and (3) lack of sufficient water in the soil for vigorous growth of plants that aid in soil formation. The degree of soil development taking place at a given time in a given parent material and under the same type of vegetation depends largely on the amount of water passing through the soil.

### *Time*

Time determines, to a great extent, the age of a soil or its degree of soil profile development. The influence of time, however, may be modified by erosion, deposition of materials, topography, and kind of parent material. Therefore, for a soil to register the full impact of time, the parent material should remain free from disturbances. Such situations are not common. Surface erosion and mass movement of superficial material cause some removal and disturbance even where slopes are gentle. Soils that formed in recent alluvial or windblown materials or on steep slopes where erosion has been more active may show very little development and so can be thought of as young soils. A mature soil has well-defined, genetically related horizons because the rate of soil formation has exceeded the rate of geologic erosion. The Miami soils are mature. The Shoals soils formed in recent water-laid material, show very little horizon development, and are therefore immature soils.

## Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas, such as countries or continents.

The system of classifying soils currently used by the National Cooperative Soil Survey was developed in the early 60's (*3*) and was adopted in 1965 (*5*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 10 shows the classification of each soil series of Elkhart County by family, subgroup, and order, according to the current system.

ORDER.—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. The two exceptions, Entisols and Histosols, occur in many different kinds of climate. Table 10 shows that the five soil orders in Elkhart County are Alfisols, Entisols, Histosols, Inceptisols, and Mollisols.

Alfisols are mineral soils that contain horizons of clay accumulation. Unlike the Mollisols, they lack a thick, dark-colored surface layer that contains colloids dominated by bivalent cations, but the base status of the lower horizons is not extremely low.

Entisols are light-colored soils that do not have natural genetic horizons or that have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect soil mixing caused by shrinking and swelling.

Histosols are dark-colored soils that formed from the partial decomposition of plant remains.

Inceptisols are young soils. They have one or more diagnostic horizons that are thought to have formed quickly and that do not represent significant illuviation or eluviation or extreme weathering.

Mollisols formed under grass and have a thick, dark-colored surface horizon that contains colloids dominated by bivalent cations. The soil material in these soils has not been mixed by shrinking and swelling.

SUBORDER.—Each order is subdivided into suborders, primarily on the basis of the characteristics that seemed to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separation are those in which clay, iron, or humus has accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 10, because it is the last word in the name of the subgroup.

TABLE 10.—*Soil series classified according to the current system of classification*

| Series | Family | Subgroup | Order |
|---|---|---|---|
| Aubbeenaubbee | Fine-loamy, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Blount | Fine, illitic, mesic | Aeric Ochraqualfs | Alfisols. |
| Brady | Coarse-loamy, mixed, mesic | Aquollic Hapludalfs | Alfisols. |
| Brems | Sandy, mixed, mesic | Aquic Udipsamments | Entisols. |
| Bronson | Coarse-loamy, mixed, mesic | Aquic Hapludalfs | Alfisols. |
| Brookston | Fine-loamy, mixed, noncalcareous, mesic | Typic Argiaquolls | Mollisols. |
| Carlisle | Euic, mesic | Typic Medisaprist | Histosols. |
| Chelsea | Sandy, mixed, mesic | Alfic Udipsamments | Entisols. |
| Crosby | Fine-loamy, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Del Rey | Fine, illitic, mesic | Aeric Ochraqualfs | Alfisols. |
| Dickinson | Coarse-loamy, mixed, mesic | Typic Hapludolls | Mollisols. |
| Dowagiac | Fine-loamy over sandy or sandy-skeletal, mixed, mesic | Mollic Hapludalfs | Alfisols. |
| Edwards | Marl, euic, mesic | Limnic Medisaprist | Histosols. |
| Fox | Fine-loamy over sandy or sandy-skeletal, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Gilford | Coarse-loamy, mixed, noncalcareous, mesic | Typic Haplaquolls | Mollisols. |
| Haskins | Fine-loamy, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Homer | Fine-loamy over sandy or sandy-skeletal, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Linwood | Loamy, euic, mesic | Terric Medisaprists | Histosols. |
| Maumee | Sandy, mixed, noncalcareous, mesic | Typic Haplaquolls | Mollisols. |
| Metea | Coarse-loamy, mixed, mesic | Arenic Hapludalfs | Alfisols. |
| Miami | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Oshtemo | Coarse-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Pewamo | Fine, mixed, noncalcareous, mesic | Typic Argiaquolls | Mollisols. |
| Plainfield | Sandy, mixed, mesic | Typic Udipsamments | Entisols. |
| Rawson | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Rensselaer | Fine-loamy, mixed, noncalcareous, mesic | Typic Argiaquolls | Mollisols. |
| Riddles | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Sebewa | Fine-loamy over sandy or sandy-skeletal, mixed, noncalcareous, mesic. | Typic Argiaquolls | Mollisols. |
| Shoals | Fine-loamy, mixed, nonacid, mesic | Aeric Fluventic Haplaquepts | Inceptisols. |
| Tawas | Sandy, euic | Terric Borosaprists | Histosols. |
| Tedrow | Sandy, mixed, mesic | Aquic Udipsamments | Entisols. |
| Tyner | Sandy, mixed, mesic | Typic Udipsamments | Entisols. |
| Volinia | Fine-loamy over sandy or sandy-skeletal, mixed, mesic | Typic Argiudolls | Mollisols. |
| Wallkill | Fine-loamy, mixed, nonacid, mesic | Thapto Histic Haplaquepts | Inceptisols. |
| Washtenaw | Fine-loamy, mixed, nonacid, mesic | Typic Haplaquents | Entisols. |
| Whitaker | Fine-loamy, mixed, mesic | Aeric Ochraqualfs | Alfisols. |

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group.

FAMILY.—Families are established within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

# *General Nature of the County*

This section discusses the climate, drainage, and farming in Elkhart County. The statistics on farming are from the 1959 and the 1964 United States Census of Agriculture.

The Miami and Pottawatomie Indians were early inhabitants of Elkhart County. The first permanent white settlers came from Ohio, Pennsylvania, and the New England States in the fall of 1828. In 1830 the county was organized.

## Climate [6]

Elkhart County has an invigorating climate, and four well-defined seasons of the year, because of its location in the middle latitudes and in the interior of a continent away from the moderating effects of the oceans. Air of both tropical and polar origin brings frequent changes in temperature and humidity and well-distributed rainfall. Low-pressure centers from the west cross the plains and move up the Ohio River Valley and the St. Lawrence River Valley to the Atlantic. Most rainfall comes from these storms. Afternoon thunderstorms are the primary source of summer rainfall; they average about 45 a year. About one thunderstorm a year occurs during the winter months. Severe storms are rare, but 22 tornadoes were reported in the county in the 50-year period from 1916 to 1966.

Temperature and precipitation data for the county are given in table 11. Probable dates for the last freezing

[6] By LAWRENCE A. SCHAAL, climatologist for Indiana, National Weather Service, U.S. Department of Commerce.

temperature in spring and the first freezing temperature in fall are given in table 12.

Temperatures in July, the warmest month of the year, reach 90° F. or higher on an average of eight days a year. In an average winter season, there are seven days with temperatures below zero. January is usually the coldest month of the year.

Precipitation is often greatest late in spring and early in summer. The winter months average a little less than 2 inches, and the spring months, about 3.3 inches. Days having 0.10 inch or more of rain average 8 a month in April and May, 7 a month in June and July, and 4 a month during winter. Droughts are infrequent and affect farming only occasionally.

Snowfall has occurred as early as October and as late as May. The largest amount of snow comes in February. The greatest recorded snowfall on any one day was 10.3 inches on February 25, 1961. The greatest monthly total occurred in February 1950, when a total of 16.6 inches was recorded. The average yearly snowfall is 25.9 inches. Many severe cold periods are preceded by snow, and this helps protect over-wintering crops from extreme temperatures.

On an average summer day, relative humidity varies from the 40's in the afternoon to 90 percent or higher just before dawn. Relative humidity rises and falls much as temperature does during a 24-hour period, but the highest relative humidity usually occurs with the minimum temperature and the lowest humidity with the maximum temperature. In winter the most probable range of relative humidity is from the 60's to the 90's. Southerly winds bring higher humidity than northerly winds.

TABLE 11.—*Temperature and precipitation*

[All data from records at Goshen]

| Month | Temperature | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Average monthly maximum | Average monthly minimum | Average monthly total | One year in 10 will have— | | Days with snow cover 1 inch or more | Average depth of snow on days with snow cover of 1 inch or more |
| | | | | | | Less than— | More than— | | |
| | °F. | °F. | °F. | °F. | Inches | Inches | Inches | Number | Inches |
| January | 33 | 17 | 51 | −5 | 2.0 | 0.9 | 3.0 | 12 | 3 |
| February | 36 | 19 | 54 | −3 | 1.9 | .6 | 3.7 | 9 | 3 |
| March | 46 | 27 | 68 | 6 | 2.6 | 1.4 | 3.7 | 3 | 2 |
| April | 59 | 37 | 79 | 22 | 3.7 | 1.8 | 5.6 | [1] | 6 |
| May | 71 | 47 | 86 | 30 | 3.6 | 1.7 | 5.0 | 0 | 0 |
| June | 81 | 57 | 93 | 42 | 3.8 | 2.3 | 5.7 | 0 | 0 |
| July | 85 | 61 | 96 | 48 | 3.8 | 1.7 | 7.8 | 0 | 0 |
| August | 84 | 60 | 94 | 45 | 3.4 | 1.4 | 6.5 | 0 | 0 |
| September | 76 | 52 | 91 | 35 | 2.8 | 1.0 | 4.8 | 0 | 0 |
| October | 66 | 42 | 82 | 25 | 2.8 | .8 | 5.2 | 1 | 1 |
| November | 49 | 31 | 68 | 13 | 2.3 | 1.1 | 3.4 | 2 | 3 |
| December | 36 | 20 | 56 | −1 | 1.7 | .6 | 3.1 | 1 | 3 |
| Year | 60 | 39 | [2] 98 | [3] −10 | 34.4 | 26.3 | 40.4 | 28 | 3 |

[1] Less than one-half day.
[2] Average annual maximum.
[3] Average annual minimum.

TABLE 12.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Goshen]

| 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: | | | | | |
| 1 year in 10 later than | March 28 | April 10 | April 25 | May 10 | May 23 |
| 2 years in 10 later than | March 23 | April 5 | April 20 | May 6 | May 19 |
| 5 years in 10 later than | March 13 | March 24 | April 8 | April 27 | May 11 |
| Fall: | | | | | |
| 1 year in 10 earlier than | November 11 | October 29 | October 22 | October 6 | September 24 |
| 2 years in 10 earlier than | November 17 | November 4 | October 27 | October 11 | September 28 |
| 5 years in 10 earlier than | November 30 | November 16 | November 7 | October 20 | October 7 |

Prevailing winds are from the southwest most of the time, but westerly and northwesterly winds are predominant in winter. At a height of 20 feet above the ground, the average wind velocity is about 11 miles per hour in spring and nearly 8 miles per hour late in summer.

The most nearly ideal weather for outdoor activities comes in fall, when temperatures are usually in the comfortable range, showers are least frequent, and the amount of sunshine averages about 70 percent of the maximum possible.

## Drainage [7]

Elkhart County is mainly in the St. Joseph drainage basin, the mouth of which is at St. Joseph, Michigan. A very small area in the southwestern part of the county is in the Kankakee River drainage basin, which drains to the Mississippi River.

The 573-square-mile area drained by the Elkhart River, upstream from Goshen, includes about 120 square miles in southeastern Elkhart County. Many abandoned meanders occur in the Elkhart River Valley. Solomon Creek is a small stream that has a wide valley. Haphazard drainage patterns mark moraine areas in the county, and local watershed divides occur near the crests of the moraines.

There are several lakes in the county, and most of them are shallow. Gaging stations are located on Heaton, Hunter, Indiana, Simonton, and Wolf Lakes. Stream gaging stations are located on the St. Joseph River at Elkhart, on Christiana Creek at Elkhart, and on the Elkhart River at Goshen.

## Farming

In 1959 and 1964, Elkhart County ranked first among Indiana counties in dairy products sold and second in number of farms, number of dairy farms, number of poultry farms, value of farm products sold, value of livestock products sold, value of poultry products sold, and farm sales of $40,000 or more.

In 1959, there were 299,520 acres in farms and 2,166 farms, but by 1964 the number of farms had dropped to 2,095. The average size of farm was 108.5 acres in 1959 and 110.7 acres in 1964.

Of the 2,095 farms in the county in 1964, there were 677 miscellaneous and unclassified farms, 423 dairy farms, 321 cash-grain farms, 299 livestock farms, 204 poultry farms, 157 general farms, 8 fruit and nut farms, and 6 vegetable farms.

Between 1959 and 1964, the acreage of harvested cropland decreased from 150,121 acres to 147,405 acres and the cropland used only for pasture decreased from 21,119 to 18,576 acres.

Corn occupied the largest acreage of any crop in the county in 1959 and in 1964, but wheat and soybeans also were important, as were hay and pasture. Poultry and dairy are the most important livestock enterprises in Elkhart County.

[7] By DONALD SMITH, district conservationist, Soil Conservation Service.

# Literature Cited


(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus. Washington, D.C.

(2) OUTDOOR RECREATION RESOURCES REVIEW COMMISSION.
1962. OUTDOOR RECREATION FOR AMERICA. 245 pp., illus., Washington, D.C.

(3) SIMONSON, ROY W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Sci. 137: 1027-1034.

(4) UNITED STATES DEPARTMENT OF AGRICULTURE.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook 18, 503 pp., illus. [Supplement issued in May 1962]

(5) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. Soil Survey Staff, Soil Conservation Service, 265 pp., illus. [Supplements issued in March 1967 and September 1968]

(6) ———
1961. LAND CAPABILITY CLASSIFICATION. U.S. Dept. Agr. Handbook 210, 21 pp.

(7) UNITED STATES DEPARTMENT OF DEFENSE.
1968. UNIFIED SOIL CLASSIFICATION SYSTEM FOR ROADS, AIRFIELDS, EMBANKMENTS AND FOUNDATIONS. MIL-STD-619B, 30 pp., illus.


# Glossary

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

**Available water capacity** (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard and brittle; little affected by moistening.

**Cover Crop.** A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Drainage, natural.** Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil. Opposed to al-

tered 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 soil drainage are recognized.

*Excessively drained* soils are commonly very porous and rapidly permeable and have a 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 are commonly of intermediate texture.

*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, and some soils commonly have mottlings below a depth of 6 to 16 inches, in the lower A horizon and in the B and C horizons.

*Poorly drained* soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in many 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.

**Drift** (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift material deposited by glaciers and by streams and lakes associated with them.

**Effluent.** The outflow of water from a subterranean storage space. The term is also used in reference to gases and other liquids.

**Eluviation.** The movement of material from one place to another within the soil, in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial.

**Genesis, soil.** The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age or landform.

**Green manure crop.** A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

**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 therefore is 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 to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. 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. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the 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 an A or B horizon.

**Illuviation.** The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils have moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.

**Immature soil.** A soil that lacks clearly defined horizons because the soil-forming forces have acted on the parent material for only a relatively short time since it was deposited or exposed.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material. Contrasted with percolation, which is movement of water through soil layers or material.

**Internal soil drainage.** The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

**Lacustrine deposit** (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

**Leaching.** The removal of soluble materials from soils or other material by percolating water.

**Marl.** An earthy, unconsolidated deposit formed in fresh-water lakes that consists chiefly of calcium carbonate mixed with various amounts of clay or other impurities.

**Mature soil.** Any soil with well-developed soil horizons that has characteristics produced by the natural processes of soil formation and in near equilibrium with its present environment.

**Mineral soil.** Soil composed mainly of inorganic (mineral) material and low in content of organic material. Its bulk density is greater than that of organic soil.

**Moraine** (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are *terminal, lateral, medial,* and *ground.*

**Mottled.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 milimeters (about 0.6 inch) in diameter along the greatest dimension.

**Muck.** An organic soil that consists of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

**Organic soil.** A general term applied to a soil or to a soil horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers. In chemistry, organic refers to the compounds of carbon.

**Percolation.** The downward movement of water through the soil.

**Permeability.** The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

**Plow layer.** The soil ordinarily moved in tillage; equivalent to surface soil.

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction. In words, the degree of acidity or alkalinity are expressed thus:

| | *pH* | | *pH* |
|---|---|---|---|
| Extremely acid | Below 4.5 | Neutral | 6.6 to 7.3 |
| Very strongly acid | 4.5 to 5.0 | Mildly alkaline | 7.4 to 7.8 |
| Strongly acid | 5.1 to 5.5 | Moderately alkaline | 7.9 to 8.4 |
| Medium acid | 5.6 to 6.0 | Strongly alkaline | 8.5 to 9.0 |
| Slightly acid | 6.1 to 6.5 | Very strongly alkaline | 9.1 and higher |

**Runoff** (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking

in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** Individual rock or mineral fragments in soils that have diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent 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.

**Solum.** 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. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

**Structure, soil.** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** Technically, the part of the soil below the solum.

**Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

**Terrace** (geological). An old alluvial plain, ordinarily flat or undulating, that borders a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of 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 specifiying "coarse," "fine," or "very fine."

**Tilth, soil.** The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Upland** (geology). Land that consists of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

**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.

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## GUIDE TO MAPPING UNITS

For full information about a mapping unit, read both the description of the mapping unit and that of the soil series to which it belongs. In referring to a capability unit, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:



| Map symbol | Mapping unit | Page | Capability unit: Symbol | Capability unit: Page | Shrub and tree group: Number |
|---|---|---|---|---|---|
| Ad | Alluvial land, loamy | 7 | I-2 | 34 | 3 |
| Am | Alluvial land, mixed | 7 | Vw-2 | 41 | 2 |
| Au | Aubbeenaubbee sandy loam | 9 | IIw-11 | 38 | 2 |
| BlA | Blount silt loam, 0 to 2 percent slopes | 9 | IIw-2 | 37 | 2 |
| BlB2 | Blount silt loam, 2 to 4 percent slopes, eroded | 9 | IIe-12 | 36 | 2 |
| Bp | Borrow pits | 10 | VIIe-3 | 42 | -- |
| Br | Brady sandy loam | 10 | IIIw-4 | 39 | 2 |
| Bu | Brems loamy fine sand | 11 | IVs-1 | 41 | 4 |
| Bv | Bronson sandy loam | 11 | IIIs-2 | 39 | 4 |
| Bw | Brookston silt loam | 12 | IIw-1 | 36 | 1 |
| Ca | Carlisle muck | 13 | Vw-2 | 41 | 1 |
| Cd | Carlisle muck, drained | 13 | IIIw-8 | 39 | 1 |
| ChA | Chelsea fine sand, 0 to 2 percent slopes | 13 | IIIs-1 | 38 | 4 |
| ChB | Chelsea fine sand, 2 to 6 percent slopes | 13 | IIIs-1 | 38 | 4 |
| ChC | Chelsea fine sand, 6 to 12 percent slopes | 13 | IIIe-12 | 38 | 4 |
| CrA | Crosby loam, 0 to 2 percent slopes | 14 | IIw-2 | 37 | 2 |
| CrB | Crosby loam, 2 to 4 percent slopes | 14 | IIe-12 | 36 | 2 |
| De | Del Rey silt loam | 15 | IIw-2 | 37 | 2 |
| Dk | Dickinson sandy loam | 15 | IIIs-2 | 39 | 4 |
| Do | Dowagiac loam | 16 | IIs-2 | 36 | 3 |
| Ed | Edwards muck | 16 | IVw-3 | 41 | 1 |
| FcA | Fox sandy loam, 0 to 2 percent slopes | 17 | IIIs-2 | 39 | 3 |
| FoB | Fox sandy loam, 2 to 6 percent slopes | 17 | IIIe-13 | 38 | 3 |
| FoC2 | Fox sandy loam, 6 to 12 percent slopes, eroded | 17 | IIIe-13 | 38 | 3 |
| Gf | Gilford sandy loam | 18 | IIw-4 | 37 | 1 |
| Gm | Gilford mucky sandy loam | 18 | IIw-4 | 37 | 1 |
| Gp | Gravel pit | 18 | VIIe-3 | 42 | -- |
| HaA | Haskins loam, 0 to 2 percent slopes | 19 | IIw-2 | 37 | 2 |
| HaB | Haskins loam, 2 to 4 percent slopes | 19 | IIe-12 | 36 | 2 |
| Ho | Homer loam | 19 | IIw-6 | 37 | 2 |
| Lm | Linwood muck | 20 | IIw-10 | 37 | 1 |
| Ma | Made land | 20 | VIIe-3 | 42 | -- |
| Mh | Marsh | 20 | VIIIw-1 | 43 | -- |
| Mm | Maumee loamy fine sand | 21 | IIIw-1 | 39 | 1 |
| MnB | Metea loamy fine sand, 0 to 6 percent slopes | 21 | IIIs-2 | 39 | 3 |
| MnC | Metea loamy fine sand, 6 to 12 percent slopes | 21 | IIIe-13 | 38 | 3 |
| MoB2 | Miami loam, 2 to 6 percent slopes, eroded | 22 | IIe-1 | 35 | 3 |
| MoC2 | Miami loam, 6 to 12 percent slopes, eroded | 22 | IIIe-1 | 38 | 3 |
| MoD2 | Miami loam, 12 to 18 percent slopes, eroded | 22 | IVe-1 | 40 | 3 |
| MrC3 | Miami clay loam, 6 to 12 percent slopes, severely eroded | 22 | IVe-1 | 40 | 3 |
| MrD3 | Miami clay loam, 12 to 18 percent slopes, severely eroded | 22 | VIe-1 | 41 | 3 |
| OsA | Oshtemo loamy sand, 0 to 2 percent slopes | 23 | IIIs-2 | 39 | 4 |
| OsB | Oshtemo loamy sand, 2 to 6 percent slopes | 23 | IIIe-13 | 38 | 4 |
| OsC | Oshtemo loamy sand, 6 to 12 percent slopes | 23 | IIIe-13 | 38 | 4 |
| OsD | Oshtemo loamy sand, 12 to 18 percent slopes | 23 | IVe-13 | 40 | 4 |
| OsE | Oshtemo loamy sand, 18 to 25 percent slopes | 23 | VIe-3 | 42 | 4 |
| Pe | Pewamo silty clay loam | 24 | IIw-1 | 36 | 1 |
| PlA | Plainfield fine sand, 0 to 2 percent slopes | 25 | IVs-1 | 41 | 4 |
| PlB | Plainfield fine sand, 2 to 6 percent slopes | 25 | IVs-1 | 41 | 4 |
| PlC | Plainfield fine sand, 6 to 12 percent slopes | 26 | VIs-1 | 42 | 4 |
| RaA | Rawson loam, 0 to 2 percent slopes | 26 | I-1 | 34 | 3 |
| RaB | Rawson loam, 2 to 6 percent slopes | 26 | IIe-1 | 35 | 3 |
| RaC2 | Rawson loam, 6 to 12 percent slopes, eroded | 26 | IIIe-1 | 38 | 3 |
| Re | Rensselaer silt loam | 27 | IIw-1 | 36 | 1 |
| RsA | Riddles sandy loam, 0 to 2 percent slopes | 27 | IIs-3 | 36 | 3 |
| RsB | Riddles sandy loam, 2 to 6 percent slopes | 28 | IIe-5 | 35 | 3 |
| RsC | Riddles sandy loam, 6 to 12 percent slopes | 28 | IIIe-5 | 38 | 3 |
| RsD2 | Riddles sandy loam, 12 to 18 percent slopes, eroded | 28 | IVe-5 | 40 | 3 |
| RsE2 | Riddles sandy loam, 18 to 25 percent slopes, eroded | 28 | VIe-1 | 41 | 3 |
| RtA | Riddles loam, 0 to 2 percent slopes | 28 | I-1 | 34 | 3 |
| RtB2 | Riddles loam, 2 to 6 percent slopes, eroded | 28 | IIe-1 | 35 | 3 |
| RtC2 | Riddles loam, 6 to 12 percent slopes, eroded | 28 | IIIe-1 | 38 | 3 |
| Se | Sebewa loam | 29 | IIw-4 | 37 | 1 |
| Sh | Shoals loam | 29 | IIw-7 | 37 | 2 |
| Ta | Tawas muck | 30 | Vw-2 | 41 | 1 |
| Td | Tawas muck, drained | 30 | IVw-3 | 41 | 1 |
| Te | Tedrow loamy sand | 30 | IVw-4 | 41 | 2 |
| TyA | Tyner loamy sand, 0 to 2 percent slopes | 31 | IIIs-1 | 38 | 4 |
| TyB | Tyner loamy sand, 2 to 6 percent slopes | 31 | IIIs-1 | 38 | 4 |
| TyC | Tyner loamy sand, 6 to 12 percent slopes | 31 | IIIe-12 | 38 | 4 |
| Vo | Volinia loam | 31 | IIs-2 | 36 | 3 |
| Wa | Wallkill silt loam | 32 | IIw-7 | 37 | 1 |
| Wh | Washtenaw silt loam | 32 | IIw-1 | 36 | 1 |
| Wk | Whitaker loam | 33 | IIw-2 | 37 | 2 |

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