SOIL SURVEY

Ionia County Michigan

Issued December, 1967

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
MICHIGAN AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1952–1957. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1957. This survey was made cooperatively by the Soil Conservation Service and the Michigan Agricultural Experiment Station; it is part of the technical assistance furnished to the Ionia County Soil Conservation District.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the section that describes the soils and in the section that discusses management of the soils for various kinds of crops.

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

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

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

Students, teachers, and others can find information about soils and their management in various parts of the text, according to their particular interest.

Newcomers in Ionia 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."

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NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued December 1967

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF IONIA COUNTY, MICHIGAN

BY GEORGE THRELKELD AND STANLEY ALFRED, SOIL CONSERVATION SERVICE, U.S. DEPARTMENT OF AGRICULTURE

FIELDWORK BY CARL EBY, LYNN KANNENBERG, WARREN STUDLEY, AND W. A. VAN ECK, MICHIGAN AGRICULTURAL EXPERIMENT STATION, AND ROBERT JOHNSON, RICHARD LARSON, AND KARL E. PREGITZER, SOIL CONSERVATION SERVICE, U.S. DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH MICHIGAN AGRICULTURAL EXPERIMENT STATION

IONIA COUNTY is in the west-central part of the lower peninsula of Michigan (fig. 1). Ionia, the county seat, is near the center of the county, on the Grand River. The area of the county is 575 square miles, or 368,000 acres. About 365,405 acres was surveyed. Much of the area of the county is suited to cultivation, and most of the area surveyed is in farms.

The most conspicuous physical feature of the county is a trench that extends from a point near Matherton, on the east side, southwest and west to a point just west of Saranac. This trench was not cut by the Grand River but was formed by the old glacial connector between glacial Lake Saginaw and glacial Lake Chicago. The land north of the trench was then an island.

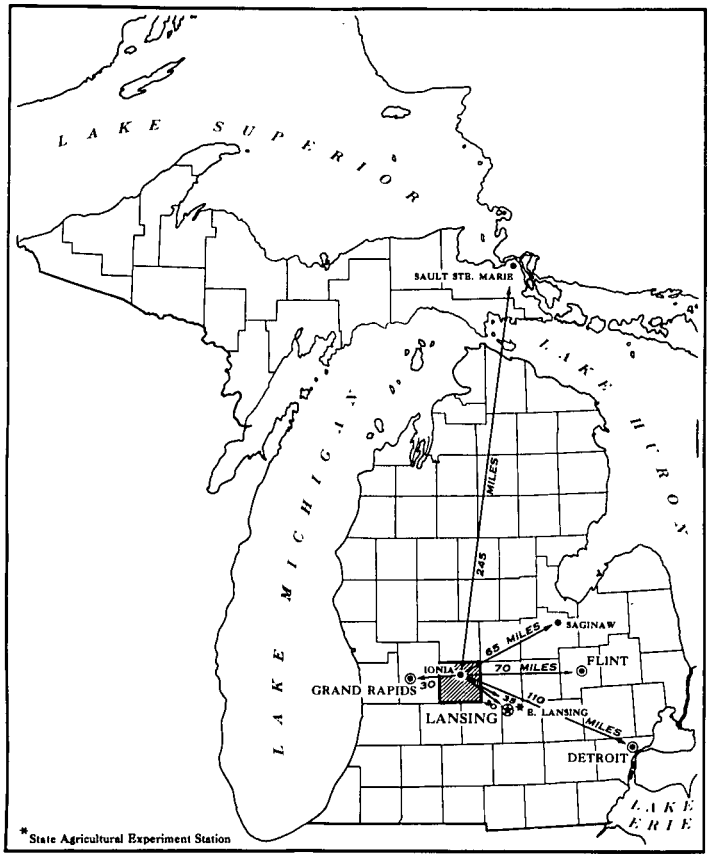

Figure 1.—Location of Ionia County in Michigan.

North of the trench the pattern of soils is complex, drainage is youthful, and lakes and undrained depressions are common. Some of the depressions contain peat. The peat deposits, some of which are very deep, present a problem in highway construction. The peat must be removed and replaced with stable material.

In addition to the Carlisle and other organic soils, soils of the Blount, Montcalm, Kawkawlin, Grayling, Spinks, Mancelona, Celina, and Miami series are extensive north of the trench.

The dominant soils south of the trench are members of the Miami, Celina, Conover, Brookston, McBride, Matherton, Mancelona, Fox, and Boyer series.

Many kinds of crops are grown, the choice depending on local kinds of soil and systems of farming. Small areas of organic soils are used for growing mint, celery, and other vegetables. Potatoes are commonly grown on the sandier soils, mostly in the northwestern part of the county. Many farmers grow white beans as a cash crop. Because growth is slowed during even a short drought, beans are grown most successfully on well-drained soils that have good available moisture capacity.

Alfalfa can be grown if the soils are adequately limed. Small grain has been grown traditionally, partly as a cover for seedings of alfalfa. Except on sandy soils, hybrid corn can be grown successfully if adequately fertilized. Hybrid corn has been a great boon to the county because it matures earlier than the older open-pollinated corn.

Dairy farms are numerous. A large proportion of general farms have both dairy cattle and beef cattle. Other farms specialize in fruits, mainly apples. Strawberries, raspberries, pears, and peaches are also grown to some extent. Ionia County is a bit too far from Lake Michigan to benefit enough from the lake's moderating effect on climate to permit growing peaches without considerable risk of freezing.

How This Survey Was Made

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

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

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

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Conover and Marlette, 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 natural, undisturbed landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

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

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miami loam, 2 to 6 percent slopes, is one of several phases of Miami loam, a soil type that ranges from level to steep.

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 in the back of this survey was prepared from the aerial photographs.

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

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. Therefore, such an area is shown as one mapping unit and is called a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Landes-Eel loams.

Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that may occur together without regularity in pattern or relative proportion. The individual tracts of the component soils could be shown separately on the map, but the differences between the soils are so slight that the separation is not important for the objectives of the soil survey. An example is Boyer and Spinks loamy sands, 0 to 2 percent slopes.

Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they are not identifiable as soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Made land or Gravel pits, 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 soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, 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. On the basis of yield and practice tables and other data, the soil scientists set up trial groups and test them 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 consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Ionia County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of two 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, stoniness, drainage, and other characteristics that affect management. Described in the pages following and shown on the colored map at the back of this survey are the eight soil associations in Ionia County.

1. Carlisle-Cohoctah-Sloan association

Level, very poorly drained organic soils in depressions, and poorly drained loamy soils that formed in alluvium on flood plains

This association is made up of level or nearly level areas and depressions along stream valleys and on the uplands. The organic soils occupy swales in the broad level or nearly level areas and the deep depressions in the more rolling areas. Soils that formed in alluvium are along the Grand and Maple Rivers and Prairie Creek. Some organic soils also occur in small depressions along the outer margin of the alluvial soils.

The Carlisle soils formed in woody and fibrous plant material. They are in deep depressions and in some broad level areas.

The Cohoctah and Sloan soils formed in alluvium and range from sandy loam to heavy loam or light clay loam in texture. These soils occur in shallow depressions and are poorly drained.

The Tawas, Linwood, Willette, and Edwards are minor soils that occur in broad level areas where organic deposits are less than 42 inches thick. They are underlain by sand, loam, clay, and marl, respectively. The Saranac soils also are minor soils. They formed in clay loam or silty clay loam alluvium and are poorly drained.

Most of this association is cultivated. However, there is a cover of second-growth forest in some undrained areas of organic soils and in very sandy or swampy depressions and oxbows.

Natural fertility is moderate or moderately high in all of the soils except the sandy soils that formed in alluvium, and it is low or moderately low in the sandy soils. The available moisture capacity is high in the organic soils, moderate or moderately high in all of the other soils except the sandy ones, and moderately low or low in the sandy soils.

The organic soils are well suited to onions and other truck crops, and to corn, soybeans, legume-grass hay, and pasture. The soils that formed in alluvium are suited to corn, wheat, oats, beans, soybeans, some truck crops, legume-grass hay, and pasture.

Excess wetness and susceptibility to wind erosion are the principal limitations of the organic soils. Flooding and excess wetness are limitations of the soils that formed in alluvium, and low available moisture capacity and low fertility are particular limitations of the very sandy soils that formed in alluvium.

2. Morley-Blount-Nester association

Rolling, well-drained to somewhat poorly drained loamy soils

This association is in the northeastern part of the county. It consists of short, relatively steep, irregular slopes; narrow hilltops; and shallow depressions.

The Morley, Blount, and Nester soils are dominant. The Blount soils are on narrow flats on uplands and in shallow depressions. They are somewhat poorly drained. The Morley and Nester soils occupy the steeper slopes and are well drained or moderately well drained. Small areas of poorly drained Pewamo and Bergland soils and somewhat poorly drained Kawkawlin soils are in level areas and depressions. These minor soils stay wet longer in spring and after rains than the dominant soils in this association.

Most of this association is cultivated. Natural fertility is moderately high or high. The available moisture capacity is moderately high in all of the soils, except those on slopes from which much of the water runs off.

The crops commonly grown are corn, wheat, oats, beans, soybeans, legume-grass hay, and pasture. The major limitations that affect the production of crops are excess wetness, erosion, and the slow movement of water through the soils.

3. Miami-Celina-Marlette association

Gently undulating to rolling, well drained and moderately well drained loamy soils

This association occurs throughout the county. The topography is rolling and consists mainly of gentle to steep slopes, but there are a few level areas and depressions. The steeper slopes generally are adjacent to well-developed natural drainageways. Relatively large areas of this association are along the Grand and Maple Rivers.

The Miami, Celina, and Marlette soils are dominant. The Miami and Celina soils occur on gentle to steep slopes along the Grand and Maple Rivers and throughout the southern half of the county. The Marlette soils occupy similar slopes in the northern half. The Miami and Marlette soils are well drained, and the Celina soils are moderately well drained. These soils have a loamy surface layer and a clay loam subsoil. They are underlain by loamy material.

Other soils in this association include the somewhat poorly drained Conover and Capac soils and the poorly drained Brookston soils. The Conover and Capac soils occur in less sloping areas than the dominant soils, and the Brookston soils are in shallow swales and depressions. These soils stay wet longer in spring and after rains than the Miami, Celina, and Marlette soils. Small areas of the Kendallville soils are on some slopes adjacent to drainageways, and few small areas of soils that formed in deep sand, loamy sand, sandy loam, and organic material occur throughout the association.

The dominant soils are moderately high in both available moisture capacity and natural fertility. Susceptibility to erosion is a limitation of the sloping soils, and excess wetness is a limitation of level soils that have a high water table.

This association and the Conover-Brookston association comprise the major farming areas of the county.

The crops commonly grown are corn, wheat, oats, beans, soybeans, and legume-grass hay or pasture. Tree fruits are also of economic importance in parts of this association. Apples are the leading fruit crop, but peaches, pears, plums, and cherries are also grown. Orchards generally are at the highest elevations where air drainage is good. Most orchards are north and northwest of the city of Ionia. Some of the more steeply sloping areas are in second-growth forest.

4. *Conover-Brookston association*

Level to gently undulating, somewhat poorly drained and poorly drained loamy soils

This association is in the southern part of the county. It consists mainly of low swells and undulating uplands with broad level tops, interspersed with low-lying swales and irregularly shaped flats.

The somewhat poorly drained Conover soils are dominant on the flats and on the gently undulating slopes, and the Brookston soils are dominant in the swales and depressions. Both soils have a loamy surface layer and a clay loam subsoil They are underlain by loamy material. The Brookston soils remain wet longer in spring and after rains than the Conover and have slower surface drainage.

The Matherton, Gilford, Sebewa, Macomb, Berville, Celina, and Boyer are minor soils of this association. The gravelly and sandy Matherton, Gilford, and Sebewa soils are along natural drainageways, particularly in the vicinity of the Matherton-Sebewa-Wasepi association; the Macomb and Berville soils occur at slightly higher elevations near natural drainageways; and the Celina and Boyer soils are on small isolated mounds and elongated hills. Muck and peat soils occur in small depressions and in narrow drainageways.

Most of this association is intensively cultivated. A few scattered wet areas remain in forest. The available moisture capacity of the dominant soils is moderately high, and natural fertility is high or moderately high. This association and the Miami-Celina-Marlette association comprise the major farming areas of the county. The crops commonly grown are corn, wheat, oats, beans, soybeans, and grass-legume hay or pasture. The major management needs are to reduce excess wetness and to maintain good tilth.

5. *McBride-Lapeer-Coral association*

Level to strongly rolling, well-drained to somewhat poorly drained loamy soils

This association occurs mainly in the western half of the county. The complex topography ranges from broad level or nearly level areas to numerous knobs, narrow hilltops, shallow to deep basins, and sharply sloping draws and ravines.

The McBride and Lapeer soils occur mainly on slopes and are well drained, whereas the Coral soils are in level areas and are somewhat poorly drained. These soils have a loamy surface layer and a sandy clay loam subsoil. They are underlain by sandy loam.

Minor soils in the association include the somewhat poorly drained Locke, Capac, and Conover soils, which are in level areas; the well-drained Miami and Marlette soils, on slopes; and the somewhat poorly drained Gladwin soils, in drainageways. Peat and muck soils are in small depressions and in narrow drainageways.

Most of this association is cultivated. The crops commonly grown are corn, wheat, oats, beans, and legume-grass hay or pasture. Tree fruits are also of economic importance in parts of this association. Apples are the leading fruit crop, but peaches, pears, plums, and cherries are also grown. Orchards generally are at the highest elevations where air drainage is good. Most orchards are near Belding and Ionia The major limitations that affect the production of crops are medium natural fertility, moderately low available moisture capacity, excess wetness, and susceptibility to erosion.

6. *Matherton-Sebewa-Wasepi association*

Level, somewhat poorly drained and poorly drained loamy soils underlain by sand and gravel

This association occurs in the southern half of the county. It consists of shallow, elongated depressions that in places are as much as 10 miles long. Limy sand and gravel commonly are at a depth of 18 to 42 inches.

The Sebewa soils occupy most of the lowest areas in the association and are poorly drained. The Matherton and Wasepi soils are at slightly higher elevations, adjacent to the Sebewa, and are somewhat poorly drained.

The minor soils in the association are in the Carlisle, Tawas, Linwood, Fox, Boyer, Macomb, Metamora, Gilford, and Berville series. The Carlisle, Tawas, and Linwood mucks occupy the bottoms of some of the deeper depressions. The well-drained Fox and Boyer soils are on low hills and sandy knobs that are scattered throughout some areas. The poorly drained Berville and Gilford soils occur in low areas near the Sebewa soils, whereas the somewhat poorly drained Macomb and Metamora soils are at slightly higher elevations, near the Matherton and Wasepi. The Berville soils are underlain by loamy material instead of sand and gravel.

Most of this association is cultivated. Some areas, particularly the wetter areas, remain in forest. The principal crops are corn, wheat, oats, soybeans, beans, truck crops, and legume-grass hay or pasture. Natural fertility and the available moisture capacity are medium or moderately high in the Sebewa and Matherton soils and medium in the Gilford and Wasepi soils. Excess wetness and droughtiness are the major limitations that affect the production of crops.

7. *Mancelona-Fox-Boyer association*

Level to steep, well-drained loamy soils underlain by sand and gravel

This association is along rivers and creeks throughout the county. It consists chiefly of gently sloping to strongly sloping knobs, ridges, and high terraces; of valley walls; and of nearly level to sloping stream terraces adjacent to valley walls. Large areas border the Grand, Maple, and Flat Rivers and Prairie Creek. Limy sand and gravel are at a depth of 18 to 42 inches. In a few places, mainly on the terraces along the Grand and Maple Rivers, there are numerous stones and boulders.

The Mancelona, Fox, and Boyer soils are dominant. These soils are well drained and have a loamy surface layer and subsoil. They are closely associated and in places occur on the same slope. For the most part, how-

ever, the Mancelona and Boyer soils are on river terraces and on gently sloping or sloping high terraces, adjacent to valleys. The Fox soils are on knobs and hills.

The Ionia, Perrin, Matherton, and Gladwin soils—minor soils—occur in level or nearly level areas in valleys, and on uplands above the valleys. Also in the association are the well-drained Newaygo, Marlette, Miami, Menominee, and Grayling soils, which are closely associated on the uplands. Some small isolated areas of these soils occur within larger areas of the Fox, Boyer, and Mancelona soils.

Most of this association is cultivated. The principal crops are corn, wheat, oats, beans, and legume-grass hay or pasture. Tree fruits are also of economic importance in parts of this association. Apples are the leading fruit crop, but peaches, pears, plums, and cherries are also grown. Orchards generally are at the highest elevations where air drainage is good. Most orchards are near Belding. Very steep or very stony areas are mainly idle or in second-growth forest. The major limitations that affect the production of crops are susceptibility to erosion, stoniness, and droughtiness.

8. Grayling-Spinks-Montcalm association

Rolling to hilly, well drained and moderately well drained sandy soils

This association occurs mainly in the western part of the county. It consists of rolling to hilly uplands that are dissected by deep cuts and narrow draws and drainageways. In many areas there are blowouts, where the wind has scooped out the soil material.

The Grayling, Spinks, and Montcalm soils occupy the stronger slopes and the more rolling uplands. They are well drained or moderately well drained and sandy. Of these soils, the Grayling are the coarsest textured and the most droughty. The Spinks and Montcalm soils are sandy in the uppermost 2 or 3 feet but have thin layers of finer textured material below this depth.

The Menominee and McBride soils occur within larger areas of the Montcalm and Spinks soils. They are well drained and are finer textured than the surrounding soil. The Mancelona soils occupy the more nearly level areas on high terraces or low ridges and are well drained and moderately well drained. The wet Otisco, Edmore, and Au Gres soils are in depressions and drainageways.

Much of this association has been cleared and cultivated, but many areas are now reverting to brush and second-growth forest or have been planted to trees. Droughtiness, low natural fertility, and susceptibility to wind erosion are the major limitations.

Descriptions of the Soils

This section describes the soil series and the mapping units in Ionia County. The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of the unit and also the description of the soil series to which it belongs. Following the soil name in the description of each mapping unit is the symbol used to identify that unit on the detailed soil map at the back of the survey.

The soil series contains a description of the soil profile—the major horizons from the surface downward. This profile is considered typical for all the mapping units of the series. If the profile for a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit unless they are apparent in the name. In describing the mapping units, some of the major limitations or hazards that affect the production of crops or tame pasture are mentioned.

In describing the typical profile, the scientist frequently assigns a letter symbol to each horizon, for example, "A1." This symbol has special meaning for soil scientists. Most readers will need to remember only that all letter symbols beginning with "A" are surface and subsurface soil; those beginning with "B" are subsoil; and those beginning with "C" are substratum, or parent material.

The color of the soil is designated in the profile description by words, such as "dark brown," and by symbols, such as "10YR 4/3." These symbols, called Munsell color notations, are used by soil scientists to evaluate soil colors precisely. Unless otherwise stated, the color given is that of the soil when moist.

Soil structure is an indication of the way the individual soil particles are arranged in larger grains, or aggregates, and the amount of pore space between the grains. It is determined by the strength or grade, the size, and the shape of the aggregates. Structure is described in the profile by such terms as "weak, fine, angular blocky structure."

Many of the technical terms used in this section are defined in the Glossary. The acreage and proportionate extent of the mapping units are shown in table 1.

The "Guide to Mapping Units" at the back of the survey lists all of the mapping units in the county and shows the soil management unit, woodland suitability group, and wildlife suitability group of each. The page where each of these groups is described is also given.

Abscota Series

The Abscota series consists of well drained and moderately well drained soils that formed in stratified calcareous sand and loamy sand, on level and nearly level flood plains. These soils occur throughout the county, generally as small areas. The original vegetation consisted mainly of elm, red maple, ash, and sycamore.

Typical profile of Abscota sandy loam:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; friable; moderately high organic-matter content; mildly alkaline; abrupt, smooth boundary.

C1—10 to 15 inches, very dark grayish-brown (10YR 3/2) loamy sand; moderate, medium, granular structure; friable; mildly alkaline; gradual, wavy boundary.

C2—15 to 28 inches, dark-brown (10YR 4/3) loamy sand; single grain; loose; calcareous; clear, wavy boundary.

C3—28 inches +, brown (10YR 5/3) loamy sand; single grain; loose; calcareous.

The C2 and C3 horizons range from sand to loamy sand in texture and in some places contain thin layers of fine gravel and sandy loam. In some areas the Ap and C1 horizons are calcareous. Mottles of gray (10YR 6/1) or light brownish gray (10YR 6/) occur below a

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

Soils	Area	Extent	Soils	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Abscota loam	245	0.1	Celina loam, 0 to 2 percent slopes	3,141	0.8
Abscota loamy sand	279	.1	Celina loam, 2 to 6 percent slopes	13,281	3.6
Abscota sandy loam	377	.1	Celina loam, 2 to 6 percent slopes, moderately eroded	9,253	2.5
Algansee loam	215	.1	Celina loam, 6 to 12 percent slopes, moderately eroded	494	.1
Algansee loamy sand	30	(1)	Ceresco-Shoals loams	2,201	.6
Algansee sandy loam	394	.1	Ceresco-Shoals sandy loams	355	.1
Alluvial land, marl substratum	51	(1)	Chelsea loamy sand, 0 to 2 percent slopes	222	.1
Au Gres sand	244	.1	Chelsea loamy sand, 2 to 6 percent slopes	634	.2
Barry loam	181	(1)	Chelsea loamy sand, 2 to 6 percent slopes, moderately eroded	490	.1
Barry sandy loam	812	.2	Chelsea loamy sand, 6 to 12 percent slopes, moderately eroded	224	.1
Belding sandy loam, 0 to 2 percent slopes	375	.1	Chelsea sand, 0 to 2 percent slopes	103	(1)
Belding sandy loam, 2 to 6 percent slopes	386	.1	Chelsea sand, 2 to 6 percent slopes	131	(1)
Bergland silty clay loam	149	(1)	Chelsea sand, 2 to 6 percent slopes, moderately eroded	196	.1
Berville loam	229	.1	Chelsea sand, 6 to 12 percent slopes, moderately eroded	364	.1
Berville sandy loam	127	(1)	Cohoctah-Sloan loams	5,230	1.4
Blount loam, 0 to 2 percent slopes	1,810	.5	Cohoctah-Sloan sandy loams	543	.1
Blount loam, 2 to 6 percent slopes	2,109	.6	Colwood loam	1,530	.4
Blount loam, 2 to 6 percent slopes, moderately eroded	111	(1)	Conover loam, 0 to 2 percent slopes	24,459	6.7
Boyer loamy sand, 0 to 2 percent slopes	159	(1)	Conover loam, 2 to 6 percent slopes	9,617	2.6
Boyer loamy sand, 2 to 6 percent slopes	580	.1	Conover loam, 2 to 6 percent slopes, moderately eroded	828	.2
Boyer loamy sand, 2 to 6 percent slopes, moderately eroded	437	.1	Conover extremely stony loam, 2 to 6 percent slopes	79	(1)
Boyer loamy sand, 6 to 12 percent slopes, moderately eroded	585	.2	Coral loam, 0 to 2 percent slopes	587	.2
Boyer loamy sand, 12 to 18 percent slopes, moderately eroded	276	.1	Coral loam, 2 to 6 percent slopes	328	.1
Boyer loamy sand, 18 to 25 percent slopes, moderately eroded	378	.1	Coral sandy loam, 0 to 2 percent slopes	897	.2
Boyer loamy sand, 25 to 40 percent slopes, moderately eroded	368	.1	Coral sandy loam, 2 to 6 percent slopes	1,522	.4
Boyer sandy loam, 0 to 2 percent slopes	338	.1	Dighton clay loam, 6 to 12 percent slopes, severely eroded	46	(1)
Boyer sandy loam, 2 to 6 percent slopes	980	.3	Dighton sandy loam, 0 to 2 percent slopes	128	(1)
Boyer sandy loam, 2 to 6 percent slopes, moderately eroded	710	.2	Dighton sandy loam, 2 to 6 percent slopes	109	(1)
Boyer sandy loam, 6 to 12 percent slopes, moderately eroded	539	.1	Dighton sandy loam, 2 to 6 percent slopes, moderately eroded	168	(1)
Boyer sandy loam, 12 to 18 percent slopes, moderately eroded	213	.1	Dighton sandy loam, 6 to 12 percent slopes, moderately eroded	47	(1)
Boyer very stony loamy sand, 0 to 2 percent slopes	172	(1)	Dryden sandy loam, 0 to 2 percent slopes	476	.1
Boyer very stony loamy sand, 2 to 6 percent slopes	306	.1	Dryden sandy loam, 2 to 6 percent slopes	1,581	.4
Boyer very stony loamy sand, 6 to 12 percent slopes	111	(1)	Dryden sandy loam, 2 to 6 percent slopes, moderately eroded	424	.1
Boyer and Spinks loamy sands, 0 to 2 percent slopes	720	.2	Edmore sandy loam	1,162	.3
Boyer and Spinks loamy sands, 2 to 6 percent slopes	803	.2	Edwards muck	591	.2
Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded	967	.3	Edwards muck, sloping	190	.1
Boyer and Spinks loamy sands, 6 to 12 percent slopes, moderately eroded	1,175	.3	Ensley loam	1,983	.5
Boyer and Spinks loamy sands, 12 to 18 percent slopes, moderately eroded	289	.1	Epoufette loamy sand	153	(1)
Boyer and Spinks loamy sands, 18 to 25 percent slopes, moderately eroded	249	.1	Epoufette sandy loam	857	.2
Boyer and Spinks loamy sands, 25 to 40 percent slopes	256	.1	Fox sandy loam, 0 to 2 percent slopes	1,226	.3
Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded	160	(1)	Fox sandy loam, 2 to 6 percent slopes	2,338	.6
Breckenridge sandy loam	246	.1	Fox sandy loam, 2 to 6 percent slopes, moderately eroded	2,447	.7
Brevort loamy sand	176	(1)	Fox sandy loam, 6 to 12 percent slopes	112	(1)
Brookston loam	23,752	6.5	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	1,796	.5
Cadmus loam, 0 to 2 percent slopes	167	(1)	Fox sandy loam, 12 to 18 percent slopes, moderately eroded	643	.2
Cadmus loam, 2 to 6 percent slopes	708	.2	Fox sandy loam, 18 to 25 percent slopes, moderately eroded	520	.1
Cadmus sandy loam, 0 to 2 percent slopes	90	(1)	Fox sandy loam, 25 to 40 percent slopes	385	.1
Cadmus sandy loam, 2 to 6 percent slopes	552	.1	Fox stony sandy loam, 2 to 6 percent slopes	45	(1)
Capac loam, 0 to 2 percent slopes	2,335	.6	Fox sandy clay loam, 6 to 12 percent slopes, severely eroded	728	.2
Capac loam, 2 to 6 percent slopes	1,678	.5	Fox sandy clay loam, 12 to 18 percent slopes, severely eroded	556	.2
Capac sandy loam, 0 to 2 percent slopes	688	.2	Fox sandy clay loam, 18 to 25 percent slopes, severely eroded	413	.1
Capac sandy loam, 2 to 6 percent slopes	472	.1	Fox sandy clay loam, 25 to 40 percent slopes, severely eroded	216	.1
Carlisle muck	11,025	3.0	Gilford loamy sand	315	.1

See footnotes at end of table.

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

Soils	Area	Extent
	Acres	*Percent*
Gilford sandy loam	272	0. 1
Gladwin loamy sand, 0 to 2 percent slopes	285	. 1
Gladwin loamy sand, 2 to 6 percent slopes	105	(1)
Gladwin sandy loam, 0 to 2 percent slopes	381	. 1
Gladwin sandy loam, 2 to 6 percent slopes	191	. 1
Glendora loam	1, 027	. 3
Glendora sandy loam	796	. 2
Granby loamy sand	639	. 2
Gravel pits	390	. 1
Grayling sand, 0 to 6 percent slopes	902	. 2
Grayling sand, 2 to 6 percent slopes, moderately eroded	842	. 2
Grayling sand, 6 to 12 percent slopes	232	. 1
Grayling sand, 6 to 12 percent slopes, moderately eroded	1, 617	. 4
Grayling sand, 12 to 18 percent slopes	167	(1)
Grayling sand, 12 to 18 percent slopes, moderately eroded	878	. 2
Grayling sand, 18 to 40 percent slopes	916	. 3
Ionia loam, 0 to 2 percent slopes	530	. 1
Ionia loam, 2 to 6 percent slopes	745	. 2
Ionia sandy loam, 0 to 2 percent slopes	1, 372	. 4
Ionia sandy loam, 2 to 6 percent slopes	930	. 3
Ionia sandy loam, 2 to 6 percent slopes, moderately eroded	181	(1)
Iosco loamy sand, 0 to 2 percent slopes	346	. 1
Iosco loamy sand, 2 to 6 percent slopes	578	. 2
Kawkawlin loam, 0 to 2 percent slopes	322	. 1
Kawkawlin loam, 2 to 6 percent slopes	296	. 1
Kawkawlin sandy loam, 0 to 2 percent slopes	128	(1)
Kawkawlin sandy loam, 2 to 6 percent slopes	201	. 1
Kendallville loam, 0 to 2 percent slopes	149	(1)
Kendallville loam, 2 to 6 percent slopes	207	. 1
Kendallville loam, 2 to 6 percent slopes, moderately eroded	539	. 1
Kendallville loam, 6 to 12 percent slopes, moderately eroded	201	. 1
Kendallville sandy clay loam, 6 to 12 percent slopes, severely eroded	76	(1)
Kendallville sandy loam, 2 to 6 percent slopes	208	. 1
Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded	251	. 1
Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded	416	. 1
Kendallville sandy loam, 12 to 18 percent slopes, moderately eroded	89	(1)
Kent soils, 2 to 6 percent slopes	172	(1)
Kent soils, 6 to 12 percent slopes	106	(1)
Kent soils, 12 to 18 percent slopes	109	(1)
Kent silty clay, 6 to 12 percent slopes, severely eroded	40	(1)
Kerston muck	729	. 2
Kibbie loam, 0 to 2 percent slopes	1, 208	. 3
Kibbie loam, 2 to 6 percent slopes	741	. 2
Kokomo clay loam	866	. 2
Landes-Eel loams	1, 287	. 4
Landes-Eel sandy loams	349	. 1
Landes-Genesee loams	414	. 1
Landes-Genesee sandy loams	482	. 1
Lapeer loam, 0 to 2 percent slopes	85	(1)
Lapeer loam, 2 to 6 percent slopes	357	. 1
Lapeer loam, 2 to 6 percent slopes, moderately eroded	817	. 2
Lapeer loam, 6 to 12 percent slopes, moderately eroded	263	. 1
Lapeer sandy clay loam, 6 to 12 percent slopes, severely eroded	714	. 2
Lapeer sandy clay loam, 12 to 18 percent slopes, severely eroded	564	. 2
Lapeer sandy clay loam, 18 to 40 percent slopes, severely eroded	223	. 1
Lapeer sandy loam, 0 to 2 percent slopes	272	. 1
Lapeer sandy loam, 2 to 6 percent slopes	1, 425	. 4
Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	2, 297	0. 6
Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	1, 672	. 5
Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	519	. 1
Lapeer sandy loam, 18 to 40 percent slopes, moderately eroded	159	(1)
Linwood muck	1, 972	. 5
Locke sandy loam, 0 to 2 percent slopes	576	. 2
Locke sandy loam, 2 to 6 percent slopes	936	. 3
Lupton muck	327	. 1
Macomb loam, 0 to 2 percent slopes	699	. 2
Macomb loam, 2 to 6 percent slopes	537	. 1
Made land	92	(1)
Mancelona loamy sand, loamy substratum, 2 to 6 percent slopes	293	. 1
Mancelona loamy sand, loamy substratum, 6 to 12 percent slopes, moderately eroded	110	(1)
Mancelona-Chelsea loamy sands, 0 to 2 percent slopes	2, 281	. 6
Mancelona-Chelsea loamy sands, 2 to 6 percent slopes	2, 624	. 7
Mancelona-Chelsea loamy sands, 2 to 6 percent slopes, moderately eroded	2, 744	. 8
Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, moderately eroded	1, 926	. 5
Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, severely eroded	632	. 2
Mancelona-Chelsea loamy sands, 12 to 18 percent slopes	198	. 1
Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, moderately eroded	1, 306	. 4
Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, severely eroded	278	. 1
Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, moderately eroded	780	. 2
Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, severely eroded	244	. 1
Mancelona-Chelsea loamy sands, 25 to 40 percent slopes	148	(1)
Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, moderately eroded	287	. 1
Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, severely eroded	133	(1)
Mancelona-Chelsea stony complex, 0 to 2 percent slopes	179	(1)
Marlette clay loam, 6 to 12 percent slopes, severely eroded	588	
Marlette clay loam, 12 to 18 percent slopes, severely eroded	695	. 2
Marlette clay loam, 18 to 25 percent slopes, severely eroded	198	. 1
Marlette loam, 0 to 2 percent slopes	769	. 2
Marlette loam, 2 to 6 percent slopes	4, 642	1. 3
Marlette loam, 2 to 6 percent slopes, moderately eroded	5, 038	1. 4
Marlette loam, 6 to 12 percent slopes, moderately eroded	2, 727	. 7
Marlette loam, 12 to 18 percent slopes, moderately eroded	501	. 1
Marlette loam, 18 to 25 percent slopes, moderately eroded	138	(1)
Marlette loam, 25 to 40 percent slopes, moderately eroded	186	(1)
Marlette loamy sand, 2 to 6 percent slopes	116	(1)
Marlette loamy sand, 2 to 6 percent slopes, moderately eroded	268	. 1
Marlette loamy sand, 6 to 12 percent slopes, moderately eroded	189	(1)
Marlette sandy loam, 0 to 2 percent slopes	242	. 1
Marlette sandy loam, 2 to 6 percent slopes	1, 439	. 4

See footnotes at end of table.

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

Soils	Area	Extent
	Acres	*Percent*
Marlette sandy loam, 2 to 6 percent slopes, moderately eroded	2, 213	0. 6
Marlette sandy loam, 6 to 12 percent slopes, moderately eroded	2, 239	. 6
Marlette sandy loam, 12 to 18 percent slopes, moderately eroded	842	. 2
Marlette sandy loam, 18 to 25 percent slopes	87	(1)
Matherton loam, 0 to 2 percent slopes	2, 030	. 6
Matherton loam, 2 to 6 percent slopes	509	. 1
Matherton sandy loam, 0 to 2 percent slopes	838	. 2
Matherton sandy loam, 2 to 6 percent slopes	461	. 1
McBride loamy sand, 0 to 2 percent slopes	90	(1)
McBride loamy sand, 2 to 6 percent slopes	255	. 1
McBride loamy sand, 2 to 6 percent slopes, moderately eroded	759	. 2
McBride loamy sand, 6 to 12 percent slopes, moderately eroded	309	. 1
McBride sandy clay loam, 2 to 6 percent slopes, severely eroded	207	. 1
McBride sandy clay loam, 6 to 12 percent slopes, severely eroded	1, 326	. 4
McBride sandy clay loam, 12 to 18 percent slopes, severely eroded	720	. 2
McBride sandy clay loam, 18 to 25 percent slopes, severely eroded	142	(1)
McBride sandy loam, 0 to 2 percent slopes	889	. 2
McBride sandy loam, 2 to 6 percent slopes	3, 852	1. 1
McBride sandy loam, 2 to 6 percent slopes, moderately eroded	7, 347	2. 0
McBride sandy loam, 6 to 12 percent slopes	246	. 1
McBride sandy loam, 6 to 12 percent slopes, moderately eroded	3, 074	. 8
McBride sandy loam, 12 to 18 percent slopes, moderately eroded	1, 027	. 3
McBride sandy loam, 18 to 25 percent slopes, moderately eroded	224	. 1
McBride sandy loam, 25 to 40 percent slopes, moderately eroded	302	. 1
Menominee loamy sand, 0 to 2 percent slopes	149	(1)
Menominee loamy sand, 2 to 6 percent slopes	977	. 3
Menominee loamy sand, 2 to 6 percent slopes, moderately eroded	763	. 2
Menominee loamy sand, 6 to 12 percent slopes, moderately eroded	529	. 1
Menominee loamy sand, 6 to 12 percent slopes, severely eroded	208	. 1
Menominee loamy sand, 12 to 18 percent slopes, moderately eroded	179	(1)
Menominee loamy sand, 12 to 18 percent slopes, severely eroded	94	(1)
Menominee loamy sand, 18 to 25 percent slopes, moderately eroded	126	(1)
Metamora sandy loam, 0 to 2 percent slopes	603	. 2
Metamora sandy loam, 2 to 6 percent slopes	698	. 2
Miami clay loam, 2 to 6 percent slopes, severely eroded	110	(1)
Miami clay loam, 6 to 12 percent slopes, severely eroded	3, 542	1. 0
Miami clay loam, 12 to 18 percent slopes, severely eroded	2, 002	. 5
Miami clay loam, 18 to 25 percent slopes, severely eroded	495	. 1
Miami clay loam, 25 to 40 percent slopes, severely eroded	424	. 1
Miami loam, 0 to 2 percent slopes	351	. 1
Miami loam, 2 to 6 percent slopes	3, 889	1. 1
Miami loam, 2 to 6 percent slopes, moderately eroded	8, 894	2. 4
Miami loam, 6 to 12 percent slopes	223	. 1
Miami loam, 6 to 12 percent slopes, moderately eroded	4, 798	1. 3
Miami loam, 12 to 18 percent slopes, moderately eroded	676	. 2
Miami loam, 18 to 25 percent slopes, moderately eroded	399	0. 1
Miami loam, 25 to 40 percent slopes	164	(1)
Miami sandy loam, 2 to 6 percent slopes	612	. 2
Miami sandy loam, 2 to 6 percent slopes, moderately eroded	909	. 2
Miami sandy loam, 6 to 12 percent slopes, moderately eroded	1, 582	. 4
Miami sandy loam, 12 to 18 percent slopes, moderately eroded	289	. 1
Miami-Owosso sandy loams, 0 to 2 percent slopes	969	. 3
Miami-Owosso sandy loams, 2 to 6 percent slopes	3, 014	. 8
Miami-Owosso sandy loams, 2 to 6 percent slopes, moderately eroded	1, 832	. 5
Miami-Owosso sandy loams, 6 to 12 percent slopes, moderately eroded	953	. 3
Miami-Owosso sandy loams, 12 to 18 percent slopes, moderately eroded	157	(1)
Montcalm loamy sand, 0 to 2 percent slopes	547	. 1
Montcalm loamy sand, 2 to 6 percent slopes	2, 006	. 5
Montcalm loamy sand, 2 to 6 percent slopes, moderately eroded	2, 792	. 7
Montcalm loamy sand, 6 to 12 percent slopes, moderately eroded	3, 059	. 8
Montcalm loamy sand, 6 to 12 percent slopes, severely eroded	702	. 2
Montcalm loamy sand, 12 to 18 percent slopes, moderately eroded	906	. 2
Montcalm loamy sand, 12 to 18 percent slopes, severely eroded	660	. 2
Montcalm loamy sand, 18 to 25 percent slopes, moderately eroded	473	. 1
Montcalm loamy sand, 18 to 25 percent slopes, severely eroded	140	(1)
Montcalm loamy sand, 25 to 40 percent slopes, moderately eroded	134	(1)
Montcalm sandy loam, 0 to 2 percent slopes	215	. 1
Montcalm sandy loam, 2 to 6 percent slopes	415	. 1
Montcalm sandy loam, 2 to 6 percent slopes, moderately eroded	398	. 1
Montcalm sandy loam, 6 to 12 percent slopes, moderately eroded	262	. 1
Morley clay loam, 6 to 12 percent slopes, severely eroded	97	(1)
Morley clay loam, 12 to 18 percent slopes, severely eroded	106	(1)
Morley loam, 0 to 2 percent slopes	912	. 2
Morley loam, 2 to 6 percent slopes	2, 607	. 7
Morley loam, 2 to 6 percent slopes, moderately eroded	3, 470	. 9
Morley loam, 6 to 12 percent slopes, moderately eroded	2, 127	. 6
Morley loam, 12 to 18 percent slopes, moderately eroded	296	. 1
Morley sandy loam, 2 to 6 percent slopes	224	. 1
Morley sandy loam, 2 to 6 percent slopes, moderately eroded	192	. 1
Morley sandy loam, 6 to 12 percent slopes, moderately eroded	162	(1)
Nester clay loam, 2 to 6 percent slopes, severely eroded	153	(1)
Nester clay loam, 6 to 12 percent slopes, severely eroded	421	. 1
Nester clay loam, 12 to 18 percent slopes, severely eroded	86	(1)
Nester clay loam, 18 to 25 percent slopes, severely eroded	78	(1)
Nester loam, 2 to 6 percent slopes	417	. 1
Nester loam, 2 to 6 percent slopes, moderately eroded	359	. 1

See footnotes at end of table.

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

Soils	Area	Extent
	Acres	*Percent*
Nester loam, 6 to 12 percent slopes, moderately eroded	219	0. 1
Nester sandy loam, 2 to 6 percent slopes	1, 064	. 3
Nester sandy loam, 2 to 6 percent slopes, moderately eroded	1, 925	. 5
Nester sandy loam, 6 to 12 percent slopes, moderately eroded	1, 270	. 3
Nester sandy loam, 12 to 18 percent slopes	379	. 1
Newaygo sandy clay loam, 6 to 12 percent slopes, severely eroded	83	(1)
Newaygo sandy clay loam, 12 to 18 percent slopes, severely eroded	71	(1)
Newaygo sandy loam, 0 to 2 percent slopes	1, 273	. 3
Newaygo sandy loam, 2 to 6 percent slopes	593	. 2
Newaygo sandy loam, 2 to 6 percent slopes, moderately eroded	569	. 2
Newaygo sandy loam, 6 to 12 percent slopes, moderately eroded	360	. 1
Newaygo sandy loam, 12 to 18 percent slopes, moderately eroded	102	(1)
Newaygo sandy loam, 18 to 40 percent slopes, moderately eroded	72	(1)
Otisco loamy sand, 0 to 2 percent slopes	368	. 1
Otisco loamy sand, 2 to 6 percent slopes	174	(1)
Otisco sandy loam, 0 to 2 percent slopes	385	. 1
Otisco sandy loam, 2 to 6 percent slopes	204	. 1
Perrin loamy sand, 0 to 2 percent slopes	878	. 2
Perrin loamy sand, 2 to 6 percent slopes	445	. 1
Perrin loamy sand, 2 to 6 percent slopes, moderately eroded	103	(1)
Perrin sandy loam, 0 to 2 percent slopes	202	. 1
Perrin sandy loam, 2 to 6 percent slopes	252	. 1
Pewamo clay loam	1, 507	. 4
Pewamo loam	1, 619	. 4
Plainfield sand, slightly acid variant, 0 to 6 percent slopes	163	(1)
Plainfield sand, slightly acid variant, 6 to 12 percent slopes, moderately eroded	315	. 1
Plainfield sand, slightly acid variant, 12 to 18 percent slopes, moderately eroded	57	(1)
Plainfield sand, slightly acid variant, 18 to 25 percent slopes, moderately eroded	61	(1)
Rifle muck	152	(1)
Saranac clay loam	662	. 2
Saranac silt loam	2, 734	. 7
Sebewa loam	7, 449	2. 0
Selkirk loamy sand, 0 to 2 percent slopes	95	(1)
Selkirk silt loam, 0 to 2 percent slopes	85	(1)
Shallow sandy land	78	(1)
Shoals clay loam, heavy subsoil variant	43	(1)
Shoals loam, heavy subsoil variant	99	(1)
Shoals sandy loam, heavy subsoil variant	69	(1)
Sims clay loam	218	0. 1
Sims loam	972	. 3
Spinks loamy sand, 0 to 2 percent slopes	403	. 1
Spinks loamy sand, 2 to 6 percent slopes	1, 139	. 3
Spinks loamy sand, 2 to 6 percent slopes, moderately eroded	998	. 3
Spinks loamy sand, 6 to 12 percent slopes, moderately eroded	1, 011	. 3
Spinks loamy sand, 6 to 12 percent slopes, severely eroded	308	. 1
Spinks loamy sand, 12 to 18 percent slopes, moderately eroded	102	(1)
Spinks loamy sand, 12 to 18 percent slopes, severely eroded	290	. 1
Tawas muck	2, 821	. 8
Tuscola soils, 0 to 2 percent slopes	102	(1)
Tuscola soils, 2 to 6 percent slopes	362	. 1
Tuscola soils, 2 to 6 percent slopes, moderately eroded	568	. 2
Tuscola soils, 6 to 12 percent slopes, moderately eroded	124	(1)
Tuscola loamy fine sand, 2 to 6 percent slopes	74	(1)
Ubly sandy clay loam, 6 to 12 percent slopes, severely eroded	242	. 1
Ubly sandy loam, 0 to 2 percent slopes	270	. 1
Ubly sandy loam, 2 to 6 percent slopes	1, 200	. 3
Ubly sandy loam, 2 to 6 percent slopes, moderately eroded	1, 143	. 3
Ubly sandy loam, 6 to 12 percent slopes, moderately eroded	601	. 2
Ubly sandy loam, 12 to 18 percent slopes, moderately eroded	201	. 1
Ubly sandy loam, 18 to 25 percent slopes, moderately eroded	45	(1)
Wallkill soils	53	(1)
Wasepi sandy loam, 0 to 2 percent slopes	390	. 1
Wasepi sandy loam, 2 to 6 percent slopes	304	. 1
Wasepi-Brady loamy sands, 0 to 2 percent slopes	533	. 1
Wasepi-Brady loamy sands, 2 to 6 percent slopes	397	. 1
Wasepi-Brady sandy loams, 0 to 2 percent slopes	159	(1)
Wasepi-Brady sandy loams, 2 to 6 percent slopes	139	(1)
Washtenaw soils	415	. 1
Willette-Linwood mucks	815	. 2
Wind eroded land, sloping	217	. 1
Wind eroded land, steep	135	(1)
Total	[2]365, 405	97. 9

[1] Less than 0.05 percent.

[2] Total area of the county is 368,000 acres. Difference is made up of lakes and miscellaneous areas not classified.

depth of 24 inches in the moderately well drained soils.

Surface runoff is very slow, permeability is very rapid, and the available moisture capacity and natural fertility are low.

The Abscota soils are in the drainage sequence that includes the somewhat poorly drained Algansee soils and the poorly drained or very poorly drained Glendora soils. Although they formed in sand and loamy sand, their drainage is comparable to that of the Landes soils, which formed in loamy fine sand and fine sandy loam.

Abscota loam (0 to 1 percent slopes) (Ac).—This soil occurs on flat bottom lands and flood plains that border rivers and creeks. The texture of the surface layer varies within short distances but is dominantly loam. The second layer generally is sandy loam. In places the first and second layers are limy. In a few places numerous stones occur both on the surface and to a depth of 42 inches. Included in the areas mapped are a few small areas in which the surface layer is loamy sand or sandy loam

Most of this soil is cultivated, but some small areas are in farm woodlots. Corn, pasture, and hay are the principal crops. Areas where stones are numerous are not suited to cultivated crops but can be used for hay or improved pasture. Low natural fertility, droughtiness, and occasional flooding are the major limitations. (Soil management unit L–4aA (IIIw); woodland suitability group O; wildlife suitability group 5)

Abscota loamy sand (0 to 1 percent slopes) (Ab).—This soil occurs on bottom lands bordering rivers and creeks. The surface layer is very dark grayish brown or dark grayish brown and is moderate in organic-matter content. It varies in texture within short distances but is dominantly loamy sand. In most places the second layer is also loamy sand. In some areas both the first and second layers are limy. Gray and light brownish-gray mottles occur in places below a depth of 24 inches. Included in the areas mapped are small areas in which the surface layer is loam or sandy loam.

Most of this soil is cultivated. Some small areas are in farm woodlots. The principal crops are corn, hay, and pasture. Occasional flooding, low natural fertility, and droughtiness are the major limitations. (Soil management unit L–4aA (IIIw); woodland suitability group O; wildlife suitability group 5)

Abscota sandy loam (0 to 1 percent slopes) (Ad).—This soil occurs on slightly elevated bottom lands and flood plains bordering rivers and creeks. The surface layer is very dark grayish brown and is moderately high in organic-matter content. It varies in texture within short distances but is dominantly sandy loam. In many areas the first and second layers are limy. Gray and light brownish-gray mottles occur in places below a depth of 24 inches. Included in the areas mapped are small areas in which the surface layer is loam or loamy sand.

Most of this soil is cultivated. Some areas are in farm woodlots. The principal crops are corn, hay, and pasture. Occasional flooding, low natural fertility, and droughtiness are the major limitations. (Soil management unit L–4aA (IIIw); woodland suitability group O; wildlife suitability group 5)

Algansee Series

The Algansee series is made up of somewhat poorly drained soils that formed in neutral to calcareous stratified sand and loamy sand. These soils occur throughout the county, generally as small areas, on level to gently sloping flood plains. The native vegetation consisted mainly of red maple, elm, swamp oak, and aspen.

Typical profile of Algansee sandy loam:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; neutral; moderately high organic-matter content; abrupt, smooth boundary.

IIC1—10 to 15 inches, dark grayish-brown (10YR 4/2) fine sand; common, fine, faint, yellowish-brown (10YR 5/6) mottles; single grain; loose; calcareous; gradual, wavy boundary.

IIIC2—15 to 36 inches, brown (10YR 5/3) loamy sand; common, medium, faint, yellowish-brown (10YR 5/6) mottles; single grain; loose; calcareous; clear, wavy boundary.

IIIC3—36 to 66 inches +, dark grayish-brown (10YR 4/2) loamy sand; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; calcareous.

The Ap horizon ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2) or very dark brown (10YR 2/2) in color and from loamy sand to loam in texture. Where the Ap horizon is loam, it is underlain at a depth of 6 to 12 inches by sand or loamy sand. The depth to mottling ranges from 8 inches to about 20 inches. The mottles range from yellowish brown (10YR 5/6) to pale brown (10YR 6/3) or gray (10YR 6/1). In many areas thin very dark brown (10YR 2/2) layers, relatively high in organic-matter content, occur in the C horizon. In some places there are thin layers of fine gravel or sandy loam in the lower part of the C horizon.

Surface runoff is very slow, permeability is rapid, and the available moisture capacity and natural fertility are low.

Drainage on the Algansee soils is similar to that of the Ceresco soils, although the Ceresco soils developed in loamy fine sand to fine sandy loam.

Algansee loam (0 to 1 percent slopes) (Ae).—This soil occurs on bottom lands bordering rivers and creeks. The surface layer is very dark grayish brown, dark grayish brown, or very dark brown, and it is moderately high in organic-matter content. It varies in texture within short distances but is dominantly loam that is 6 to 12 inches thick over sand or loamy sand. Included in the areas mapped are small areas in which the surface layer is sandy loam or loamy sand.

Much of this soil is cultivated. The rest is used for farm woodlots. The principal crops are corn, hay, and pasture. Somewhat poor drainage, low natural fertility, droughtiness, and occasional flooding are the major limitations. (Soil management unit L–4cA (IIIw); woodland suitability group O; wildlife suitability group 6)

Algansee loamy sand (0 to 2 percent slopes) (Ag).—This soil occurs on bottom lands bordering rivers and creeks. The surface layer varies in texture but is dominantly very dark grayish-brown loamy sand. It is moderate in organic-matter content. In many areas there are thin layers of fine gravel in the third and fourth layers. Included in the areas mapped are small areas in which the surface layer is sandy loam or loam.

Some areas of this soil are cultivated. Others are used for farm woodlots. The principal crops are corn, hay, and pasture. The major limitations are low natural fertility, somewhat poor drainage, occasional flooding, and droughtiness in dry years. (Soil management unit L–4cA (IIIw); woodland suitability group O; wildlife suitability group 6)

Algansee sandy loam (0 to 1 percent slopes) (Ah).—This soil occurs on bottom lands bordering rivers and creeks. The surface layer varies in texture within short distances but is dominantly very dark grayish-brown sandy loam. It is moderately high in organic-matter content. In many areas there are thin layers of fine gravel in the third and fourth layers. In a few small areas, numerous stones occur both on the surface and throughout the soil material. Some small areas in which the surface layer is loam or loamy sand were included in the areas mapped.

Most areas of this soil are cultivated, some areas are used for farm woodlots, and stony areas are used mainly for pasture or woods. The principal crops are corn, hay, and pasture. Low natural fertility, somewhat poor drainage, occasional flooding, and droughtiness in prolonged dry periods are the major limitations. (Soil management unit L–4cA (IIIw); woodland suitability group O; mildlife suitability group 6)

Alluvial Land, Marl Substratum

Alluvial land, marl substratum (0 to 1 percent slopes) (Am) consists of somewhat poorly drained soils that formed in recently deposited sand, loamy sand, and sandy loam. These soils are underlain by marl at a depth of 10 to 40 inches. They are in level areas along the outer margin of broad flood plains, adjacent to strongly sloping or steep uplands. They commonly are on alluvial fans at the mouth of narrow, steep-sided drains that are actively eroding. Most areas are along the Grand River in Easton Township. The vegetation is sparse because of the deposition of new material.

Soils of this land type generally have a very dark grayish-brown sandy loam surface layer about 10 inches thick. The texture of this layer ranges from sand to loamy sand or sandy loam within short distances. This layer has weak granular structure and is calcareous.

The material below the surface layer, to a depth ranging from 10 to 40 inches, is mainly sandy loam mottled with various colors. This material has weak granular structure and is calcareous. It is underlain by gray marl. The depth to marl ranges from 10 to 40 inches but commonly is about 24 inches. The marl is massive and calcareous.

Surface runoff is slow or very slow, permeability is moderately rapid, and the available moisture capacity and natural fertility are moderately low or low.

Most of this acreage is idle. A few areas are used for pasture or hay. The major limitations are somewhat poor drainage, high soil reaction, and low or moderately low fertility and available moisture capacity. (Soil management unit M/mcA (VIw); woodland suitability group O; wildlife suitability group 6)

Au Gres Series

The Au Gres series consists of somewhat poorly drained soils that formed in sand on the level to gently sloping parts of outwash plains and moraines. These soils occur largely in the northern part of the county. They developed under forest consisting mainly of northern hardwoods and some white pine and cedar.

Typical profile of Au Gres sand:

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) sand; very weak, fine, granular structure; very friable; medium acid; moderately high organic-matter content; abrupt, smooth boundary.

A2—5 to 9 inches, light brownish-gray (10YR 6/2) sand; single grain; loose; medium acid; abrupt, wavy boundary.

B21hir—9 to 12 inches, dark reddish-brown (5YR 3/3) sand; single grain; weakly cemented in places; few hard concretions; loose; medium acid; gradual, irregular boundary.

B22ir—12 to 21 inches, dark yellowish-brown (10YR 4/4) sand; few, fine, faint, brownish-yellow (10YR 6/6) mottles in lower part; single grain; loose; medium acid; gradual, irregular boundary.

B3—21 to 33 inches, brown (10YR 5/3) sand; few, fine, distinct, brownish-yellow (10YR 6/6) mottles; single grain; loose; medium acid; gradual, wavy boundary.

C—33 inches +, pale-brown (10YR 6/3) sand; many, fine, distinct, yellow (10YR 7/6) mottles; single grain; loose; slightly acid.

In a few places, the A2 horizon is lacking or is very thin. The solum ranges from strongly acid to slightly acid in reaction and from 20 to 40 inches in thickness. The C horizon is slightly acid to mildly alkaline.

Surface runoff is very slow, permeability is rapid, and the available moisture capacity and natural fertility are low.

The Au Gres soils are coarser textured throughout the solum than the Otisco and Gladwin soils, and they lack the B2t horizon that is characteristic of these soils. The Gladwin soils are underlain by sand and gravel at a depth of 18 to 42 inches.

Au Gres sand (0 to 3 percent slopes) (As).—This soil is on level to undulating lake and outwash plains. In most areas it has a profile similar to the one described as representative of the series. In some areas there is a cemented layer of iron oxide and organic matter at a depth of 10 to 18 inches.

Most of the acreage is idle or in second-growth forest or pasture. White pine and red pine have been planted in a few places, where the Au Gres soil is associated with soils of the Grayling series. Somewhat poor drainage and low natural fertility are the major management limitations. (Soil management unit 5bA (IVw); woodland suitability group F; wildlife suitability group 6)

Barry Series

In the Barry series are poorly drained and very poorly drained soils that formed in calcareous sandy loam till. These soils are in level or nearly level areas and slight depressions on till plains and moraines The native vegetation consisted of mixed stands of hardwoods but was dominantly elm, ash, hickory, pin oak, and aspen.

Typical profile of Barry loam:

Ap—0 to 8 inches, very dark gray (10YR 3/1) loam; moderate, fine, granular structure; friable; high organic-matter content; neutral; abrupt, smooth boundary.

A12—8 to 12 inches, very dark brown (10YR 2/2) loam; moderate, fine, subangular blocky structure; friable; neutral; gradual, wavy boundary.

B21g—12 to 16 inches, dark grayish-brown (10YR 4/2) loam; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, subangular blocky structure; friable; neutral; gradual, wavy boundary.

B22g—16 to 24 inches, grayish-brown (2.5Y 5/2) light sandy clay loam; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; dark grayish-brown (10YR 4/2) coats on numerous peds; weak, medium, subangular blocky structure; firm; neutral; diffuse, irregular boundary.

B23g—24 to 38 inches, light brownish-gray (10YR 6/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; mildly alkaline; abrupt, irregular boundary.

C—38 inches +, light brownish-gray (2.5Y 6/2) sandy loam; common, medium, distinct, olive-yellow (2.5Y 6/8) mottles; massive; friable; calcareous.

The B22g and B23g horizons range from heavy sandy loam to sandy clay loam or light clay loam. The depth to the calcareous C horizon ranges from 24 to 50 inches. In some areas thin strata of loamy sand or sand occur in the profile.

Surface runoff is very slow or ponded, permeability is moderate, and the available moisture capacity and fertility are moderate.

The Barry soils have a coarser textured B horizon than the Brookston soils, and their C horizon is sandy loam instead of loam to light clay loam.

Barry loam (0 to 1 percent slopes) (Ba).—This soil is on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drains on the uplands. In some areas it is closely associated with the Brookston soils. In these areas, small areas of Brookston soils are included in the areas mapped. Also included are a few small gently sloping areas.

Areas with adequate drainage are used mostly for corn, wheat, oats, beans, and legume-grass hay or pasture. A few small areas are in farm woodlots. Poor drainage is the major limitation. (Soil management unit 3cA (IIw); woodland suitability group W; wildlife suitability group 2)

Barry sandy loam (0 to 1 percent slopes) (Bd).—This soil occurs on the broad flats, in shallow basins and swales, and in narrow depressions bordering natural drains on the uplands. The layer of limy sandy loam occurs at a depth of 42 inches or slightly more.

Most of the acreage is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Some undrained areas are used for farm woodlots. Poor drainage is the major limitation. (Soil management unit 3cA (IIw); woodland suitability group W; wildlife suitability group 2)

Belding Series

The Belding series consists of somewhat poorly drained soils that formed in loamy fine sand to fine sandy loam that is underlain at a depth of 18 to 42 inches by calcareous loam, clay loam, or silty clay loam till. These soils occur on the level to gently sloping parts of till plains and low moraines throughout the northern part of the county. The native vegetation consisted of mixed stands of hardwoods, principally elm, maple, oak, hickory, and some scattered white pine.

Typical profile of Belding sandy loam:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; moderately high organic-matter content; neutral; abrupt, smooth boundary.

B21ir—9 to 16 inches, strong-brown (7.5YR 5/6) sandy loam; few, fine, distinct, brownish-yellow (10YR 6/6) mottles; weak, fine, granular structure; friable; medium acid; clear, wavy boundary.

B22ir—16 to 21 inches, dark-brown (7.5YR 4/4) sandy loam; few, fine, distinct, very pale brown (10YR 7/4) mottles; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B'21t—21 to 28 inches, strong-brown (7.5YR 5/6) heavy sandy loam; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; weak, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

IIB'22t—28 to 36 inches, brown (7.5YR 5/4) clay loam; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

IIC—36 inches +, brown (7.5YR 5/4) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; calcareous.

In undisturbed areas, there is a gray or light-gray A2 horizon above the B21ir horizon. In places a 1- to 4-inch grayish-brown (10YR 5/2) sandy loam A'2 horizon occurs above the B'21t horizon. In some places a calcareous horizon of sandy loam to loamy fine sand occurs between the IIB'22t and IIC horizons.

Surface runoff is slow, and permeability is moderately rapid in the solum and moderately slow in the substratum. Natural fertility is medium, and the available moisture capacity is moderately low.

The Belding soils are in the drainage sequence that includes the well drained and moderately well drained Ubly soils and the poorly drained and very poorly drained Breckenridge soils. They are finer textured throughout the solum than the Iosco soils.

Belding sandy loam, 0 to 2 percent slopes (BeA).—This soil occurs on small shallow flats and in swales at the higher elevations on gently undulating uplands. In some areas the surface layer is about 12 inches thick because of an accumulation of soil material that washed from adjacent uplands. This soil is closely associated with the Ubly soils, and small areas of the Ubly soils are included in some of the areas mapped.

Adequately drained areas can be used for corn, wheat, oats, white beans, hay, and pasture. Some undrained areas are in farm woodlots or permanent pasture. Moderately low available moisture capacity and excess wetness are major limitations. (Soil management unit 3/2bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Belding sandy loam, 2 to 6 percent slopes (BeB).—This soil occurs on low ridges and in gently sloping areas on the uplands. The surface layer contains a moderate amount of organic matter and generally is dark brown in color. In a few areas part of the original surface layer has been removed by erosion, and the present surface layer is brown to strong brown. Included in many of the areas mapped are small areas of higher lying Ubly soils.

Most of this acreage is used for corn, wheat, oats, white beans, and hay or pasture. A few areas are in farm woodlots. Moderately low available moisture capacity and excess wetness are major limitations. (Soil management unit 3/2bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Bergland Series

In the Bergland series are very poorly drained soils that formed in reddish or pinkish, calcareous lacustrine silty clay or clay. These soils occur in small level areas and depressions on the lake plains. They are widely scattered throughout the northern third of the county. The native vegetation consisted mainly of mixed stands of elm, ash, birch, aspen, maple, hemlock, white cedar, and spruce.

Typical profile of Bergland silty clay loam:

Ap—0 to 7 inches, black (10YR 2/1) silty clay loam; weak, coarse, granular structure; firm; high organic-matter content; neutral; abrupt, smooth boundary.

B—7 to 35 inches, reddish-brown (5YR 4/4) silty clay; common, medium, distinct, dark yellowish-brown (10YR 4/4) and gray (10YR 5/1) mottles; moderate, coarse, angular blocky structure; very firm; neutral; abrupt, wavy boundary.

C—35 inches +, reddish-brown (5YR 5/4) silty clay; common, coarse, distinct, gray (10YR 5/1) mottles; weak, very coarse, angular blocky structure; very firm; calcareous.

In many undisturbed areas, there is a 1- to 12-inch layer of muck or peat on the surface. The B and C horizons are clay in some areas. The depth to the C horizon ranges from 20 to 36 inches.

Surface runoff is very slow or ponded, permeability is slow or very slow, and the available moisture capacity and natural fertility are high.

The Bergland soils are finer textured throughout the solum than the Sims soils, and their C horizon is reddish or pinkish clay or silty clay instead of grayish clay loam or silty clay loam. The Bergland soils are in the drainage sequence that includes the well drained or moderately well drained Kent soils and the somewhat poorly drained Selkirk soils.

Bergland silty clay loam (0 to 2 percent slopes) (Bg).—This soil occurs in nearly level to depressed areas, in shallow basins and swales, in narrow depressions bordering natural drainageways, and on narrow toe slopes bordering areas of muck and peat. In many areas, there is a 1- to 12-inch layer of muck or peat on the surface. Included in the areas mapped are small areas of Willette muck.

Most of this acreage is in farm woodlots or forest. A few areas are used for pasture and hay. Excess wetness is a major limitation. (Soil management unit 1cA (IVw); woodland suitability group P; wildlife suitability group 4)

Berville Series

The Berville series is made up of poorly drained and very poorly drained soils that formed in loamy deposits that contained a considerable amount of gravel and sand. These soils are underlain at a depth of 18 to 40 inches by loam to silty clay loam. They occur in small nearly level areas and slight depressions on till plains and low moraines in the southern part of the county. The native vegetation consisted largely of elm, ash, hickory, maple, and swamp white oak.

Typical profile of Berville loam:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; moderately high organic-matter content; neutral; abrupt, smooth boundary.

B21g—10 to 20 inches, grayish-brown (2.5Y 5/2) sandy loam; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.

IIB22g—20 to 30 inches, light brownish-gray (2.5Y 6/2) gravelly clay loam; common, medium, distinct, olive-brown (2.5Y 4/4) mottles; weak, medium, subangular blocky structure; firm; neutral; gradual, wavy boundary.

IIIB23g—30 to 38 inches, grayish-brown (2.5Y 5/2) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIIC—38 inches +, grayish-brown (2.5Y 5/2) loam; common, medium, distinct, dark-brown (10YR 4/3) mottles; massive; firm; calcareous.

The B22g and B23g horizons range from heavy sandy loam to clay loam. The upper part of the IIIC horizon is not calcareous in some areas, particularly where the gravelly and sandy overburden approaches the minimum thickness of 18 inches.

Surface runoff is very slow or ponded, permeability is moderate or moderately slow, and the available moisture capacity and natural fertility are moderate or moderately high.

The Berville soils are underlain by loam to silty clay loam, whereas the Sebewa soils are underlain by sand and gravel. They are more gravelly throughout the solum than the Barry soils, which are underlain by sandy loam.

Berville loam (0 to 2 percent slopes) (Bh).—This soil occurs on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways on the uplands. Included in the areas mapped are small areas that slope as much as 6 percent. Water does not pond in these areas, because surface drainage is better than in less sloping areas. Also included are some small areas of Sebewa soils.

Drained areas of this soil are used mainly for corn, wheat, soybeans, white beans, and legume-grass hay or pasture. Some areas are used for sugarbeets. Undrained areas are in farm woodlots or permanent pasture. Excess wetness is the major limitation. (Soil management unit 3/2cA (IIw); woodland suitability group P; wildlife suitability group 2)

Berville sandy loam (0 to 2 percent slopes) (Bk).—This soil occurs on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways, on the uplands. The third and fourth layers generally are sandy loam to light gravelly sandy clay loam. Included in the areas mapped are small areas that slope as much as 6 percent. Water does not pond in these areas, because surface drainage is better than in the less sloping areas. Also included in some areas are small areas of the Sebewa soils.

Drained areas of this soil are used for corn, wheat, soybeans, white beans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness is the major limitation. (Soil management unit 3/2cA (IIw); woodland suitability group P; wildlife suitability group 2)

Blount Series

In the Blount series are somewhat poorly drained soils that formed in calcareous clay loam or silty clay loam till. These soils occur in level to gently sloping or gently undulating areas on till plains and moraines. Although they are widely distributed throughout the southern two-thirds of the county, the larger areas are in the eastern part. The native vegetation was hardwood forest consisting largely of maple, elm, hickory, and some oak.

Typical profile of Blount loam:

Ap—0 to 7 inches, dark-brown (10YR 4/3) loam; moderate, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—7 to 10 inches, pale-brown (10YR 6/3) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B21g—10 to 13 inches, light-gray (10YR 7/2) light silty clay loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; medium acid; clear, irregular boundary.

B22—13 to 16 inches, brown (7.5YR 5/4) silty clay loam; common, medium, faint, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; strongly acid; clear, irregular boundary.

B23—16 to 22 inches, dark-brown (7.5YR 4/4) silty clay loam; common, medium, faint, yellowish-brown (10YR 5/6) mottles; strong, subangular blocky

structure; firm; slightly acid; gradual, wavy boundary.

B24—22 to 28 inches, dark-brown (7.5YR 4/4) silty clay loam; common, medium, faint, yellowish-brown (10YR 5/8) mottles; strong, coarse, subangular blocky structure; firm; neutral; abrupt, irregular boundary.

C—28 inches +, dark yellowish-brown (10YR 4/4) silty clay loam; common, medium, distinct, brown (10YR 5/2) mottles; coarse, blocky structure; firm; calcareous.

The depth to mottling ranges from 7 to 16 inches. The B horizon ranges from clay loam to silty clay loam or light clay. The depth to the C horizon ranges from 20 to 36 inches.

Surface runoff is slow, permeability is moderately slow, and the available moisture capacity and natural fertility are moderately high.

The Blount soils formed in clay loam or silty clay loam till and consequently are finer textured than the Conover soils, which formed in loam, silt loam, or light clay loam till.

Blount loam, 0 to 2 percent slopes (BlA).—This soil occurs on broad flats and in small shallow swales on the uplands. The surface layer is dark-brown or dark grayish-brown loam. In some small areas soil material that washed from surrounding uplands has formed a thin surface layer only 2 to 6 inches thick. Included in the areas mapped are small areas of Pewamo soils that are in depressions.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Some cleared undrained areas are in permanent pasture. A few areas are in farm woodlots. Excess wetness and moderately slow permeability are the major limitations. (Soil management unit 1.5bAB (IIw); woodland suitability group Z; wildlife suitability group 4)

Blount loam, 2 to 6 percent slopes (BlB).—This soil occurs on low swells and ridges on the uplands and on narrow toe slopes bordering areas of Pewamo soils. The surface layer is dark-brown loam. In some small areas, generally on toe slopes, soil material that washed from surrounding more sloping uplands has formed a thin surface layer, only 2 to 6 inches thick. Included in the areas mapped are small areas of Morley soils that occur on the crests of low ridges and swells, and small areas of Pewamo soils that occur around the edges of this soil and in small depressions within the mapped areas.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Some cleared undrained areas are used for permanent pasture. A few areas are in farm woodlots. Excess wetness and moderately slow permeability are the major limitations. (Soil management unit 1.5bAB (IIw); woodland suitability group Z; wildlife suitability group 4)

Blount loam, 2 to 6 percent slopes, moderately eroded (BlB2).—This soil occurs on low ridges and swells on the uplands. Most of the original surface layer has been removed by erosion, and the present surface layer consists of pale-brown or light brownish-gray loam. It is low in organic-matter content. In most areas the depth to mottling ranges from 12 to 15 inches. Small seepy spots are common. Included in the areas mapped are small areas of Morley soils that occur on the crests of the low ridges and swells.

This soil is used mainly for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Excess wetness and moderately slow permeability are the major limitations. (Soil management unit 1.5bAB (IIw); woodland suitability group Z; wildlife suitability group 4)

Boyer Series

The Boyer series consist of well-drained soils that formed in loamy sand and light sandy loam outwash that is from 24 to 42 inches thick over calcareous coarse sand and gravel. These soils occur on nearly level to strongly sloping outwash plains, in old glacial drainageways, and on moraines. They are widely distributed throughout the southern part of the county and are extensive on outwash plains adjacent to streams in Danby, Sebewa, Portland, and Orange Townships. They developed under forest consisting mainly of oak, hickory, and some scattered white pine.

Typical profile of Boyer loamy sand:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; slightly acid; moderately high organic-matter content; abrupt, smooth boundary.

A2—7 to 11 inches, grayish-brown (10YR 5/2) loamy sand; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

B1—11 to 18 inches, yellowish-brown (10YR 5/4) heavy loamy sand; weak, fine, subangular blocky structure; very friable; clear, wavy boundary.

B21—18 to 27 inches, dark-brown (7.5YR 4/4) loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B22—27 to 34 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; medium acid; abrupt, irregular boundary.

IIC—34 inches +, grayish-brown (10YR 5/2) sand and gravel; single grain; loose; calcareous.

Fine gravel occurs on the surface in some areas. The texture of the Ap horizon ranges from loamy sand to sandy loam. The texture of the B22 horizon is sandy loam, sandy clay loam, or light clay loam. Where the B22 horizon is sandy clay loam or light clay loam, the thickness does not exceed 9 inches. In some areas thin vertical strata of B22 material extend from several inches to as much as 2 feet into the IIC horizon. The depth to the IIC horizon generally ranges from 24 to 42 inches.

Surface runoff is slow on the more gentle slopes and rapid on the stronger slopes. Permeability is moderately rapid, and the available moisture capacity and natural fertility are moderately low.

The Boyer soils are in the drainage sequence that includes the moderately well drained Perrin soils, the somewhat poorly drained Wasepi soils, and the poorly drained and very poorly drained Gilford soils. The Boyer soils are coarser textured than the Fox soils. They are finer textured than the Spinks soils, and their B horizon commonly occurs as thin and, in places, discontinuous bands.

Boyer loamy sand, 0 to 2 percent slopes (BmA).—This soil occurs on nearly level outwash plains, moraines, and lake plains. In some small areas, because of local accumulations of soil from adjacent uplands, the surface layer is darker colored and somewhat higher in organic-matter

content than that of the soil described as typical of the series.

This soil is used largely for corn, small grain, and alfalfa. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer loamy sand, 2 to 6 percent slopes (BmB).—This soil occurs on undulating or gently sloping terraces and outwash plains, principally in the valleys of streams. The plow layer is dark-brown loamy sand. Small areas of Perrin soils are included in some of the areas mapped.

Most of this soil is used for corn, small grain, hay, pasture, and other general farm crops. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer loamy sand, 2 to 6 percent slopes, moderately eroded (BmB2).—This soil occurs in undulating or gently sloping areas, principally on high terraces adjacent to the valleys of streams and rivers. Most of the original surface layer has been lost through erosion, and the present surface layer is dark yellowish-brown loamy sand. In several small areas, the surface layer is brown.

Most of this soil is used for corn, small grain, hay, pasture, and other general farm crops. Susceptibility to erosion, moderately low natural fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer loamy sand, 6 to 12 percent slopes, moderately eroded (BmC2).—This soil occurs on sloping terraces, generally adjacent to drainageways. The surface layer is dark yellowish-brown loamy sand. Included in the areas mapped are several small wooded areas in which the surface layer is very dark grayish brown.

Runoff is rapid on these strong slopes. Consequently, the amount of water available for crops is limited, and erosion is a serious hazard if the soil is cultivated.

Except for the small included wooded areas, all of this soil has been cleared. A large part of this acreage is used for corn, small grain, hay, pasture, and other general farm crops. A small acreage is idle. Susceptibility to erosion, moderately low natural fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 4aC (IIIe); woodland suitability group M; wildlife suitability group 5)

Boyer loamy sand, 12 to 18 percent slopes, moderately eroded (BmD2).—This soil occurs chiefly on high terraces adjacent to drainageways. The present surface layer commonly is dark yellowish-brown loamy sand and consists of a mixture of the grayish-brown and the yellowish-brown layers. It is low in organic-matter content.

Runoff is rapid, and erosion is active if this soil is cultivated. Because of the steeper slopes and greater runoff, this soil has less water available for plants than the less sloping soils.

Little of the acreage is cultivated. Most areas are idle or in pasture. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aD (IVe); woodland suitability group M; wildlife suitability group 5)

Boyer loamy sand, 18 to 25 percent slopes, moderately eroded (BpE2).—This soil occurs on strongly sloping stream terraces. In most areas the surface layer is yellowish-brown loamy sand and is low in organic-matter content. In a few areas it is very dark grayish brown.

Runoff is more rapid on this soil than on the slightly eroded soils. Because the surface tends to crust, a full stand of plants is difficult to obtain. Fertility, quality of tilth, and content of organic matter have been reduced by erosion.

Most of this soil is idle or in pasture. Susceptibility to erosion, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4aE (VIe); woodland suitability group M; wildlife suitability group 5)

Boyer loamy sand, 25 to 40 percent slopes, moderately eroded (BpF2).—This soil occurs on steep terraces, generally adjacent to drainageways. The present surface layer consists of a mixture of the very dark grayish-brown, grayish-brown, and yellowish-brown layers and in most places is brown loamy sand. The organic-matter content is low. The depth to loose sand and gravel commonly is between 24 and 30 inches.

At one time nearly all of this soil was used for crops, but now most of the acreage is idle or is used for pasture. A small acreage is in corn, small grain, and hay crops. Some areas have been replanted to trees. The use of machinery is limited on this soil because of the steep slopes. The major limitations are susceptibility to erosion, moderately low available moisture capacity, and moderately low fertility. (Soil management unit 4aF (VIIe); woodland suitability group M; wildlife suitability group 5)

Boyer sandy loam, 0 to 2 percent slopes (BnA).—This soil is on nearly level or gently undulating terraces and plains. The surface layer commonly is dark-brown to dark grayish-brown sandy loam and is moderately high in organic-matter content. In a few small areas, the surface layer is loamy sand. Included in the areas mapped are small areas of Perrin sandy loam.

Most of this soil is used for general farm crops. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer sandy loam, 2 to 6 percent slopes (BnB).—This soil occurs on undulating or gently sloping terraces and plains. It generally is associated with the steeper Boyer soils. The surface layer commonly is dark-brown sandy loam and is moderately high in organic-matter content. In a few small areas the surface layer is loamy sand. Small areas of Perrin sandy loam were included in the areas mapped.

Most of this soil is used for general farm crops. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer sandy loam, 2 to 6 percent slopes, moderately eroded (BnB2).—This soil occurs on undulating to gently sloping terraces and plains. It commonly is associated

with the steeper Boyer soils. The surface layer is dominantly dark yellowish-brown sandy loam and contains only a moderate amount of organic matter. Included in the areas mapped are small areas of loamy sand.

Most of this soil is used for general farm crops. Moderately low natural fertility, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer sandy loam, 6 to 12 percent slopes, moderately eroded (BnC2).—This soil occurs on sloping terraces and plains, generally adjacent to drainageways. The original surface soil has been removed by erosion. The present surface layer is a mixture of former underlying layers and is a dark yellowish-brown sandy loam. The organic-matter content is moderately low.

Most of the acreage has been cleared, and a large part is used for pasture. A smaller acreage remains in forest or is idle. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aC (IIIe); woodland suitability group M; wildlife suitability group 5)

Boyer sandy loam, 12 to 18 percent slopes, moderately eroded (BnD2).—This soil is on strongly sloping terraces and plains and generally is adjacent to drainageways. Most of the original surface layer has been lost through erosion. The present surface layer consists of a mixture of former underlying layers and is dark yellowish-brown sandy loam. In some small uncleared areas, all or nearly all of the original surface layer remains.

Surface runoff is rapid, and erosion is active if this soil is cultivated. Because slopes are steeper and runoff is greater, this soil has less water available for plants than the less sloping Boyer soils.

Most of this acreage is used for pasture. Some small areas remain in forest. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aD (IVe); woodland suitability group M: wildlife suitability group 5)

Boyer very stony loamy sand, 0 to 2 percent slopes (BoA).—This soil occurs on nearly level outwash plains and terraces along rivers and streams. The individual layers are thin, and there is a layer of sand and gravel at a depth of 24 to 30 inches. Numerous stones and cobblestones are on the surface and scattered throughout the soil material.

This soil is moderately rapidly permeable and tends to be droughty. Most of the acreage is idle or is used for unimproved pasture. The major limitations are the many stones and cobblestones, which make cultivation difficult or impractical; the moderately low available moisture capacity; and the moderately low natural fertility. (Soil management unit 4aABC (Vs); woodland suitability group M; wildlife suitability group 5)

Boyer very stony loamy sand, 2 to 6 percent slopes (BoB).—This soil occurs chiefly on undulating or gently sloping terraces along streams and rivers. The surface layer is dark-brown very stony loamy sand. Although some material from the underlying grayish-brown layer has been mixed with it, the surface layer consists mostly of the original surface soil. The individual layers of this soil are thin, and a layer of loose sand and gravel is at a depth of about 24 inches. Numerous stones and cobblestones occur both on the surface and throughout the soil material. Permeability is moderately rapid, and the available moisture capacity and natural fertility are moderately low. In a few areas, the thickness of the surface layer has been reduced by erosion, and as a result the organic-matter content has been lowered.

Most of this soil is idle or is in unimproved pasture. The major limitations are the many stones and cobblestones, which make cultivation difficult or impractical; the moderately low available moisture capacity; and moderately low natural fertility. (Soil management unit 4aABC (Vs); woodland suitability group M; wildlife suitability group 5)

Boyer very stony loamy sand, 6 to 12 percent slopes (BoC).—This soil is principally on terraces along rivers and creeks. The surface layer consists of dark yellowish-brown very stony loamy sand. In most areas there are also numerous stones and cobblestones throughout the underlying soil material. The individual layers of this soil are thin, and sand and gravel occur at a depth of about 24 inches.

Most of this soil is in permanent pasture or is idle. The major limitations are the numerous stones and cobblestones, which make cultivation difficult or impractical; the moderately low available moisture capacity; and moderately low natural fertility. (Soil management unit 4aABC (Vs); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 0 to 2 percent slopes (BsA).—These soils occur mostly on nearly level to undulating low terraces. They have a dark grayish-brown surface layer that is moderately high in organic-matter content. Stones occur on the surface in a few areas. The Boyer soil is finer textured than the Spinks. In the Spinks soil, the B horizon commonly occurs as thin and, in places, discontinuous narrow bands. The Spinks soil is described in detail under the heading "Spinks Series." Included in the areas mapped are small areas of the Plainfield soils, slightly acid variant.

Most of this acreage is used for corn, small grain, beans, hay, pasture, and other general farm crops. A few areas are in farm woodlots. The major limitations are moderately low available moisture capacity and moderately low natural fertility. (Soil management unit 4aA (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 2 to 6 percent slopes (BsB).—These soils occur mostly on low rounded ridges and mounds on the valley plains. Some areas are on valley terraces. In these areas, the surface layer is dark grayish brown and is from 12 to 14 inches thick because of the accumulation of soil materials from adjacent uplands. Included in the areas mapped are some small areas of a sandier soil. The Spinks soil is described under the heading "Spinks Series."

Most of this acreage is used for corn, small grain, beans, hay, pasture, and other general farm crops. Some areas are in farm woodlots. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded (BsB2).—These soils occur on low rounded ridges on the uplands. Most of the original surface layer has been lost through erosion, and the present surface layer is brown or yellowish-brown loamy sand. It is low in organic-matter content. Included in the areas mapped are small areas in which the dark-brown layer has been exposed by erosion. Also included are some small areas of a sandier soil. The Spinks soil is described under the heading "Spinks Series."

Most of this acreage is used for corn, small grain, beans, hay, pasture, and other general farm crops. Yields generally are low. The major limitations are moderately low natural fertility, moderately low available moisture capacity, and susceptibility to erosion. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 6 to 12 percent slopes, moderately eroded (BsC2).—These soils occur mostly on short convex slopes on the uplands and on short slopes adjacent to the valleys of rivers and creeks. Most of the original surface layer has been lost through erosion. The present surface layer is brown or yellowish-brown loamy sand and contains little organic matter. Included in the areas mapped are a few areas that are not eroded and some that are only slightly eroded. Also included are a few small areas of a sandier soil. The Spinks soil is described in detail under the heading "Spinks Series."

Most of this acreage is idle or in shrubs and second-growth forest. A few areas are used for pasture or hay. Susceptibility to erosion, moderately low natural fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 4aC (IIIe); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 12 to 18 percent slopes, moderately eroded (BsD2).—These soils occur on short slopes, both on the uplands and adjacent to valleys. Most of the original surface layer has been lost through erosion. The present surface layer is brown or yellowish-brown loamy sand and contains little organic matter. Some areas are stony and are difficult to farm. The Spinks soil is described in detail under the heading "Spinks Series."

Most of this acreage is idle, a few areas are used occasionally for pasture or hay, and some small areas have been planted to pine. The major limitations are moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion. (Soil Management unit 4aD (IVe); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 18 to 25 percent slopes, moderately eroded (BsE2).—These soils occur on short slopes in valleys and on uplands. Most of the original surface layer has been lost through erosion. The present surface layer is brown or yellowish-brown loamy sand and contains little organic matter. Included in the areas mapped are a few small areas of severely eroded soils that are low in organic-matter content. The Spinks soil is described in detail under the heading "Spinks Series."

Most of this acreage is idle or in second-growth forest and shrubs. A few areas have been planted to pine. The major limitations are moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion. (Soil management unit 4aE (VIe); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 25 to 40 percent slopes (BsF).—These soils occur on short steep slopes adjacent to valleys and drainageways. The Spinks soil is described in detail under the heading "Spinks Series."

In most areas the vegetation consists primarily of oak, hickory, and some scattered white pine and red pine. The major limitations are moderately low available moisture capacity, moderately low natural fertility, steep slopes, and susceptibility to erosion. (Soil management unit 4aF (VIIe); woodland suitability group M; wildlife suitability group 5)

Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded (BsF3).—These soils are on steep slopes, generally adjacent to drainageways and valleys. All of the original surface layer and part of the underlying layer have been lost through erosion. The present surface layer in most areas is dark-brown to yellowish-brown loamy sand. Shallow blowouts occur on some west-facing slopes, and there are shallow gullies in some areas. The Spinks soil is described in detail under the heading "Spinks Series."

Most of the acreage is idle or in second-growth forest and shrubs. Some areas have been planted to pine. The major limitations are moderately low available moisture capacity, moderately low natural fertility, steep slopes, and susceptibility to erosion. (Soil management unit 4aF3 (VIIe); woodland suitability group M; wildlife suitability group 5)

Brady Series

The Brady series consists of somewhat poorly drained soils that formed in sandy loam and loamy sand outwash material that is from 42 to 66 inches thick over neutral or calcareous loose sand and gravel. These soils occur on level to gently sloping outwash plains, valley trains, lake plains, and deltas. They are widely distributed throughout the southern two-thirds of the county, mainly along the Grand and Maple Rivers and associated outwash plains. The native vegetation was principally deciduous forest consisting largely of elm, ash, swamp white oak, soft maple, and hickory.

Typical profile of Brady sandy loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; very friable; high organic-matter content; slightly acid; abrupt, smooth boundary.

A2g—7 to 10 inches, light brownish-gray (10YR 6/2) light sandy loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, granular structure; very friable; medium acid; clear, smooth boundary.

B1g—10 to 13 inches, grayish-brown (10YR 5/2) light sandy loam; common, fine, distinct, strong-brown (7.5YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B21g—13 to 19 inches, light-gray (10YR 7/2) sandy clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; strongly acid; gradual, wavy boundary.

B22g—19 to 33 inches, grayish-brown (10YR 5/2) light sandy loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure; friable; strongly acid; gradual, irregular boundary.

IIB3—33 to 48 inches, pale-brown (10YR 6/3) loamy sand; single grain; loose; slightly acid; abrupt, irregular boundary.

IIIC—48 inches +, pale-brown (10YR 6/3) sand and gravel; single grain; loose; calcareous.

The texture of the B21g horizon ranges from sandy loam to sandy clay loam, gravelly clay loam, or clay loam. Where the texture is sandy clay loam, gravelly clay loam, or clay loam, the thickness of the B21g horizon does not exceed 10 inches. The reaction of the B horizon ranges from slightly acid to strongly acid, but the dominant reaction is medium acid or strongly acid. The reaction of the IIIC horizon ranges from neutral to calcareous. The texture of the IIIC horizon ranges from stratified sand and fine gravel to dominantly sand or gravel.

Surface runoff is very slow, permeability is moderately rapid, and the available moisture capacity and natural fertility are moderately low.

The Brady soils are not mapped separately in Ionia County but are mapped as a complex with the Wasepi soils. They have a thicker, more acid solum than the Wasepi soils, and they have a coarser textured B horizon than the Matherton soils, which are underlain by calcareous sand and gravel at a depth of only 24 to 42 inches.

Breckenridge Series

The Breckenridge series is made up of poorly drained and very poorly drained soils that formed in sandy loam and fine sandy loam that is from 18 to 42 inches thick over calcareous loam to silty clay loam till. These soils occur in level areas and slight depressions on till plains and moraines. They are widely distributed throughout the northern part of the county. The native vegetation was dominantly hardwood forest consisting largely of elm, ash, and red maple and an understory of swamp grasses and sedges.

Typical profile of Breckenridge sandy loam:

Ap—0 to 8 inches, very dark brown (10YR 2/2) sandy loam; weak, fine, granular structure; friable; high organic-matter content; medium acid; abrupt, smooth boundary.

B21g—8 to 16 inches, dark grayish-brown (10YR 4/2) fine sandy loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B22g—16 to 24 inches, grayish-brown (10YR 5/2) heavy sandy loam to light clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B23g—24 to 36 inches, pale-brown (10YR 6/3) fine sandy loam; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; massive; friable; slightly acid.

IIC—36 inches +, light brownish-gray (10YR 6/2) clay loam; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; firm; calcareous.

There is a thin layer of muck, from 2 to 4 inches thick, on the surface in some areas. The texture of the B22g and B23g horizons ranges from fine sandy loam to sandy clay loam. The reaction of the B horizon ranges from medium acid to mildly alkaline.

Surface runoff is very slow or ponded. Permeability is moderately rapid in the solum but moderately slow in the substratum. The available moisture capacity is moderately low, and natural fertility is medium.

The Breckenridge soils developed in finer textured material and have a thicker, finer textured Bg horizon than the Epoufette soils, which are underlain by sand and gravel. They have a thinner, somewhat coarser textured Bg horizon than the Berville soils.

Breckenridge sandy loam (0 to 1 percent slopes) (Bt).—This soil occurs in shallow basins and swales and in narrow depressions bordering natural drainageways. In some areas it occupies depressions in association with the somewhat poorly drained Capac soils. Small areas of Brevort soils are included in some of the areas mapped.

Most areas are used for corn, wheat, oats, beans, hay, and pasture. Poor drainage is the major limitation. (Soil management unit 3/2cA (IIw); woodland suitability group W; wildlife suitability group 2)

Brevort Series

The Brevort series consists of poorly drained and very poorly drained soils that formed in sand and loamy sand that is underlain by calcareous loam to silty clay loam till at a depth of 18 to 42 inches. These soils occur in level or nearly level areas and depressions on till plains and moraines. They are largely in the northern part of the county. The native vegetation consisted mainly of swamp white oak, ash, and elm and an understory of swamp grasses and sedges.

Typical profile of Brevort loamy sand:

Ap—0 to 8 inches, very dark gray (10YR 3/1) loamy sand; weak, fine, granular structure; very friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

C1—8 to 11 inches, light brownish-gray (10YR 6/2) loamy sand; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; slightly acid; clear, wavy boundary.

C2—11 to 24 inches, grayish-brown (10YR 5/2) loamy sand; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; slightly acid; gradual, wavy boundary.

C3—24 to 30 inches, grayish-brown (2.5Y 5/2) sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; abrupt, wavy boundary.

IIC4—30 inches +, grayish-brown (2.5Y 5/2) loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; calcareous.

A thin accumulation of mucky material occurs on the surface in some areas. The solum ranges from slightly acid to mildly alkaline. The texture of the uppermost 18 to 42 inches ranges from sand to loamy sand. The depth to the IIC4 layer ranges from 18 to 42 inches, and the texture of the IIC4 horizon ranges from loam to clay loam or silty clay loam.

Surface runoff is very slow or ponded. Permeability is rapid in the solum but slow in the substratum. The available moisture capacity is moderately low in drained areas. Natural fertility is low.

The Brevort soils lack the sandy loam B horizon that is typical of the Epoufette soils. They are underlain by loam to silty clay loam, whereas the Epoufette soils are underlain by sand and gravel. The Brevort soils are in the drainage sequence that includes the well drained and

moderately well drained Menominee soils and the somewhat poorly drained Iosco soils.

Brevort loamy sand (0 to 1 percent slopes) (Bv).—This soil occurs in level or nearly level areas and depressions on till plains and moraines. A profile of this soil is similar to the one described as representative of the series. In some areas, however, there is a 2- to 12-inch layer of muck on the surface. Included in the areas mapped are small areas in which the surface layer is sandy loam or fine sandy loam.

Most of this acreage is in pasture or woodlots. Poor drainage, low natural fertility, and moderately low available moisture capacity in drained areas are the major limitations. (Soil management unit 4/2cA (IIIw); woodland suitability group W; wildlife suitability group 6)

Brookston Series

In the Brookston series are poorly drained and very poorly drained soils that developed in calcareous loam, silt loam, or light clay loam till. These soils are in level or nearly level areas and depressions on till plains and moraines. They are widely distributed throughout the southern part of the county. The native vegetation was deciduous forest consisting mainly of elm, soft maple, basswood, and ash.

Typical profile of Brookston loam:

Ap—0 to 9 inches, very dark gray (10YR 3/1) loam; strong, fine, granular structure; friable; high organic-matter content; mildly alkaline; abrupt, smooth boundary.

B21g—9 to 11 inches, dark grayish-brown (2.5Y 4/2) clay loam; common, fine, distinct mottles of yellowish brown (10YR 5/8); strong, medium, subangular blocky structure; firm; medium organic-matter content; mildly alkaline; diffuse, wavy boundary.

B22g—11 to 18 inches, grayish-brown (2.5Y 5/2) clay loam; common, medium, distinct mottles of olive yellow (2.5Y 6/8); strong, medium, subangular blocky structure; firm; mildly alkaline; diffuse, wavy boundary.

B23g—18 to 28 inches, grayish-brown (2.5Y 5/2) clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/4); strong, coarse, subangular blocky structure; firm; mildly alkaline; abrupt, irregular boundary.

Cg—28 inches +, grayish-brown (2.5Y 5/2) loam; common, medium, distinct mottles of light olive brown (2.5Y 5/6); weak, coarse, angular blocky structure; friable; calcareous.

The texture of the B horizon ranges from clay loam to heavy silty clay loam. The depth to the Cg horizon ranges from 25 to 40 inches.

Surface runoff is very slow or ponded, permeability is moderately slow, and the available moisture capacity and natural fertility are high.

The Brookston soils have a coarser textured Bg horizon than the Pewamo soils, which developed in heavy clay loam or silty clay loam, and a finer textured Bg horizon than the Barry soils. They are in the drainage sequence that includes the well drained Miami soils, the moderately well drained Celina soils, the somewhat poorly drained Conover soils, and the very poorly drained Kokomo soils.

Brookston loam (0 to 1 percent slopes) (Bw).—This soil occurs on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways.

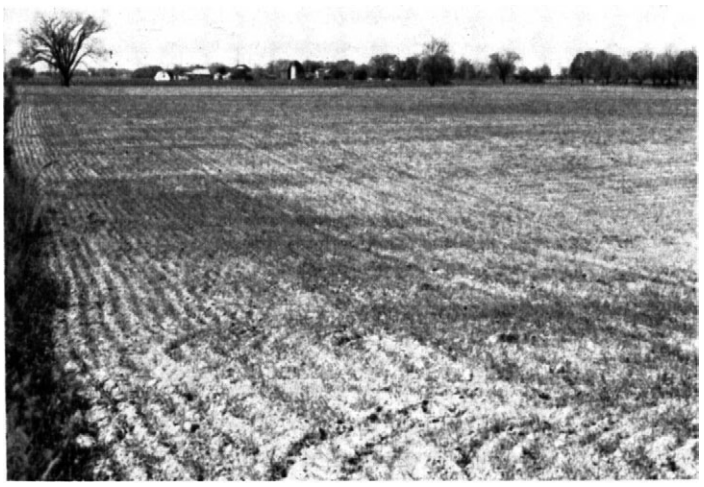

Figure 2.—**Level, poorly drained Brookston soils. Slow surface drainage and poor internal drainage are limitations on these soils.**

In some places the surface layer is sandy loam. In others soil material that washed from surrounding areas has formed a surface layer only 2 to 4 inches thick. Small areas of Berville soils, mainly on broad flats adjacent to natural drainageways, are included in the areas mapped. Also included are small areas of Conover soils that occur on slight rises.

Most areas of Brookston loam are cleared. If drainage is adequate, these areas are used for corn, wheat, oats, soybeans, white beans, sugarbeets, and legume-grass hay or pasture. Some undrained areas are used for permanent pasture or farm woodlots. Providing adequate drainage is the principal management problem on this soil (fig. 2). (Soil management unit 2.5cA (I); woodland suitability group P; wildlife suitability group 2)

Cadmus Series

The Cadmus series consists of moderately well drained soils that formed in loamy deposits that contained a considerable amount of gravel and sand. These soils are underlain by loam to silty clay loam glacial till at a depth of 18 to 42 inches. They occur in level to gently sloping areas on till plains and low moraines throughout the southern part of the county. The native vegetation consisted chiefly of hard maple, hickory, white oak, and red oak.

Typical profile of Cadmus sandy loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—7 to 12 inches, pale-brown (10YR 6/3) sandy loam; weak, fine, granular structure; friable; medium acid; clear, wavy boundary.

B1—12 to 14 inches, brown (10YR 5/3) sandy loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

IIB2—14 to 34 inches, brown (7.5YR 5/4) gravelly sandy clay loam; common, fine, faint, dark-brown (7.5YR 4/4) mottles in lower part; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

IIIC—34 inches +, brown (10YR 5/3) loam; common, fine, faint, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; firm; calcareous.

The texture of the B2 horizon ranges from heavy sandy loam to gravelly clay loam or clay loam. In some areas there is a thin, 1- to 5-inch horizon of calcareous sand and gravel just above the calcareous IIIC horizon. The depth to mottling ranges from 14 to 30 inches.

Runoff is slow, permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Cadmus soils are in the drainage sequence that includes the well-drained Kendallville soils, the somewhat poorly drained Macomb soils, and the poorly drained and very poorly drained Berville soils. The Cadmus soils have a coarser textured solum and contain more gravel than the Celina soils. They are underlain by loam to silty clay loam, whereas the Ionia soils are underlain by sand and gravel.

Cadmus loam, 0 to 2 percent slopes (CaA).—This soil occurs on nearly level and very gently undulating uplands, in close association with the Macomb soils, which are at slightly lower elevations and generally surround the Cadmus soil. In most places the texture of the fourth layer is clay loam. Mottles commonly occur in the upper part of the fourth layer and extend downward. Included in some of the areas mapped are small areas of Macomb soils that are in slight depressions.

Most of the acreage is used for corn, wheat, oats, and legume-grass hay or pasture. Except for a slight need for drainage, the limitations are minor. (Soil management unit 3/2aA (I); woodland suitability group U; wildlife suitability group 1)

Cadmus loam, 2 to 6 percent slopes (CaB).—This soil occurs on undulating uplands, generally between the Kendallville soils, which are at higher elevations, and the Macomb soils, which are at lower elevations. The surface layer is dark brown or brown in a few areas. Small areas of both Kendallville and Macomb soils are included in many of the areas mapped. The texture of the fourth layer generally is clay loam.

Most of this acreage is used for corn, wheat, oats, and legume-grass hay or pasture. The slope and, to some extent, the need for drainage are limitations. (Soil management unit 3/2aB (IIe); woodland suitability group U; wildlife suitability group 1)

Cadmus sandy loam, 0 to 2 percent slopes (CdA).—This soil occurs on flats and on very gently undulating uplands. It is closely associated with the Macomb soils, which are at slightly lower elevations than the Cadmus soil and generally surround it. In many of the areas mapped there are small depressions in which the Macomb soils occur. Mottles occur in the upper part of the fourth layer of the Cadmus soil and extend downward.

Most of this acreage is used for corn, wheat, oats, and legume-grass hay or pasture. Except for a slight need for drainage, the limitations are minor. (Soil management unit 3/2aA (I); woodland suitability group U; wildlife suitability group 1)

Cadmus sandy loam, 2 to 6 percent slopes (CdB).—This soil occurs on undulating uplands, generally between the Kendallville soils, which are at higher elevations, and the Macomb soils, which are at lower elevations. The depth to mottling ranges from 16 inches to about 30 inches. Small areas of Kendallville and Macomb soils are included in many of the areas mapped.

Most of the acreage is used for corn, wheat, oats, and legume-grass hay or pasture. The slope and, to some extent, the need for drainage are limitations. (Soil management unit 3/2aB (IIe); woodland suitability group U; wildlife suitability group 1)

Capac Series

Soils of the Capac series formed in calcareous loam, silt loam, or light clay loam till and are somewhat poorly drained. These soils occur in level to gently sloping areas on till plains and low moraines throughout the northern part of the county. The native vegetation was dominantly hardwood forest consisting largely of sugar maple, elm, oak, and some white pine and red pine.

Typical profile of Capac loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

Bir—8 to 13 inches, yellowish-brown (10YR 5/6) loam; few, fine, distinct, brown (10YR 5/3) mottles; weak, thin, platy structure; friable; slightly acid; clear, wavy boundary.

B'21t—13 to 18 inches, dark yellowish-brown (10YR 4/4) clay loam; common, fine, distinct, pale-brown (10YR 6/3) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B'22t—18 to 26 inches, brown (10YR 5/3) clay loam; common, medium, faint, light brownish-gray (10YR 6/2) mottles; strong, medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

B'23t—26 to 34 inches, brownish-yellow (10YR 6/8) clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

C—34 inches +, brown (10YR 5/3) loam; common, medium, faint, very pale brown (10YR 7/3) mottles; weak, coarse, angular blocky structure; firm; calcareous.

The texture of the Bt horizon is clay loam, sandy clay loam, or silty clay loam. In some areas there is a grayish-brown (10YR 5/2) A'2 horizon, 1 to 3 inches thick, above the B'21t horizon. The depth to the C horizon ranges from 24 to 42 inches.

Surface runoff is slow or medium, permeability is moderate, and the available moisture capacity is moderately high. Natural fertility is moderately high or high.

The Capac soils are finer textured than the Coral soils. They are in the drainage sequence that includes the well drained and moderately well drained Marlette soils and the poorly drained and very poorly drained Brookston soils.

Capac loam, 0 to 2 percent slopes (CeA).—This soil occurs on broad flats and in small shallow depressions and swales on gently undulating uplands. The surface layer is moderately high in organic-matter content. In places soil material that washed from surrounding uplands has formed a thin surface layer only 2 to 4 inches thick. Included in the areas mapped are small areas of Brookston soils that occur in slight depressions.

Drained areas are used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Some undrained areas are in permanent pasture or farm woodlots. Excess wetness is the major limitation. (Soil manage-

ment unit 2.5bAB (IIw); woodland suitability group Z; wildlife suitability group 2)

Capac loam, 2 to 6 percent slopes (CeB).—This soil occurs on low swells, on low ridges, and on narrow toe slopes bordering the Brookston soils. Surface runoff is medium. In places soil material that washed from surrounding uplands has formed a thin surface layer only 2 to 4 inches thick. Included in the areas mapped are small areas of the moderately well drained Marlette soils and small areas of Capac sandy loam, 2 to 6 percent slopes.

Most of the acreage is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Excess wetness and, to some extent, slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5AB (IIw); woodland suitability group Z; wildlife suitability group 2)

Capac sandy loam, 0 to 2 percent slopes (CfA).—This soil occurs on broad flats and in small shallow swales on gently undulating uplands. The third, fourth, and fifth layers are mostly sandy clay loam. In most areas the surface layer contains only a moderate amount of organic matter. In some areas soil material that washed from surrounding uplands has formed a thin surface layer only 2 to 4 inches thick. Small areas of Coral soils are included in some of the areas mapped.

Most drained areas are used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Some small undrained areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 2.5bAB (IIw); woodland suitability group Z; wildlife suitability group 2)

Capac sandy loam, 2 to 6 percent slopes (CfB).—This soil occurs mainly on low ridges and swells on the uplands. Small narrow areas are on toe slopes, adjacent to the more sloping well-drained Marlette soils. The surface layer is dark grayish brown and is moderately low in organic-matter content. Small areas of Marlette soils were included in the mapping of the very gently undulating areas.

Most of the acreage is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small areas are in farm woodlots or permanent pasture. Excess wetness and, to some extent, slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5bAB (IIw); woodland suitability group Z; wildlife suitability group 2)

Carlisle Series

In the Carlisle series are very poorly drained soils that formed in deep mixed organic deposits that consisted largely of woody material, reeds, grasses, and sedges. These soils occur on the level parts of moraines, till plains, and outwash plains. They are widely distributed throughout the county and are relatively extensive. The native vegetation consisted largely of elm, ash, soft maple, tamarack, oak, and aspen and an understory of grasses, reeds, sedges, and other water-tolerant plants.

Typical profile of Carlisle muck:

1—0 to 14 inches, black (10YR 2/1) muck; numerous small fragments of wood; moderate, fine, granular structure; friable; slightly acid; gradual, smooth boundary.

2—14 to 24 inches, very dark grayish-brown (10YR 3/2) muck; moderate, medium, granular structure; more woody fragments than in layer above; friable; slightly acid; gradual, smooth boundary.

3—24 to 42 inches +, brown (10YR 5/3) peat composed mostly of grasses, sedges and some woody fragments; massive; fibrous; slightly acid.

In some areas the first horizon is very dark gray (10YR 3/1). The second horizon ranges from very dark grayish brown (10YR 3/2) to very dark brown (10YR 2/2) in color, and the third horizon from brown (10YR 5/3) to dark yellowish brown (10YR 4/4). The depth to undecomposed peat ranges from about 20 to 36 inches. The reaction ranges from strongly acid to slightly acid.

Surface runoff is very slow or ponded. In undrained areas, the water table is at or near the surface. Permeability is moderately rapid, and the available moisture capacity is high. Natural fertility is only moderately high because of the unbalanced proportions of essential plant nutrients. Wind erosion is a hazard in cleared areas.

The Carlisle soils differ from the Tawas, Linwood, and Willette in that the depth to the mineral substratum is more than 42 inches. They are less acid throughout and generally are more decomposed than Rifle muck.

Carlisle muck (0 to 1 percent slopes) (Cg).—A profile of this soil is similar to the one described as representative of the series. In a few areas there is a 6- to 10-inch layer of mineral soil on the surface. Small areas of Linwood, Willette, and Wallkill soils are included in the areas mapped.

A large acreage is in corn and mint. A smaller acreage is in soybeans, oats, and hay. Some areas are used for Irish potatoes, onions, and other vegetables. Poor drainage, susceptibility to wind erosion, and unbalanced fertility are the major limitations. (Soil management unit McA (IIIw); woodland suitability group J; wildlife suitability group 8)

Celina Series

The Celina series consists of moderately well drained soils that formed in calcareous loam, silt loam, or light clay loam till. These soils occur on the level to sloping parts of till plains and low moraines throughout the southern part of the county. The native vegetation was mainly hardwood forest consisting largely of sugar maple, elm, ash, hickory, and oak.

Typical profile of Celina loam:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) loam; moderate, fine, granular structure; friable; medium organic-matter content; slightly acid; abrupt, smooth boundary.

A2—7 to 11 inches, pale-brown (10YR 6/3) loam; moderate, fine, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B21—11 to 16 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B22—16 to 24 inches, brown (10YR 5/3) clay loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; strong, medium, subangular blocky structure; firm; slightly acid; clear, irregular boundary.

C—24 inches +, brown (10YR 5/3) heavy loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; friable; medium, subangular blocky structure; calcareous.

In some areas the Ap horizon is dark gray (10YR 4/1). The texture of the B22 horizon ranges from clay loam to

heavy silty clay loam. The depth to mottling ranges from 16 to 28 inches. The depth to the C horizon ranges from 20 to 42 inches. The C horizon is calcareous loam, silt loam, or light clay loam.

Runoff is slow on the level or nearly level soils and medium on the sloping soils. Permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Celina soils are finer textured throughout the solum than the Dryden soils and are coarser textured than the Morley. They are in the drainage sequence that includes the well-drained Miami soils, the somewhat poorly drained Conover soils, the poorly drained and very poorly drained Brookston soils, and the very poorly drained Kokomo soils.

Celina loam, 0 to 2 percent slopes (ChA).—This soil occurs on the smooth broad ridgetops and narrow flats between low ridges of Miami soils. The surface layer generally is moderately high in organic-matter content. In some areas it is dark gray in color. Some small depressions, in which the darker colored wetter Conover soils occur, are included in the areas mapped. Also included are a few small stony areas.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few fairly large areas are in farm woodlots. Excess wetness is a minor limitation. (Soil management unit 2.5aA (I); woodland suitability group D; wildlife suitability group 1)

Celina loam, 2 to 6 percent slopes (ChB).—This soil occurs on broad gently undulating ridgetops. For the most part, the surface layer is grayish-brown loam and is moderate in organic-matter content. In a few areas the surface layer is silt loam, and in a few small areas it ranges from 10 to 12 inches in thickness because of an accumulation of soil material that washed from adjacent uplands. Small areas of Conover and Miami soils are included in most of the areas mapped. The Conover soils are in slight depressions, and the Miami soils are at the higher elevations.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas are in farm woodlots. Slope and susceptibility to erosion are the major limitations, and excess wetness is a minor limitation. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Celina loam, 2 to 6 percent slopes, moderately eroded (ChB2).—This soil occurs on undulating and gently sloping uplands. The surface layer is dominantly brown in color and is moderately low in organic-matter content. In some areas a few shallow gullies have formed, and the surface layer is yellowish brown. Small areas of Miami soils are included in most of the areas mapped.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations, and excess wetness is a minor limitation. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Celina loam, 6 to 12 percent slopes, moderately eroded (ChC2).—This soil occurs on the short slopes of ridges and swells on the uplands. It is closely associated with the Miami soils, which generally occupy the ridgetops and hill crests. The surface layer of brown loam is moderately low in organic-matter content. Small areas of Miami soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Ceresco Series

The Ceresco series consists of somewhat poorly drained soils that formed in stratified, neutral to calcareous heavy loamy fine sand and fine sandy loam. These soils are on level or nearly level flood plains. They are widely scattered throughout the county but generally occur as small areas. The native vegetation consisted mainly of elm, ash, hickory, and cottonwood.

Typical profile of Ceresco sandy loam:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; friable; moderately high organic-matter content; mildly alkaline; abrupt, smooth boundary.

C1g—9 to 12 inches, dark grayish-brown (10YR 4/2) sandy loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; weak, medium, granular structure; friable; calcareous; gradual, wavy boundary.

C2g—12 to 26 inches, dark grayish-brown (10YR 4/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, granular structure; friable; calcareous; gradual, wavy boundary.

C3—26 inches +, yellowish-brown (10YR 5/4) sandy loam; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles; massive; friable; calcareous.

The Ap horizon is very dark gray (10YR 3/1) or dark grayish brown (10YR 4/2) in some areas. The texture of the material below the surface layer ranges from fine sandy loam to heavy loamy fine sand. The depth to mottling ranges from 6 to 20 inches. In places thin strata of loam and sand occur in the C horizon.

Surface runoff is very slow, permeability is moderately rapid, and the available moisture capacity and natural fertility are moderate or moderately low.

The Ceresco soils are in the drainage sequence that includes the well drained and moderately well drained Landes soils and the poorly drained and very poorly drained Cohoctah soils. Although their drainage is comparable to that of the Algansee and Shoals soils, they are finer textured than the Algansee and coarser textured than the Shoals.

Ceresco-Shoals loams (0 to 1 percent slopes) (Cl).—This complex occurs on level bottom lands along the valleys of rivers and creeks. The surface layer is dominantly loam, but there are some areas in which the surface layer is silt loam. The Shoals soil is described in detail under the heading "Shoals Series." Within the areas mapped are some small depressions in which the wetter, darker colored Cohoctah or Sloan soils occur.

Most of the acreage is cleared. Where drainage is adequate, the soils are used for cultivated crops. Corn is the principal crop. Other crops commonly grown are soybeans, white beans, and legume-grass hay or pasture. A few narrow nearly inaccessible areas are in farm woodlots or permanent pasture. Excess wetness and occasional flooding are the major limitations. (Soil management

unit L-2cA (IIIw); woodland suitability group O; wildlife suitability group 2)

Ceresco-Shoals sandy loams (0 to 1 percent slopes) (Cm).—This complex occurs on level bottom lands along the valleys of rivers and creeks and in many places is adjacent to the banks of rivers and creeks. Although the surface layer is dominantly sandy loam, in some places it is fine sandy loam. In many areas there are thin layers of loamy sand in the layers below the surface layer. Included in the areas mapped are small depressions in which the wetter darker colored Cohoctah soils occur. The Shoals soils are described in detail under the heading "Shoals Series."

Most of this acreage is cleared. Adequately drained areas are used for cultivated crops. Corn is the principal crop. Other crops commonly grown are soybeans, white beans, and legume-grass hay or pasture. A few areas are in farm woodlots or permanent pasture. Excess wetness and occasional flooding are the major limitations. (Soil management unit L-2cA (IIIw); woodland suitability group O; wildlife suitability group 2)

Chelsea Series

In the Chelsea series are well drained and moderately well drained soils that formed in sand and loamy sand on level to gently sloping till and outwash plains and on the nearly level to steep parts of moraines. These soils are widely distributed throughout the northern half of the county. The native vegetation consisted mainly of red pine, white pine, oak, and hickory.

Typical profile of Chelsea loamy sand:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; moderately low organic-matter content; medium acid; abrupt, smooth boundary.

Bir—10 to 28 inches, dark yellowish-brown (10YR 4/4) loamy sand; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

A'2—28 to 42 inches, light yellowish-brown (10YR 6/4) medium sand; single grain; loose; medium acid; clear, wavy boundary.

A'2&B't—42 to 60 inches, light yellowish-brown (10YR 6/4) sand (representing the A'2 horizon) and thin, ½- to 3-inch, commonly discontinuous intersecting bands of dark-brown (7.5YR 4/4) loamy sand (representing the B't horizon); the A'2 material is single grain and loose; the B't material has weak, fine, subangular blocky structure and is friable; medium acid; boundary between the last B't horizon and the C horizon is abrupt and smooth.

C—60 inches +, very pale-brown (10YR 7/3) medium sand; single grain; loose; slightly acid.

In undisturbed areas there is a thin O2 horizon and a light-gray (10YR 7/1) loamy sand A2 horizon above the Bir horizon. The texture of the B't horizon ranges from loamy sand to light sandy loam. The bands of the B't horizon generally occur between a depth of 42 and 60 inches. Where the Chelsea soils grade toward the Montcalm, a few very thin, ⅛- to ¼-inch discontinuous bands of the B't horizon occur above a depth of 42 inches, and the bands below this depth are thicker than those in the profile described. Where the Chelsea soils grade toward the Grayling, bands of the B't horizon occur at a depth of 60 inches, or slightly more, and are very thin (⅛- to ¼-inch).

Surface runoff is very slow, permeability is rapid, and the available moisture capacity and natural fertility are low. Both wind and water erosion are hazards if the Chelsea soils are left without a cover of vegetation or if the plow layer is depleted of organic matter.

The Chelsea soils are associated with the Montcalm, Mancelona, and Grayling soils. They differ from the Montcalm in that the bands of the textural B horizon are coarser textured but are less numerous and thinner, and they differ from the Grayling in that the bands of the textural B horizon extend to a greater depth.

Chelsea loamy sand, 0 to 2 percent slopes (CnA).—A profile of this soil is similar to the one described, except that in some areas the surface layer is very dark gray. Some small areas of Grayling soils are included in the areas mapped.

Most of the acreage is in forest. Cleared areas are used for a rotation of crops and pasture, but crop yields generally are low. Low available moisture capacity and low natural fertility are the major limitations. (Soil management unit 5aAB (IVs); woodland suitability group E; wildlife suitability group 5)

Chelsea loamy sand, 2 to 6 percent slopes (CnB).—This soil is gently undulating. Included in the areas mapped are some small areas of Grayling soils.

Most of this soil is used for a rotation of crops and pasture. Some areas are idle or are used for woodlots. Broad areas that are not protected by vegetation are susceptible to both wind and water erosion. Low natural fertility and low available moisture capacity are major limitations. (Soil management unit 5aAB (IVs); woodland suitability group E; wildlife suitability group 5)

Chelsea loamy sand, 2 to 6 percent slopes, moderately eroded (CnB2).—In most areas the surface layer of this soil is browner and contains less organic matter than that of the soil described as typical of the series. On about a third of the acreage, most of the original surface layer has been removed by erosion, and the present surface layer consists mostly of soil material from the underlying dark yellowish-brown layer. There are some small areas in which all of the original surface layer has been lost through either wind or water erosion and the dark yellowish-brown layer is exposed. Some small areas of Grayling soils were included in mapping.

Although some of this soil is used for a rotation of crops and pasture, most of the acreage is idle or in second-growth forest. Pine has been planted in a few small areas. Susceptibility to erosion, low natural fertility, and low available moisture capacity are the major limitations. (Soil management unit 5aAB (IVs); woodland suitability group E; wildlife suitability group 5)

Chelsea loamy sand, 6 to 12 percent slopes, moderately eroded (CnC2).—Most of the original surface layer of this soil has been removed by erosion, and the present surface layer consists mostly of soil material from the underlying dark yellowish-brown layer. It is low in organic-matter content. Included in some of the areas mapped are small areas of Grayling soils.

Most of this acreage is used for pasture. Some areas are idle or in second-growth forest. Susceptibility to erosion, low available moisture capacity, and low fertility are the principal limitations. (Soil management unit

5aC (VIs); woodland suitability group E; wildlife suitability group 5)

Chelsea sand, 0 to 2 percent slopes (CoA).—Most of this soil is well drained. However, there are some small areas that are only moderately well drained. In some places the bottom layer is limy coarse sand and gravel. Included in some of the areas mapped are small isolated spots of Mancelona and Grayling soils that were too small to be mapped separately.

Most of the acreage is forested. A few areas are used for pasture. Low available moisture capacity and low natural fertility are the major limitations. (Soil management unit 5aAB (IVs); woodland suitability group E; wildlife suitability group 5)

Chelsea sand, 2 to 6 percent slopes (CoB).—This soil is well drained. In some areas the bottom layer is limy coarse sand and fine gravel. A layer of dark-brown loamy sand or coarse sandy loam occurs just above this limy layer. Included in some of the areas mapped are small areas of Mancelona and Grayling soils.

Most of the acreage is used for pasture. Some small areas are in farm woodlots, and others are used for cultivated crops. Yields generally are low. Susceptibility to erosion, low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 5aAB (IVs); woodland suitability group E; wildlife suitability group 7)

Chelsea sand, 2 to 6 percent slopes, moderately eroded (CoB2).—This soil is low in organic-matter content. Most of the original surface layer has been removed by erosion, and the present surface layer consists mainly of soil material from the underlying dark yellowish-brown layer. In places the light yellowish-brown layer is exposed. In some areas the bottom layer is limy coarse sand and fine gravel. Small areas of the Mancelona and Grayling soils are included in the areas mapped.

Most of the acreage is idle. A few areas are used for pasture, and some areas have been planted to pine. Susceptibility to erosion, low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 5aAB (IVs); woodland suitability group E; wildlife suitability group 5)

Chelsea sand, 6 to 12 percent slopes, moderately eroded (CoC2).—Most of the original surface layer has been removed by erosion, and the present surface layer consists mostly of soil material from the dark yellowish-brown layer. In places the light yellowish-brown layer is exposed. In some areas the bottom layer is limy coarse sand and fine gravel. Some areas of Mancelona and Grayling soils are included in some of the areas mapped.

Most of the acreage is idle. Some areas are planted to pine, and a few areas are used for pasture. Erosion, low natural fertility, and low available moisture capacity are the major limitations. (Soil management unit 5aC (VIs); woodland suitability group E; wildlife suitability group 5)

Cohoctah Series

The Cohoctah series consists of poorly drained and very poorly drained soils that formed in stratified heavy loamy fine sand, sandy loam, or fine sandy loam. These soils occur in level or nearly level areas and depressions along rivers and creeks throughout the county but are mainly along the Maple and Grand Rivers. The native vegetation consisted chiefly of red maple, ash, swamp white oak, elm, and aspen.

Typical profile of Cohoctah sandy loam:

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

B2—8 to 15 inches, brown (10YR 4/3) sandy loam; common, medium, faint, dark-brown (10YR 3/3) mottles; weak, medium, subangular blocky structure; friable; calcareous; clear, wavy boundary.

C1—15 to 30 inches, light olive-brown (2.5Y 5/4) sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; calcareous; clear, wavy boundary.

C2—30 inches +, light-gray (2.5Y 7/2) sandy loam; few, fine, distinct, olive-yellow (2.5Y 6/8) mottles; massive; friable; calcareous.

In some areas thin strata of loam, silt, and sand occur in the B2 and C horizons. The texture of the B2 and C horizons ranges from heavy loamy fine sand to sandy loam or fine sandy loam but is predominantly sandy loam.

Surface runoff is slow, permeability is moderate or moderately rapid, and the available moisture capacity and natural fertility are moderate or moderately low.

The Cohoctah soils are in the drainage sequence that includes the well drained and moderately well drained Landes soils and the somewhat poorly drained Ceresco soils. They are finer textured than the Glendora soils and coarser textured than the Sloan.

Cohoctah-Sloan loams (0 to 1 percent slopes) (Cp).—This complex occurs in level areas or slight depressions on bottom lands bordering rivers and creeks. Although some of the areas mapped are of only one of these soils, most of the areas include both. The surface layer is silt loam in some places. In several small areas, there are numerous stones on the surface and throughout the soil material. The Sloan soil is described in detail under the heading "Sloan Series." Included in the areas mapped are small areas of Ceresco and Shoals soils that are on slight swells.

Most of this acreage is cleared. Where drainage is adequate, the soils are cultivated. The principal crops are corn and soybeans. Some areas are used for white beans, oats, and legume-grass hay or pasture, and others are in farm woodlots or permanent pasture. Excess wetness and occasional flooding are the major limitations. (Soil management unit L–2cA (IIIw); woodland suitability group O; wildlife suitability group 2)

Cohoctah-Sloan sandy loams (0 to 1 percent slopes) (Cr).—These soils occur on level bottom lands along the valleys of rivers and creeks, commonly adjacent to the banks of these streams. Most of the areas mapped include both soils. The surface layer is predominantly sandy loam, but in some areas it is fine sandy loam or sand. In places thin layers of loamy sand or sand occur below the surface layer. In several small areas, there are numerous stones on the surface and throughout the soil material. The Sloan soil is described in detail under the heading "Sloan Series." Small areas of Ceresco and

Shoals soils that are on slight swells are included in some of the areas mapped.

Most of the acreage is cleared. Where drainage is adequate, the soils are cultivated. The principal crops are corn and soybeans. Some areas are used for white beans, oats, and legume-grass hay or pasture, and stony and undrained areas are in farm woodlots or permanent pasture. Excess wetness and occasional flooding are major limitations. (Soil management unit L-2cA (IIIw); woodland suitability group O; wildlife suitability group 2)

Colwood Series

The Colwood series consists of poorly drained and very poorly drained soils that formed in stratified silt, fine sand, and very fine sand. These soils are in level or nearly level areas and slight depressions throughout the county. The native vegetation consisted mainly of soft maple, elm, aspen, and alder and an understory of marsh grasses.

Typical profile of Colwood loam:

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

B21g—8 to 12 inches, dark grayish-brown (10YR 4/2) heavy fine sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, granular structure; friable; neutral; clear, wavy boundary.

B22g—12 to 18 inches, gray (10YR 6/1) sandy loam; common, medium, distinct, yellow (10YR 7/8) and yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; friable; neutral; clear, wavy boundary.

B23g—18 to 28 inches, gray (10YR 6/1) light sandy clay loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; moderate, medium, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

B3g—28 to 36 inches, gray (10YR 6/1) light sandy loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, fine, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.

IICg—36 to 66 inches +, light-gray (10YR 7/1) silt; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; massive; friable; calcareous.

The A horizon ranges from slightly acid to mildly alkaline in reaction. The texture of the B horizon depends on the thickness and sequence of the various deposits but ranges from fine sandy loam to light silty clay loam. The texture of the IICg horizon is dominantly silt but in places is stratified silt, fine sand, and very fine sand. In some areas thin strata, from 1 to 3 inches thick, of sand, clay, or silty clay loam occur in the B and IICg horizons. The depth to the IICg horizon ranges from 24 to 42 inches.

Surface runoff is very slow or ponded, permeability and the available moisture capacity are moderate, and natural fertility is moderate or moderately high.

The Colwood soils are in the drainage sequence that includes the moderately well drained Tuscola soils and the somewhat poorly drained Kibbie soils. They have a coarser textured Bg horizon and a higher content of fine sand throughout the solum than the Brookston soils, which formed in loam, silt loam, or light clay loam. Their Bg horizon varies more in texture than the Bg horizon of the Barry soils, which formed in sandy loam.

Colwood loam (0 to 1 percent slopes) (Cs).—This soil occurs on flat valley and lake plains. It commonly occupies the lower lying areas in association with the Conover and Brookston soils. The surface layer ranges from fine sandy loam to silt loam or loam, although in a few small areas it is loamy fine sand. The organic-matter content is high. In places some sand and gravel occur in the bottom layer. Small areas of Brookston soils are included in some of the areas mapped.

Most of the acreage is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture (fig. 3). A few undrained areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 2.5cA (I); woodland suitability group W; wildlife suitability group 2)

Figure 3.—**New drainage ditch in the Colwood soils.**

Conover Series

In the Conover series are somewhat poorly drained soils that formed in calcareous loam, silt loam, or light clay loam till. These soils are on the level to gently sloping parts of till plains and low moraines throughout the southern part of the county. The native vegetation was mainly hardwood forest that consisted chiefly of elm, ash, soft maple, oak, hickory, and basswood.

Typical profile of Conover loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; medium organic-matter content; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, pale-brown (10YR 6/3) heavy loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, granular structure; friable; medium acid; clear, wavy boundary.

B1—12 to 16 inches, brown (10YR 5/3) heavy loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B21—16 to 24 inches, brown (10YR 5/3) clay loam; common, fine, distinct, brownish-yellow (10YR 6/8) mottles;

strong, coarse, subangular blocky structure; firm; strongly acid; gradual, wavy boundary.

B22—24 to 34 inches, pale-brown (10YR 6/3) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

C—34 inches +, brown (10YR 5/3) heavy loam; common, medium, faint, yellowish-brown (10YR 5/4) mottles; weak, coarse, angular blocky structure; friable; calcareous.

The depth to mottling ranges from 6 to 16 inches. The texture of the B21 and B22 horizons ranges from light clay loam to heavy silty clay loam. The depth to the C horizon ranges from 20 to 42 inches.

Permeability is moderate or moderately slow, the available moisture capacity is moderately high, and natural fertility is moderately high or high.

The Conover soils are finer textured throughout the solum than the Locke soils and are coarser textured than the Blount soils. They are in the drainage sequence that includes the well drained Miami soils, the moderately well drained Celina soils, the poorly drained and very poorly drained Brookston soils, and the very poorly drained Kokomo soils.

Conover loam, 0 to 2 percent slopes (CtA).—This soil occurs on broad flats and in small shallow depressions and swales on gently undulating uplands. In several small areas on toe slopes, the surface layer of very dark grayish-brown loam is 10 to 12 inches thick because of an accumulation of soil material that washed from more sloping areas. Included in the areas mapped are small areas of Brookston soils, which are in slight depressions, and small areas of Macomb soils.

Most of this soil is cleared. If adequately drained it is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small undrained areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 2.5bAB (IIw); woodland suitability group Z; wildlife suitability group 2)

Conover loam, 2 to 6 percent slopes (CtB).—This soil occurs on low swells and ridges on undulating uplands. In several small areas on toe slopes, the surface layer of very dark grayish-brown loam is from 10 to 12 inches thick because of an accumulation of soil material that washed from more sloping areas. In some places the surface layer is dark brown and is moderately low in organic-matter content. Small areas of Macomb and Celina soils were included in mapping.

Most of this soil is cleared. If adequately drained it is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Some small undrained areas are in farm woodlots. Excess wetness and, to a limited extent, slope and erosion are the major limitations. (Soil management unit 2.5bAB (IIw); woodland suitability group Z; wildlife suitability group 2)

Conover loam, 2 to 6 percent slopes, moderately eroded (CtB2).—This soil occurs on low swells on undulating uplands. In most areas the surface layer is dark-brown loam and is moderately low in organic-matter content. In a few small areas, the brown third layer is exposed. Some small areas of Celina soils were included in mapping.

Most of this soil is cleared. If adequately drained, it is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Excess wetness is the major limitation, and susceptibility to erosion is a minor limitation. (Soil management unit 2.5bAB (IIw); woodland suitability group Z; wildlife suitability group 2)

Conover extremely stony loam, 2 to 6 percent slopes (CuB).—This soil occurs on undulating uplands, generally adjacent to natural drainageways. Stones on the surface and throughout the soil material are numerous enough to make the use of all machinery, except very light machinery or hand tools, impractical.

Most areas are idle or in unimproved pasture. Excess wetness and stoniness are the major limitations. (Soil management unit 4aABC (Vs); woodland suitability group Z; wildlife suitability group 2)

Coral Series

The Coral series consists of somewhat poorly drained soils that formed in calcareous sandy loam till. These soils occur on the level to gently sloping parts of till plains and low moraines throughout the northern part of the county. They developed under forest vegetation consisting mainly of maple, elm, beech, oak, and hickory.

Typical profile of Coral sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 10 inches, pale-brown (10YR 6/3) sandy loam; weak, medium, granular structure; friable; medium acid; abrupt, wavy boundary.

Bir—10 to 13 inches, dark-brown (7.5YR 4/4) sandy loam; few, fine, faint, yellowish-brown (10YR 5/6–6/8) mottles; weak, coarse, granular structure; friable; strongly acid; abrupt, wavy boundary.

A'2—13 to 17 inches, pale-brown (10YR 6/3) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, granular structure; friable; strongly acid; clear, wavy boundary.

B'2t—17 to 35 inches, strong-brown (7.5YR 5/6) sandy clay loam; many, medium, distinct, grayish-brown (10YR 5/2) and pale-brown (10YR 6/3) mottles; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B'3t—35 to 45 inches, yellowish-brown (10YR 5/4) sandy loam; many, medium, faint, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, irregular boundary.

C—45 inches +, yellowish-brown (10YR 5/4) sandy loam; common, medium, faint, very pale-brown (10YR 7/4) mottles; massive; friable; calcareous.

In some undisturbed areas, the A2 horizon is as much as 8 inches thick. The Bir horizon ranges from 3 to 6 inches in thickness, and in places has lower value and chroma than in the profile described. In some areas the B'2t horizon is heavy sandy loam. The depth to the calcareous sandy loam C horizon ranges from 36 to 55 inches, and in some places there are strata of loamy sand in the C horizon.

Surface runoff is slow, permeability is moderate, the available moisture capacity is moderately low, and natural fertility is medium.

The Coral soils are coarser textured throughout the solum than the Capac soils and are finer textured than

the Otisco soils. They are in the drainage sequence that includes the well drained and moderately well drained McBride soils and the poorly drained and very poorly drained Ensley soils.

Coral loam, 0 to 2 percent slopes (CvA).—This soil occurs in shallow swales on gently undulating uplands. It is commonly associated with the Capac and Ensley soils. The depth to the limy sandy loam bottom layer is about 50 inches. Small areas of Capac and Ensley soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Excess wetness, medium fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Coral loam, 2 to 6 percent slopes (CvB).—This soil occurs on low ridges and swells on the uplands. Small narrow areas are on toe slopes adjacent to the more strongly sloping, well-drained McBride soils. In places the first layer is from 10 to 12 inches thick. Small areas of McBride soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Medium fertility, moderately low available moisture capacity, and excess wetness are the major limitations. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Coral sandy loam, 0 to 2 percent slopes (CwA).—This soil occurs in nearly level areas and in shallow swales on gently undulating uplands. It commonly is associated with the Capac and Ensley soils. The surface layer commonly is dark grayish brown, and in some small areas it is from 10 to 12 inches thick. The depth to the limy sandy loam bottom layer is about 50 inches. In a few areas the fifth layer is heavy sandy loam, and there are thin layers of loamy sand in the bottom layer. Small areas of Capac and Ensley soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Excess wetness, medium fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Coral sandy loam, 2 to 6 percent slopes (CwB).—This soil occurs on low ridges and swells on the uplands. Small narrow areas are on toe slopes adjacent to the more strongly sloping, well-drained McBride soils. The surface layer commonly is dark grayish brown. In a few areas the fifth layer is heavy sandy loam, and thin layers of loamy sand occur in the bottom layer. Small areas of the McBride soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Excess wetness, medium fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Dighton Series

The Dighton series consists of well drained and moderately well drained soils that formed in clay loam, sandy clay loam, or silty clay loam till. These soils are underlain at a depth of 18 to 42 inches by stratified, slightly acid to calcareous loamy sand, sand, and some gravel. They occur on the level to sloping parts of till plains and moraines, throughout the northern third of the county. The native vegetation consisted principally of sugar maple, beech, elm, birch, and some white pine and hemlock.

Typical profile of Dighton sandy loam:

Ap—0 to 8 inches, dark-brown (10YR 4/2) sandy loam; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A21—8 to 11 inches, pale-brown (10YR 6/3) sandy loam; weak, fine, subangular blocky structure; friable; medium acid; clear, wavy boundary.

IIA22&B21—11 to 14 inches, brown (7.5YR 5/4) light silty clay loam, which represents the B21 horizon; coatings, crack fillings, and fingerings of pale-brown (10YR 6/3) sandy loam represent the A22 horizon; chunks and peds of B21 material are partially or wholly surrounded by A2 material; B21 material has strong, medium, subangular blocky structure and is friable; medium acid; gradual, irregular boundary.

B22—14 to 34 inches, dark-brown (7.5YR 4/4) silty clay loam; strong, medium, angular blocky structure; firm; medium acid; abrupt, wavy boundary.

IIIC—34 inches +, yellowish-brown (10YR 5/4) stratified loamy sand and sand; small amount of gravel; single grain; loose; mildly alkaline.

The A2&B21 horizon is very thin or lacking in some areas. Where the Dighton soils are closely associated with the Newago soils, the lower part of the B22 horizon contains some fine gravel. In other areas there are thin and discontinuous layers of sandy material in the lower part of the B22 horizon. In some places thin layers of finer textured material occur in the IIIC horizon. The sandy loam type probably represents a thin surface deposit of sandy material.

Surface runoff ranges from slow on the mild slopes to rapid on the strong slopes. Permeability is moderate in the solum and very rapid in the IIIC horizon. The available moisture capacity is moderate or moderately high, and natural fertility is moderate or moderately high.

The Dighton soils are finer textured throughout the solum than the Newago soils and contain less gravel. They are more deeply leached than the Nester soils, which are underlain by clay loam or silty clay loam.

Dighton clay loam, 6 to 12 percent slopes, severely eroded (DgC3).—This severely eroded soil occurs on the short rounded slopes of ridges and swells on the uplands, generally in the vicinity of broad drainageways. The surface layer is brown or dark-brown clay loam and contains little organic matter. Shallow gullies that can be crossed with farm machinery are common throughout most areas. In many areas the depth to the bottom layer is only about 20 inches. Small areas of Nester and Marlette soils are included in many of the areas mapped, particularly in areas near the top of slopes.

Most of this soil is used for corn, wheat, oats, and legume-grass hay or pasture. Some areas are idle or in permanent pasture. Susceptibility to erosion, poor tilth, and droughtiness in extremely dry years are the

major limitations. (Soil management unit 1.5aC3 (IVe); woodland suitability group B; wildlife suitability group 4)

Dighton sandy loam, 0 to 2 percent slopes (DhA).—This soil occurs mostly in narrow smooth areas adjacent to broad drainageways on the uplands. In most areas the surface layer is dark-brown sandy loam and is moderately high in organic-matter content. In a few small areas it is loam. The depth to sand and loamy sand is about 36 inches. Small areas of Nester and Marlette soils are included in the areas mapped.

Most of this soil is used for cultivated crops. The principal crops are corn, wheat, oats, and legume-grass hay or pasture. This soil is somewhat droughty in extremely dry years. (Soil management unit 1.5aA(I); woodland suitability group B; wildlife suitability group 4)

Dighton sandy loam, 2 to 6 percent slopes (DhB).—This soil occurs on undulating and gently sloping uplands, commonly adjacent to or near broad drainageways. In most areas the surface layer is very dark grayish-brown or dark grayish-brown sandy loam and contains a moderate amount of organic matter. In a few areas, it is loam. The depth to sand and loamy sand ranges from about 40 to about 20 inches within short distances. Small areas of Nester or Marlette soils are included in some of the areas mapped.

Most of the acreage is used for cultivated crops. The principal crops are corn, wheat, oats, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. However, this soil is somewhat droughty in extremely dry years. (Soil management unit 1.5aB(IIe); woodland suitability group B; wildlife suitability group 4)

Dighton sandy loam, 2 to 6 percent slopes, moderately eroded (DhB2).—This soil occurs on undulating and gently sloping uplands, commonly adjacent to or near broad drainageways. Most of the original surface layer has been lost through erosion, and the present surface layer is dark grayish-brown or grayish-brown sandy loam. It contains little organic matter. Shallow gullies have formed in a few small areas, and in places the brown third layer is exposed. These areas generally occur where the slope breaks sharply to a slightly steeper slope of 5 or 6 percent. The depth to the bottom layer ranges from 20 to about 40 inches within short distances. Included in the areas mapped are small areas of the Nester and Marlette soils.

This soil is used for corn, wheat, oats, and legume-grass hay or pasture. Slope, susceptibility to erosion, and droughtiness in extremely dry years are the major limitations. (Soil management unit 1.5aB(IIe); woodland suitability group B; wildlife suitability group 4)

Dighton sandy loam, 6 to 12 percent slopes, moderately eroded (DhC2).—This soil occurs on the short rounded slopes of ridges and swells on the uplands, generally near broad drainageways. Most of the original surface layer has been removed by erosion, and the present first layer is dark grayish-brown or grayish-brown sandy loam. It contains little organic matter. In some small areas the texture of the surface layer is loam. In places, the bottom layer occurs at a depth of about 25 inches. Small areas of the Nester and Marlette soils are included in many of the areas mapped, particularly in areas near the top of slopes.

This soil is used principally for corn, wheat, oats, and legume-grass hay or pasture. Droughtiness in extremely dry years, slope, and susceptibility to erosion are the major limitations. (Soil management unit 1.5aC (IIIe); woodland suitability group B; wildlife suitability group 4)

Dryden Series

The Dryden series consists of moderately well drained soils that formed in calcareous sandy loam till on the level to gently sloping parts of till plains and moraines. These soils developed under forest vegetation that consisted mainly of oak, hickory, beech, sugar maple, and other hardwoods.

Typical profile of Dryden sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—8 to 11 inches, pale-brown (10YR 6/3) sandy loam; weak, medium, granular structure; friable; slightly acid; clear, wavy boundary.

B1—11 to 15 inches, brown (10YR 4/3) sandy loam; moderate, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B2—15 to 34 inches, brown (10YR 5/3) sandy clay loam; common, fine, faint, dark yellowish-brown (10YR 4/4) mottles in the lower part; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

C—34 inches +, pale-brown (10YR 6/3) sandy loam; common, fine, distinct, brown (10YR 4/3) mottles; massive; friable; calcareous.

The depth to mottling ranges from 15 to about 30 inches. The texture of the B1 horizon ranges from sandy loam to loam, and that of the B2 horizon from sandy clay loam to heavy sandy loam or light clay loam. The depth to the calcareous sandy loam C horizon ranges from 20 to 42 inches. In some areas the C horizon contains strata of loamy sand.

Surface runoff is slow or medium, permeability is moderate, the available moisture capacity is moderately low, and natural fertility is medium.

The Dryden soils lack the silty clay loam to clay loam B horizon that is characteristic of the Celina soils, and their C horizon is sandy loam instead of loam to light clay loam. They are in the drainage sequence that includes the well-drained Lapeer soils, the somewhat poorly drained Locke soils, and the poorly drained and very poorly drained Barry soils.

Dryden sandy loam, 0 to 1 percent slopes (DrA).—This soil is on broad, level to undulating ridgetops on the uplands. It occupies the level and nearly level areas adjacent to the gently sloping, well-drained Lapeer soils. The surface layer is dominatly sandy loam, but there are some areas in which the surface layer is loam. In places a brittle layer occurs in the upper part of the third layer. The depth to the limy sandy loam bottom layer commonly approaches 42 inches.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Medium natural fertility, moderately low available moisture capacity and, to some extent, excess wetness are the major limitations.

(Soil management unit 3aA (IIs); woodland suitability group U; wildlife suitability group 1)

Dryden sandy loam, 2 to 6 percent slopes (DrB).—This soil occurs on broad, undulating ridgetops on the uplands. The depth to the limy sandy loam bottom layer is nearly 42 inches. In some areas a firm brittle layer occurs in the upper part of the third layer. Small areas of Lapeer soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Medium natural fertility, moderately low available moisture capacity, and, to some extent, excess wetness are limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Dryden sandy loam, 2 to 6 percent slopes, moderately eroded (DrB2).—This soil occurs on broad, gently sloping ridgetops on the uplands. In most places the present surface layer is pale-brown sandy loam and is very low in organic-matter content. In some areas a firm brittle layer occurs in the upper part of the third layer. The depth to the limy sandy loam bottom layer ranges from 20 to about 42 inches.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Erosion, medium natural fertility, moderately low available moisture capacity, and, to some extent, excess wetness are major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 2)

Edmore Series

Soils of the Edmore series formed in deep loamy sand glacial drift. They occur in level or nearly level areas and depressions on till plains and moraines or along natural drainageways, throughout the northern part of the county. The native vegetation consisted primarily of swamp white oak, ash, red maple, and silver maple.

Typical profile of Edmore sandy loam:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, granular structure; friable; medium or high organic-matter content; slightly acid; abrupt, smooth boundary.

B21g—9 to 12 inches, light brownish-gray (10YR 6/2) loamy sand; common, medium, distinct, dark yellowish-brown (10YR 4/4) and brownish-yellow (10YR 6/8) mottles; weak, medium, granular structure; very friable; medium acid; clear, wavy boundary.

B22g—12 to 28 inches, grayish-brown (10YR 5/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B23g—28 to 32 inches, grayish-brown (2.5Y 5/2) sandy loam; many, fine, distinct, yellowish-brown (10YR 5/8) and brownish-yellow (10YR 6/8) mottles; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, irregular boundary.

C—32 inches +, light brownish-gray (2.5Y 6/2) loamy sand; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; single grain; loose; calcareous.

The B21g and B22g horizons range from loamy sand to sandy loam in texture, and the C horizon ranges from loamy sand to sand. The depth to the C horizon ranges from 30 to 45 inches. In many places the C horizon is stratified loamy sand and sand and contains lenses of sandy loam that vary in thickness.

Surface runoff is very slow or ponded, permeability is moderately rapid, natural fertility is moderately low or low, and the available moisture capacity is moderately low. Crops may be affected by wetness during extended wet periods in spring and fall.

The Edmore soils have a coarser textured solum than the Ensley soils. They are in the drainage sequence that includes the well drained and moderately well drained Montcalm soils and the somewhat poorly drained Otisco soils.

Edmore sandy loam (0 to 1 percent slopes) (Ed).—In most areas a profile of this soil is like the one described as typical of the series. However, in places the surface layer is very dark brown sandy loam. In some areas the texture is fine sandy loam, and in a few small areas it is loamy sand. Included in the areas mapped are small areas of the Epoufette soils.

Most of this soil is used for corn, beans, small grain, and hay. A few areas are in pasture or forest. Moderately low or low natural fertility and excess wetness are the major limitations. (Soil management unit 4cA (IIIw); woodland suitability group W; wildlife suitability group 6)

Edwards Series

The Edwards series consists of very poorly drained soils that formed in mixed woody and fibrous organic material that is from 12 to 42 inches thick over marl. These soils occur mainly in level areas and slight depressions on lake plains, outwash plains, and till plains. Some areas are on the gently sloping to strongly sloping parts of moraines. The native vegetation consisted principally of aspen, birch, elm, and soft maple.

Typical profile of Edwards muck:

1—0 to 10 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; mildly alkaline; gradual, wavy boundary.

2—10 to 28 inches, very dark brown (10YR 2/2) muck; weak, fine, granular structure; friable; moderately alkaline; diffuse, wavy boundary.

3—28 to 32 inches, very dark brown (10YR 2/2) muck and light-gray (10YR 7/2) marl; massive; friable; numerous small shells; calcareous; abrupt, irregular boundary.

IICg—32 inches +, light-gray (10YR 6/1) marl; massive; very friable; numerous small shells; calcareous.

Horizons Nos. 1 and 2 are calcareous in some areas, especially in those areas where the depth to marl approaches the minimum of 12 inches. The thickness and the purity of the marl varies.

Surface runoff is slow to ponded, except on the gently sloping or sloping parts of moraines, where runoff is moderate. Permeability is moderate or moderately slow, and the available moisture capacity is high. Natural fertility is medium because of the unbalanced proportions of essential plant nutrients. Wind erosion is a hazard in cleared areas.

The Edwards soils developed in shallower deposits of mixed woody and fibrous organic material than the Carlisle soils. They are underlain by marl and commonly are more alkaline than the Tawas, Linwood, and Willette soils, which are underlain by sand, loam, and clay respectively.

Edwards muck (0 to 1 percent slopes) (Ek).—A profile of this soil is like the one desrcibed as typical of the series. Small areas of Carlisle soils are included in some of the areas mapped.

Most of this soil is forested. A few areas are used for corn, vegetables, or mint. Excess wetness and, to some extent, wind erosion are the major limitations. (Soil management unit M/mcAB (IVw); woodland suitability group J; wildlife suitability group 8)

Edwards muck, sloping (6 to 12 percent slopes) (Em).—This soil is on the lower part of slopes, adjacent to potholes, swales, and broad flat swampy areas on the uplands. The surface layer commonly is limy. The depth to marl ranges from 12 to 20 inches. (Soil management unit M/mcAB (IVw); woodland suitability group J; wildlife suitability group 8)

Eel Series

The Eel series consists of moderately well drained soils that formed in deep loam, silt loam, light clay loam, and light silty clay loam. These soils are in level or nearly level areas and depressions throughout the county. Some areas are in the oxbows of old meanders of rivers and creeks. The native vegetation consisted mainly of elm, ash, soft maple, and sycamore.

Typical profile of Eel loam:

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

C1—10 to 21 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; friable; calcareous; gradual, wavy boundary.

C2—21 to 66 inches +, yellowish-brown (10YR 6/2) stratified loam and silt loam; weak, fine, granular structure; friable; calcareous.

In some areas the Ap horizon is dark grayish brown (10YR 4/2) to brown (10YR 5/3). The depth to mottling ranges from 18 to 30 inches. The texture of the C horizon is mainly loam, but in a few areas it is silt loam, light clay loam, or light silty clay loam. Thin strata of heavy clay loam or heavy silty clay loam occur in the C horizon in some areas.

Surface runoff is slow, permeability and the available moisture capacity are moderate, and natural fertility is medium.

The Eel soils are finer textured throughout the solum than the Landes soils. They are in the drainage sequence that includes the well-drained Genesee soils, the somewhat poorly drained Shoals soils, and the poorly drained and very poorly drained Sloan soils.

In Ionia County the Eel soils are mapped only as a complex with the Landes soils.

Ensley Series

In the Ensley series are poorly drained and very poorly drained soils that formed in calcareous sandy loam till. These soils occur in level or nearly level areas and depressions on till plains and moraines throughout the northern part of the county. The native vegetation consisted mainly of mixed stands of elm, ash, red maple, and other hardwoods.

Typical profile of Ensley loam:

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

B21—7 to 12 inches, light yellowish-brown (10YR 6/4) sandy loam; few, fine, faint, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; mildly alkaline; gradual, wavy boundary.

B22—12 to 34 inches, brown (10YR 5/3) sandy clay loam; many, coarse, faint, yellowish-brown (10YR 5/8) and light yellowish-brown (10YR 6/4) mottles; moderate, medium, subangular blocky structure; firm; mildly alkaline; abrupt, irregular boundary.

C—34 inches +, pale-brown (10YR 6/3) sandy loam; many, coarse, distinct, brownish-yellow (10YR 6/8) and yellowish-brown (10YR 5/4) mottles; very weak, coarse, subangular blocky structure; friable; calcareous.

In undisturbed areas, the A1 horizon commonly is very dark grayish brown (10YR 3/2) and is from 6 to 10 inches thick. In some areas there is a gray (10YR 6/1) horizon, with little mottling, below the Ap or A1 horizon. In places the B22 horizon is heavy sandy loam. The depth to the C horizon ranges from 28 to 40 inches. In places the C horizon contains strata of loamy sand.

Surface runoff is very slow or ponded, permeability is moderate, the available moisture capacity is moderately low, and natural fertility is medium.

The Ensley soils are finer textured throughout the solum than the Edmore soils and are coarser textured than the Brookston. They are in the drainage sequence that includes the well drained and moderately well drained McBride soils and the somewhat poorly drained Coral soils.

Ensley loam (0 to 1 percent slopes) (En).—This soil occurs on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways. It commonly is closely associated with the Brookston and Edmore soils, and small areas of those soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. A few small areas are in farm woodlots. Excess wetness and medium natural fertility are the major limitations. (Soil management unit 3cA (IIw); woodland suitability group W; wildlife suitability group 2)

Epoufette Series

The Epoufette series consists of poorly drained and very poorly drained soils that formed in water-sorted sandy material that is from 18 to 42 inches thick over calcareous coarse sand and gravel. These soils are in level areas and depressions on outwash plains and old glacial drainageways throughout the northern half of the county. Fairly large areas are adjacent to Prairie Creek. The native vegetation consisted principally of elm, ash, and some swamp conifers.

Typical profile of Epoufette sandy loam:

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

B21—8 to 14 inches, pale-brown (10YR 6/3) loamy sand; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; very weak, fine, subangular blocky structure; very friable; abrupt, wavy boundary.

B22g—14 to 21 inches, grayish-brown (10YR 5/2) light sandy loam; many, medium, distinct, yellowish-brown (10YR

5/8) mottles; weak, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.
IICg—21 inches +, grayish-brown (10YR 5/2) gravel and coarse sand; single grain; loose; calcareous.

In some undisturbed areas, in place of the Ap horizon, there is a 2- to 5-inch A1 horizon of black (10YR 2/1) to very dark gray (10YR 3/1) sandy loam above the B21 horizon. In some areas the texture of the B22g horizon is heavy loamy sand. The underlying material ranges from coarse sand to gravel. The solum ranges from slightly acid to mildly alkaline in reaction.

Surface runoff is very slow or ponded, and permeability is moderately rapid. These soils are low in natural fertility, and if drained are moderately low in available moisture capacity.

The Epoufette soils are finer textured throughout the solum than the Granby. They are in the drainage sequence that includes the well drained and moderately well drained Mancelona soils and the somewhat poorly drained Gladwin soils.

Epoufette loamy sand (0 to 1 percent slopes) (Eo).—This soil commonly is adjacent to organic soils. In many wooded areas it has a 2- to 6-inch layer of muck on the surface.

Most of the acreage is used for pasture or woodlots. Low natural fertility and excess wetness are the major limitations. (Soil management unit 4cA (IIIw); woodland suitability group W; wildlife suitability group 6)

Epoufette sandy loam (0 to 1 percent slopes) (Ep).—In most areas a profile of this soil is similar to the one described as representative of the series. In wooded areas, however, there generally is a 2- to 6-inch layer of muck on the surface. The surface layer ordinarily is moderately high in organic-matter content.

Most of this soil is used for pasture. Excess wetness and low natural fertility are the major limitations. (Soil management unit 4cA (IIIw); woodland suitability group W; wildlife suitability group 6)

Fox Series

The Fox series is made up of well-drained soils that formed in loamy outwash material that is from 24 to 42 inches thick over stratified calcareous sand and gravel. These soils are on the level to steep parts of outwash plains, valley trains, terraces, and moraines. They occur throughout the southern two-thirds of the county. The native vegetation consisted of mixed stands of hardwoods, mainly oak, hickory, and maple.

Typical profile of Fox sandy loam:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) sandy loam; moderate, fine, granular structure; friable; medium organic-matter content; medium acid; abrupt, wavy boundary.
A2—6 to 11 inches, brown (10YR 5/3) sandy loam; moderate, medium, granular structure; friable; medium acid; clear, wavy boundary.
B1—11 to 14 inches, dark-brown (7.5YR 4/4) heavy sandy loam; moderate, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.
IIB21—14 to 30 inches, dark-brown (7.5YR 4/4) gravelly clay loam; strong, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.
IIB22—30 to 35 inches, dark-brown (7.5YR 3/2) gravelly clay loam; moderate, coarse, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.
IIIC—35 inches +, brown (10YR 5/3) gravel and sand; single grain; loose; calcareous.

The texture of the B horizon ranges from sandy loam to sandy clay loam, gravelly sandy clay loam, gravelly clay loam, clay loam, or silty clay loam. The amount of gravel in the B horizon varies. Tongues of the B22 horizon extend into the IIIC horizon. They vary in number and in thickness but in some areas are more than 2 feet thick. The depth to the IIIC horizon ranges from 24 to 42 inches.

Surface runoff ranges from slow on the gentle slopes to rapid on the steep slopes. Permeability is moderate or moderately rapid, the available moisture capacity is moderate, and natural fertility is medium.

The Fox soils contain more gravel than the Kendallville soils, which formed in loam to silty clay loam, and they are finer textured throughout the solum than the Boyer soils. They are in the drainage sequence that includes the moderately well drained Ionia soils, the somewhat poorly drained Matherton soils, and the poorly drained and very poorly drained Sebewa soils.

Fox sandy loam, 0 to 2 percent slopes (FoA).—This soil occurs on broad flats at the higher elevations on valley plains and on the smooth tops of terrace ridges on the uplands. The surface layer is moderately high in organic-matter content. In a few areas the depth to the limy bottom layer is slightly more than 42 inches. Within the areas mapped are small depressions in which the Ionia soils occur. Also included in mapping are some areas in which the surface layer is loam.

Most of this soil is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Droughtiness in extremely dry years is the major limitation. (Soil management unit 3aA (IIs); woodland suitability group U; wildlife suitability group 1)

Fox sandy loam, 2 to 6 percent slopes (FoB).—This soil occurs on undulating valley plains and on gently sloping high terraces. Over most of the acreage the surface layer is sandy loam, but in some places it is loam, and in other small areas it consists of a thin layer, 4 to 8 inches thick, of soil material that washed from adjacent slopes. In a few areas the combined thickness of the third, fourth, and fifth layers is about 30 inches, and the depth to the limy bottom layer is more than 42 inches. There are sufficient stones and cobblestones scattered on the surface of a few areas to hinder tillage. Where this soil occurs near the bluffs of high terraces, adjacent to river valleys, small areas of the Kendallville soils are included in many of the areas mapped. In other places small areas of the Boyer soils are included.

Most of this soil is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few areas are in farm woodlots. Slope, susceptibility to erosion, and droughtiness in extremely dry years are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Fox sandy loam, 2 to 6 percent slopes, moderately eroded (FoB2).—This soil occurs on undulating valley plains and on gently sloping high terraces. Much of the original surface layer has been removed by erosion. The present surface layer is dark brown and contains only a moderate amount of organic matter. In several areas the combined thickness of the third, fourth, and fifth layers is about 30 inches, and the depth to the limy bot-

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tom layer is more than 42 inches. Gullies, shallow enough to be crossed with farm machinery, have formed in places and exposed the soil layers. In a few areas there are sufficient stones and cobblestones scattered on the surface to hinder or, in places, prevent tillage. Included in the areas mapped are some areas in which the surface layer is loam.

Most of this soil is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. However, a few of the more eroded areas are idle. Slope, susceptibility to erosion, and droughtiness in dry years are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Fox sandy loam, 6 to 12 percent slopes (FoC).—This soil is on sloping high terraces along river valleys and broad drainageways. The surface layer contains little organic matter.

Most of the acreage is in farm woodlots or forest. A few areas have been cleared and are used for pasture. Slope, droughtiness, and susceptibility to erosion are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group U; wildlife suitability group 1)

Fox sandy loam, 6 to 12 percent slopes, moderately eroded (FoC2).—This soil is on sloping terraces along river valleys and broad drainageways. Most of the original surface layer has been removed by erosion. The present surface layer commonly is dark-brown sandy loam and is low in organic-matter content. In a few areas it is loam. In places the combined thickness of the third, fourth, and fifth layers is about 30 inches, and the depth to the limy bottom layer is more than 42 inches. There are sufficient stones and cobblestones on the surface of a few areas to hinder tillage. Included in the areas mapped are some small uneroded areas.

A large part of the acreage is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few areas are idle or in second-growth forest. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group U; wildlife suitability group 1)

Fox sandy loam, 12 to 18 percent slopes, moderately eroded (FoD2).—This soil is on short side slopes of high terraces along river valleys and broad drainageways. The surface layer is dark brown and contains little organic matter. In a few areas there are numerous stones on the surface and throughout the soil material. In others the surface layer is somewhat gravelly. Small areas of Boyer soils and small uneroded areas of the Fox soils were included in some of the areas mapped.

Most of this soil is idle or in permanent pasture. Slope, susceptibility to erosion, and droughtiness are major limitations. (Soil management unit 3aD (IVe); woodland suitability group U; wildlife suitability group 1)

Fox sandy loam, 18 to 25 percent slopes, moderately eroded ((FoE2).—This soil is on the short side slopes of draws and ravines and along valley walls of high terraces, adjacent to broad drainageways and river valleys. Most of the original surface layer has been lost through erosion, and the present surface layer is dark-brown sandy loam. In a few areas there are sufficient stones on the surface to hinder tillage.

Most of this soil is idle or in second-growth forest. A few areas are in permanent pasture. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aE (VIe); woodland suitability group U; wildlife suitability group 1)

Fox sandy loam, 25 to 40 percent slopes (FoF).—This soil occurs on the short steep slopes of high terraces along river valleys and broad drainageways. Included in the areas mapped are small areas of the moderately eroded Fox soils.

Most of this soil is wooded. Slope and droughtiness are the major limitations. (Soil management unit 3aEF (VIIe); woodland suitability group U; wildlife suitability group 1)

Fox stony sandy loam, 2 to 6 percent slopes (FsB).—This soil occurs on gently sloping terraces along river valleys and broad drainageways. The surface layer is dark brown and is low in organic-matter content. Stones are scattered over the surface and to some extent throughout the soil material.

Most of this soil is cultivated. The principal crops are wheat, oats, soybeans, and legume-grass hay or pasture. Stoniness, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 4aABC (Vs); woodland suitability group U; wildlife suitability group 1)

Fox sandy clay loam, 6 to 12 percent slopes, severely eroded (FxC3).—This soil occurs on the short side slopes of high terraces along river valleys and broad drainageways. All of the original surface layer has been removed by erosion. The present surface layer is dark-brown sandy clay loam and contains little organic matter. Gullies shallow enough to be crossed with farm machinery have formed in most areas. The limy bottom layer commonly occurs at a depth of about 30 inches. In some places there are a few seepy spots.

Much of this acreage is idle or in second-growth forest. A few areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aC3 (IVe); woodland suitability group U; wildlife suitability group 1)

Fox sandy clay loam, 12 to 18 percent slopes, severely eroded (FxD3).—This soil occurs on the short side slopes of high terraces along river valleys and broad drainageways. All of the original surface layer has been removed by erosion, and the present surface layer of sandy clay loam is very low in organic-matter content. Shallow gullies are common, and in places deep gullies have formed. In a few small areas there are sufficient stones on the surface and throughout the soil material to make cultivation impractical.

Most of the acreage is idle or in second-growth forest. A few areas are in pasture that is of limited value. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aD3 (VIe); woodland suitability group U; wildlife suitability group 1)

Fox sandy clay loam, 18 to 25 percent slopes, severely eroded (FxE3).—This soil occurs on the short side slopes of high terraces along river valleys and broad drainageways. All of the original surface layer has been removed by erosion. The present surface layer is dark-brown

sandy clay loam and contains little organic matter. Numerous shallow gullies and a few deep gullies have formed in many areas. The depth to the limy bottom layer commonly is about 30 inches.

Most of the acreage is idle or in second-growth forest and shrubs. Trees have been planted in a few areas. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aEF3 (VIIe); woodland suitability group U; wildlife suitability group 1)

Fox sandy clay loam, 25 to 40 percent slopes, severely eroded (FxF3).—This soil occurs on the short steep slopes of high terraces along river valleys and broad drainageways. Erosion has removed all of the original surface layer. The present surface layer is dark-brown sandy clay loam and contains little organic matter. Numerous shallow gullies and a few deep gullies have formed in many areas. In places the combined thickness of the third, fourth, and fifth layers is more than 30 inches. In most places, however, the depth to the limy bottom layer is about 30 inches.

Most of the acreage is idle or in second-growth forest. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aEF3 (VIIe); woodland suitability group U; wildlife suitability group 1)

Genesee Series

In the Genesee series are well-drained soils that formed in deep loam, silt loam, light silty clay loam, or light clay loam on level or nearly level bottom lands along creeks and rivers. These soils occur throughout the county, generally as small areas. The native vegetation consisted primarily of elm, sycamore, and ash.

Typical profile of Genesee loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; moderately high organic-matter content; mildly alkaline; abrupt, smooth boundary.

C1—8 to 26 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; friable; calcareous; gradual, wavy boundary.

C2—26 to 45 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine, granular structure; friable; calcareous; clear, wavy boundary.

C3—45 inches +, yellowish-brown (10YR 5/6) silt loam; weak, fine, subangular blocky structure; friable; calcareous.

The color of the Ap horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The texture of the C horizon ranges from dominantly silt loam, loam, light clay loam, or light silty clay loam to a stratified layer that includes at least one of these textures. On high bottoms these soils commonly have a very weakly developed B horizon. Where the Genesee soils are closely associated with the moderately well drained Eel soils, they generally are mottled below a depth of 30 inches.

Surface runoff is slow, permeability and the available moisture capacity are moderate, and natural fertility is medium.

In Ionia County the Genesee soils are mapped only as a complex with the Landes soils. They are finer textured than the Landes soils.

Gilford Series

The Gilford series consists of poorly drained and very poorly drained soils that formed in loamy sand and light sandy loam outwash material. These soils are underlain at a depth of 24 to 42 inches by calcareous sand and gravel. They occur in depressions on outwash plains, till plains and old glacial drainageways throughout the southern part of the county. The native vegetation was hardwood forest consisting mainly of swamp white oak, hickory, and ash.

Typical profile of Gilford loamy sand:

Ap—0 to 10 inches, very dark brown (10YR 2/2) loamy sand; weak, fine, granular structure; very friable; high organic-matter content; neutral; abrupt, smooth boundary.

B21g—10 to 13 inches, dark grayish-brown (2.5Y 4/2) sandy loam; few, medium, faint, olive-brown (2.5Y 4/4) mottles; weak, medium, granular structure; friable; neutral; clear, wavy boundary.

B22g—13 to 16 inches, grayish-brown (2.5Y 5/2) sandy loam; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure; friable; slightly acid; gradual, wavy boundary.

B23g—16 to 24 inches, light brownish-gray (2.5Y 6/2) light sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

IIB3—24 to 44 inches, light brownish-gray (2.5Y 6/2) loamy sand; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure; very friable; neutral; abrupt, wavy boundary.

IIICg—44 inches +, light-gray (10YR 6/1) sand and gravel; single grain; loose; calcareous.

The Ap horizon ranges from 6 to 10 inches in thickness. The depth to the calcareous IIICg horizon ranges from 42 to 66 inches. In some areas the IIICg horizon is sand or loamy sand.

Surface runoff is very slow or ponded, permeability is moderately rapid, the available moisture capacity is moderately low, and natural fertility is medium.

The Gilford soils have a thinner sandy clay loam or clay loam Bg horizon than the Sebewa soils and are coarser textured throughout the solum. They are finer textured than the Granby soils.

Gilford loamy sand (0 to 2 percent slopes) (Gf).—In most areas a profile of this soil is similar to the one described as representative of the series. Some small areas have from 1 to 3 inches of muck on the surface. A few areas are stony and thus are difficult to cultivate. These are indicated on the soil map by stone symbols.

Most of this soil is used for pasture and woodlots. A few drained areas are used for general farm crops. Wetness is the major limitation. (Soil management unit 4cA (IIIw); woodland suitability group W; wildlife suitability group 6)

Gilford sandy loam (0 to 2 percent slopes) (Gg).—This soil occurs in level or nearly level areas and in slight depressions. In a few areas there is from 2 to 5 inches of muck on the surface.

Most of this soil is used for pasture and woodlots. A few drained areas are used for general farm crops. Wetness is a major limitation. (Soil management unit 4cA

(IIIw); woodland suitability group W; wildlife suitability group 6)

Gladwin Series

The Gladwin series consists of somewhat poorly drained soils that formed in sand and loamy sand that is from 18 to 42 inches thick over stratified calcareous sand and gravel. These soils are on level to gently sloping outwash plains and in old glacial drainageways. They are widely distributed throughout the northern half of the county, and fairly large areas are along Prairie and Dickerson Creeks. The native vegetation consisted mainly of sugar maple, ash, beech, elm, and some scattered white pine and red pine.

Typical profile of Gladwin loamy sand:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; very weak, fine, granular structure; very friable; slightly acid; medium organic-matter content; abrupt, smooth boundary.

A2—8 to 11 inches, grayish-brown (10YR 5/2) sand; single grain; loose; medium acid; clear, wavy boundary.

B2ir—11 to 20 inches, yellowish-brown (10YR 5/8) loamy sand; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; medium acid; clear, wavy boundary.

B'2t—20 to 25 inches, brownish-yellow (10YR 6/6) sandy loam; common, medium, faint, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIC—25 inches +, pale-brown (10YR 6/3) sand and gravel; single grain; stratified; loose; calcareous.

The B'2t horizon ranges from heavy loamy sand to sandy clay loam in texture and from 2 to 8 inches in thickness. The depth to the calcareous sand and gravel ranges from 18 to 42 inches. The solum ranges from medium acid to mildly alkaline in reaction.

Surface runoff is slow, permeability is moderately rapid or rapid, the available moisture capacity is moderately low or low, and natural fertility is low.

The Gladwin soils are finer textured throughout the solum than the Au Gres soils.

Gladwin loamy sand, 0 to 2 percent slopes (GhA).—In most areas a profile of this soil is like the one described as typical of the series. Small areas of Mancelona soils were included in the areas mapped. However, these inclusions do not greatly influence the use and management of this soil.

Although a large part of the acreage is used for corn, small grain, hay, and other field crops, many areas of this soil are used only for limited grazing. Low natural fertility and excess wetness are the principal limitations. (Soil management unit 4bAB (IIIw); woodland suitability group F; wildlife suitability group 6)

Gladwin loamy sand, 2 to 6 percent slopes (GhB).—This soil occurs as small areas and is associated with the nearly level Gladwin soils. The slope is dominantly less than 4 percent. In some small areas the plow layer is slightly redder or browner in color than typical and contains less organic matter.

Most of this soil is used for corn, small grain, and other field crops. Many areas, however, are idle. Excess wetness and low natural fertility are the principal limitations. (Soil management unit 4bAB (IIIw); woodland suitability group F; wildlife suitability group 6)

Gladwin sandy loam, 0 to 2 percent slopes (GlA).—The plow layer of this soil is finer textured and is slightly higher in organic-matter content than that of the soil described as representative of the series.

Most of this soil is used for corn, small grain, hay, and other field crops. Some areas are idle. Low natural fertility and excess wetness are the principal limitations. (Soil management unit 4bAB (IIIw); woodland suitability group F; wildlife suitability group 6)

Gladwin sandy loam, 2 to 6 percent slopes (GlB).—This soil occurs as small areas and is associated with the nearly level Gladwin soils. In most areas the plow layer is finer textured and is slightly higher in organic-matter content than that of the soil described as representative of the series. Small areas of Sebewa soils were included in the areas mapped. These inclusions make up only a small total acreage and do not greatly influence the use and management of this soil. In a few small areas, there are sufficient stones in the plow layer to interfere with tillage.

Most of this soil is used for corn, small grain, hay, and other field crops. Low natural fertility and excess wetness are the principal limitations. (Soil management unit 4bAB (IIIw); woodland suitability group F; wildlife suitability group 6)

Glendora Series

The Glendora series is made up of poorly drained and very poorly drained soils that formed in neutral to calcareous stratified sand and loamy sand. These soils are in level areas and slight depressions on flood plains. They are interspersed with other soils along the rivers and creeks throughout the county. The native vegetation consisted mainly of elm, ash, swamp white oak, and aspen.

Typical profile of Glendora sandy loam:

Ap—0 to 8 inches, very dark brown (10YR 2/2) sandy loam; moderate, fine, granular structure; friable; high organic-matter content; mildly alkaline; abrupt, smooth boundary.

C1—8 to 11 inches, dark-gray (10YR 4/1) loamy sand; weak, medium, granular structure; very friable; calcareous; clear, wavy boundary.

C2—11 to 36 inches, dark grayish-brown (10YR 4/2) loamy sand; common, medium, faint, grayish-brown (10YR 5/2) mottles; single grain; loose; calcareous; clear, wavy boundary.

C3—36 inches +, dark grayish-brown (2.5Y 4/2) loamy sand; common, medium, faint, light brownish-gray (2.5Y 6/2) mottles; single grain; loose; calcareous.

In some areas there is a very dark brown (10YR 2/2) A12 horizon, 2 to 6 inches thick, between the Ap and the C1 horizons. In places the C1 horizon is mottled with yellowish brown (10YR 5/4). In some areas thin layers of fine sand and gravel occur in the C horizon.

Surface runoff is very slow, permeability is rapid, and the available moisture capacity and natural fertility are moderately low or low.

Although the Glendora soils formed in sand and loamy sand, and the Cohoctah soils in heavy loamy fine sand to fine sandy loam, drainage on these soils is comparable.

Glendora loam (0 to 2 percent slopes) (Gm).—This soil occurs in level areas and slight depressions on bottom lands bordering rivers and creeks. The surface layer is dominantly loam or silt loam. It is from 6 to 12 inches

thick and in most areas is moderately high or high in organic-matter content. The underlying layers are sand and loamy sand. Included in the areas mapped are some small areas in which the surface layer is sandy loam or loamy sand. In some broad depressions, small areas of the heavier textured Cohoctah soils were included in mapping.

Most of this soil is used for farm woodlots or permanent pasture. Drained areas are used principally for corn, hay, pasture, and some white beans and soybeans. Excess wetness, moderately low or low natural fertility, occasional flooding, and droughtiness in prolonged dry periods are the major limitations. (Soil management unit L-4cA (IIIw); woodland suitability group O; wildlife suitability group 6)

Glendora sandy loam (0 to 2 percent slopes) (Gn).—This soil occurs in level areas and slight depressions on bottom lands along rivers and creeks. The surface layer is sandy loam or fine sandy loam. Some small areas in which the surface layer is loamy sand or loam were included in the areas mapped.

Most of this soil is used for farm woodlots or permanent pasture. Drained areas are used principally for corn, hay, pasture, and some white beans and soybeans. Excess wetness, moderately low or low natural fertility, occasional flooding, and droughtiness in prolonged dry periods are the major limitations. (Soil management unit L-4cA (IIIw); woodland suitability group O; wildlife suitability group 6)

Granby Series

In the Granby series are poorly drained and very poorly drained soils that formed in deep, neutral to calcareous sands. These soils occur in level or nearly level areas and in slight depressions on outwash plains and in old glacial drainageways. They are mainly in the eastern and southern parts of the county. The native vegetation was forest consisting principally of elm, ash, and swamp white oak.

Typical profile of Granby loamy sand:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; high organic-matter content; neutral; abrupt, smooth boundary.

A1—8 to 12 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, coarse, granular structure; very friable; slightly acid; clear, wavy boundary.

C1—12 to 36 inches, grayish-brown (10YR 5/2) sand; common, medium, distinct, brownish-yellow (10YR 6/6) and dark-brown (7.5YR 4/4) mottles; single grain; loose; slightly acid; gradual, wavy boundary.

C2—36 to 41 inches, light brownish-gray (10YR 6/2) sand; common, coarse, distinct, dark yellowish-brown (10YR 4/4) and brownish-yellow (10YR 6/8) mottles; single grain; loose; neutral; gradual, wavy boundary.

C3—41 inches +, pale-brown (10YR 6/3) sand; common, coarse, distinct, dark yellowish-brown (10YR 4/4) and brownish-yellow (10YR 6/6) mottles; single grain; loose; neutral.

The total thickness of the A1 horizon, or the Ap and A1 horizons, ranges from 8 to 16 inches. In some undisturbed areas there is a thin accumulation of muck above the A1 horizon. The depth to calcareous sand ranges from 40 to 72 inches. The reaction of the solum ranges from slightly acid to neutral.

Surface runoff is very slow or ponded, permeability is rapid, and the available moisture capacity and natural fertility are moderately low.

The Granby soils are coarser textured throughout the solum than the Gilford soils, and they lack the muck covering that is characteristic of the Tawas soils.

Granby loamy sand (0 to 2 percent slopes) (Go).—In most areas a profile of this soil is similar to the one described as representative of the series. Included in mapping were several small areas in which the surface layer is sandy loam and a few in which it is sand. These inclusions are small and are so widely scattered that they do not affect management. In places there is some gravel in the substratum.

Most of the acreage is undrained and is used for permanent pasture or woodlots. Excess wetness and moderately low fertility are the major limitations. (Soil management unit 5cA (IIIw); woodland suitability group O; wildlife suitability group 6)

Gravel Pits

Gravel pits (Gp).—These pits consist of land from which the overlying soil layers have been removed or pushed aside, and the sand and gravel mined for various uses. They are on sandy moraines and outwash plains throughout the county.

The areas vary considerably in size. The small pits commonly are quarried only periodically for material for home use or for small local road fills. The large ones are operated by commercial concerns. These pits ordinarily have no use other than as sources of sand and gravel. Some, however, contain water and can be used as fish ponds. (Soil management unit Sa (VIIIs))

Grayling Series

The Grayling series consists of well drained and moderately well drained soils that formed in sand. These soils occur in level to gently sloping areas on outwash plains and on the nearly level to strongly sloping parts of moraines. They are widely distributed throughout the northern half of the county, and a fairly large acreage occurs along the Montcalm-Ionia County line, north and east of Belding. The native vegetation consisted mainly of jack pine and some scattered white pine and scrub oak.

Typical profile of Grayling sand:

Ap—0 to 6 inches, dark yellowish-brown (10YR 4/4) sand; single grain; loose; low organic-matter content; medium acid; abrupt, smooth boundary.

B21ir—6 to 14 inches, brownish-yellow (10YR 6/6) sand; single grain; loose; strongly acid; clear, smooth boundary.

B22ir—14 to 26 inches, brownish-yellow (10YR 6/8) sand; single grain; loose; medium acid; clear, smooth boundary.

C1—26 to 46 inches, brown (10YR 5/3) sand; single grain; loose; slightly acid; gradual, smooth boundary.

C2—46 inches +, pale-brown (10YR 6/3) sand; single grain; loose; neutral.

In some undisturbed areas the B21ir horizon is overlain by a very dark grayish-brown (10YR 3/2) A1 horizon, 1 to 2 inches thick, and a light brownish-gray (10YR 6/2) A2 horizon, 1 to 3 inches thick. Where the Grayling soils grade to the Chelsea, some very thin bands of loamy sand

(representing the B2t horizon) occur at depths between 60 to 65 inches. The depth to calcareous sand ranges from 4 to 10 feet. The reaction of the solum ranges from slightly acid to strongly acid.

Surface runoff is very slow, permeability is very rapid, and the available moisture capacity and natural fertility are low. Wind erosion is a serious hazard if these soils are devoid of vegetation.

The Grayling soils are coarser textured throughout the solum than the Mancelona and Chelsea soils, and they lack the calcareous sand and gravel C horizon that is characteristic of the Mancelona soils.

Grayling sand, 0 to 6 percent slopes (GrA).—In most areas the surface layer of this soil is dark brown. Small areas of Au Gres soils that occur in widely scattered small depressions were included in some of the areas mapped.

Most of this soil is idle or in second-growth forest. Small areas are used for pasture. Low available moisture capacity and low natural fertility are the major limitations. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Grayling sand, 2 to 6 percent slopes, moderately eroded (GrB2).—Most of the original surface layer of this soil has been removed by erosion. The present surface layer is yellowish brown and contains little organic matter. It consists primarily of material from the first brownish-yellow layer. Small scattered areas of the Chelsea soils and some small areas of Grayling sand, 0 to 6 percent slopes, were included in some of the areas mapped.

Most of this soil is idle. Pine has been planted in a few areas. Susceptibility to erosion, low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Grayling sand, 6 to 12 percent slopes (GrC).—The plow layer of this soil is dark yellowish-brown sand. Small scattered areas of Chelsea soils were included in some of the areas mapped.

Nearly all of this soil is forested. Cleared areas are idle or used for pasture. Low available moisture capacity and low natural fertility are the major limitations. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Grayling sand, 6 to 12 percent slopes, moderately eroded (GrC2).—This soil occurs mainly on the long convex slopes of rolling sandy moraines. In most areas the surface layer is yellowish-brown sand and consists mainly of material from the first brownish-yellow layer. The brownish-yellow layer is exposed in places, and in some areas there are a few small blowouts. Small scattered areas of Chelsea soils were included in some of the areas mapped.

Most of this soil is idle and has little vegetation. Low available moisture capacity, low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Grayling sand, 12 to 18 percent slopes (GrD).—The surface layer of this soil is dark yellowish-brown sand.

Most of this soil is forested. Cleared areas are susceptible to both wind and water erosion. Low available moisture capacity and low natural fertility are the major limitations. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Grayling sand, 12 to 18 percent slopes, moderately eroded (GrD2).—In most areas the surface layer of this soil is yellowish-brown sand. It consists mainly of material from the second layer. Shallow blowouts occur in some areas, and in places the second brownish-yellow layer is exposed.

Most of this soil is idle, but there are some scattered plantings of pine. Susceptibility to erosion, low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Grayling sand, 18 to 40 percent slopes (GrF).—Most of this soil is forested. In undisturbed areas the surface layer is very dark grayish-brown or yellowish-brown sand. In a few areas nearly all of the original surface layer has been lost through erosion, and the loose yellow sand is exposed. Although pine has been planted in a few of these areas, most of this acreage is idle. Low available moisture capacity and low natural fertility are the major limitations. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Ionia Series

Soils of the Ionia series are moderately well drained. These soils formed in calcareous loamy outwash materials and are underlain by stratified calcareous sand and gravel at a depth of 24 to 42 inches. They occur on the level to gently sloping parts of outwash plains, valley trains, moraines, kames, and eskers throughout the southern two-thirds of the county. The native vegetation was hardwood forest consisting mainly of sugar maple, oak, hickory, and beech.

Typical profile of Ionia sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; medium organic-matter content; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) sandy loam; weak, medium, granular structure; friable; medium acid; clear, wavy boundary.

B1—12 to 15 inches, yellowish-brown (10YR 5/4) loam; weak, fine, granular structure; friable; medium acid; clear, wavy boundary.

B21—15 to 21 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B22—21 to 34 inches, dark-brown (7.5YR 4/4) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

IIC—34 inches +, brown (10YR 5/3) gravel and sand; single grain; loose; calcareous.

The color of the surface layer ranges from dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2) or brown (10YR 5/3). The depth to mot-

tling ranges from 16 to about 28 inches. The depth to the IIC horizon ranges from 24 to 42 inches. Tongues of B22 material, from 2 to 12 inches thick, extend into the IIC horizon to a depth ranging from a few inches to as much as 3 feet or more.

Surface runoff is slow, permeability and the available moisture capacity are moderate, and natural fertility is medium.

The Ionia soils are finer textured throughout the solum than the Perrin soils, and they contain more gravel than the Cadmus soils, which are underlain by loam to silty clay loam.

Ionia loam, 0 to 2 percent slopes (IoA).—This soil occurs on broad flats that are at slight elevations on the valley plains, and on the smooth tops of high terraces adjacent to major drainageways. The surface layer is moderate in organic-matter content. In some areas the texture of the fourth and fifth layers is silty clay loam, and the depth to the bottom layer is about 42 inches. Within most of the areas mapped are small depressions in which the Matherton soils occur.

This soil is used mainly for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small areas are in farm woodlots. Droughtiness in extremely dry years and, to a limited extent, wetness are the major limitations. (Soil management unit 3aA (IIs); woodland suitability group U; wildlife suitability group 1)

Ionia loam, 2 to 6 percent slopes (IoB).—This soil occurs on undulating valley plains and high terraces. The surface layer contains a moderate amount of organic matter. In a few areas the fourth and fifth layers are silty clay loam, and the depth to the bottom layer is about 42 inches. In places there are numerous stones on the surface and throughout the soil material. Small areas of the well-drained Fox soils were included in many of the areas mapped, especially in those on the crests of swells. Also included in mapping were slight depressions in which the Matherton soils occur, and some small moderately eroded areas.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Droughtiness in extremely dry years and, to a limited extent, wetness and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Ionia sandy loam, 0 to 2 percent slopes (IrA).—This soil occurs on broad flats that are at slight elevations on the valley plains and on the smooth tops of high terraces adjacent to major drainageways. In some areas the fourth and fifth layers are sandy clay loam. Included in the areas mapped are small areas of Matherton soils that are in slight depressions.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Droughtiness in extremely dry years and, to a limited extent, wetness are the major limitations. (Soil management unit 3aA (IIs); woodland suitability group U; wildlife suitability group 1)

Ionia sandy loam, 2 to 6 percent slopes (IrB).—This soil occurs on undulating valley plains and on high terraces. The surface layer contains a moderate amount of organic matter. In many areas the fourth and fifth layers are sandy clay loam or clay loam. Included in the areas mapped, particularly in those on the crests of slight rises and swells, are small areas of Fox soils. Also included in mapping were small areas of Matherton soils that are in slight depressions.

This soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Droughtiness in extremely dry years and, to a limited extent, wetness and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Ionia sandy loam, 2 to 6 percent slopes, moderately eroded (IrB2).—This soil occurs on undulating valley plains and high terraces. Nearly all of the original surface layer has been removed by erosion, and the present surface layer is mostly yellowish-brown sandy loam. It contains little organic matter. In some areas the fourth and fifth layers are sandy clay loam.

This soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Droughtiness in extremely dry years and, to a limited extent, wetness and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Iosco Series

The Iosco series consists of somewhat poorly drained soils that formed in 18 to 42 inches of sand or loamy sand, over loam to silty clay loam. These soils occur as small areas on nearly level to gently sloping parts of till plains and moraines throughout the northern part of the county. They developed principally under northern hardwoods consisting mainly of sugar maple, oak, elm, hickory, and some white pine and red pine.

Typical profile of Iosco loamy sand:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; very weak, fine, granular structure; very friable; medium acid; medium to moderately low organic-matter content; abrupt, smooth boundary.

A2—8 to 10 inches, pale-brown (10YR 6/3) sand; single grain; loose; medium acid; abrupt, wavy boundary.

B21hir—10 to 18 inches, dark-brown (7.5YR 3/2) sand; few, fine, distinct brownish-yellow (10YR 6/8) mottles in lower part; very weak, fine, subangular blocky structure; very friable; slightly acid; gradual, wavy boundary.

B22ir—18 to 23 inches, dark yellowish-brown (10YR 4/4) sand; few, fine, faint, yellow (10YR 7/6) and brownish-yellow (10YR 6/8) mottles; single grain; loose; slightly acid; gradual, wavy boundary.

B23ir—23 to 29 inches, yellowish-brown (10YR 5/6) sand; common, fine, yellow (10YR 7/6) and strong-brown (7.5YR 5/6) mottles; single grain; loose; slightly acid; abrupt, wavy boundary.

A'2—29 to 32 inches, light-gray (10YR 7/2) loamy sand; common, medium, distinct, light yellowish-brown (10YR 6/4) mottles; single grain; loose; slightly acid; abrupt, wavy boundary.

IIB't—32 to 38 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIC—38 inches +, pale-brown (10YR 6/3) silty clay loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, coarse, subangular blocky structure; firm; calcareous.

In undisturbed areas, the A1 horizon is very dark gray (10YR 3/1) and is from 1 to 3 inches thick. The A2 horizon ranges from 1 to 8 inches in thickness and commonly is lacking in areas where the Ap horizon is 10 or more inches thick. The B21hir and B22ir horizons range to dark brown (7.5YR 4/4) or reddish brown (5YR 4/4) in color and the B23ir horizon ranges to brown (10YR 5/3) or pale brown (10YR 6/3). The A'2 horizon ranges from 1 inch to about 5 inches in thickness. The IIB't and IIC horizons range from loam to silty clay loam or clay loam and in a few areas contain thin strata of sandy loam.

Surface runoff is slow on these soils, and the available moisture capacity and natural fertility are low. Permeability is rapid in the sandy layers and slow in the layers of loam to silty clay loam.

The Iosco soils are coarser textured in the upper part of the solum than the Belding soils, and they have a characteristic A'2 horizon that is lacking in the Au Gres soils.

Iosco loamy sand, 0 to 2 percent slopes (IsA).—In most areas a profile of this soil is similar to the one described as typical of the series. Included in mapping, however, were small areas in which the texture of the surface layer is sand. Where there is accumulation of soil material from surrounding uplands, the surface layer is deeper and darker colored than the typical soil, and it contains more organic matter.

Drained areas are used for field crops. Some undrained areas are used for pasture or are in second-growth forest and farm woodlots. Low natural fertility, variable moisture-supplying capacity, and poor drainage are the major limitations. (Soil management unit 4/2bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Iosco loamy sand, 2 to 6 percent slopes (IsB).—In most areas a profile of this soil is similar to the one described as typical of the series. In some areas, however, soil material from the pale-brown layer and from the upper part of the dark-brown layer are mixed with the surface soil. In these areas the surface layer contains little organic matter. Included in the areas mapped are a few areas in which the surface layer consists almost entirely of the dark-brown soil material, and a few small areas in which the surface layer is sand. Small areas of the Menominee soils were included in some areas of the areas mapped.

Most of this acreage is in cultivation or used for permanent pasture. Low natural fertility, variable moisture-supplying capacity, susceptibility to wind erosion in dry periods, and poor drainage are the major limitations. (Soil management unit 4/2bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Kawkawlin Series

In the Kawkawlin series are somewhat poorly drained soils that formed in calcareous clay loam or silty clay loam till. These soils are on the level to gently sloping parts of till plains and moraines throughout the northern third of the county. They developed under mixed stands of hardwoods consisting principally of sugar maple, red oak, ironwood, basswood, and aspen.

Typical profile of Kawkawlin loam:

Ap—0 to 6 inches, very dark brown (10YR 2/2) loam; weak, fine, granular structure; friable; moderately high organic-matter content; neutral; abrupt, smooth boundary.

A2—6 to 10 inches, grayish-brown (10YR 5/2) loam; moderate, medium, platy structure; friable; slightly acid; clear, wavy boundary.

B21—10 to 14 inches, dark-brown (7.5YR 4/4) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; gradual, irregular boundary.

B22—14 to 24 inches, dark-brown (7.5YR 4/4) clay loam; common, medium, distinct, dark reddish-gray (5YR 4/2) mottles; moderate, medium, angular blocky structure; very firm; neutral; gradual, irregular boundary.

C—24 inches +, dark-brown (7.5YR 4/4) clay loam; common, medium, distinct, dark reddish-gray (5YR 4/2) mottles; moderate, coarse, angular blocky structure; firm; calcareous.

In many areas A2 material occurs as ped coatings and as crack fillings in the B21 horizon. The texture of the B22 horizon ranges from clay loam to silty clay loam or light silty clay. The depth to the calcareous till ranges from 20 to 35 inches.

Surface runoff is slow, permeability is moderately slow, and the available moisture capacity and natural fertility are moderately high.

The Kawkawlin soils have a coarser textured B horizon than the Selkirk soils, and their C horizon is clay loam or silty clay loam instead of silty clay or clay.

Kawkawlin loam, 0 to 2 percent slopes (KoA).—This soil occurs on broad flats and in small shallow swales on the uplands. The surface layer is very dark brown loam and contains a medium amount of organic matter. In places soil material that washed from surrounding higher areas has formed a thin surface layer only 2 to 6 inches thick. Within most mapped areas are small slight depressions in which the Sims soils occur.

Most of this soil is cleared. Many areas have been drained and are used principally for corn, wheat, oats, white beans, and legume-grass hay or pasture. Undrained areas are used for farm woodlots or permanent pasture. Excess wetness and moderately slow permeability are the major limitations. (Soil management unit 1.5bAB (IIw); woodland suitability group Z; wildlife suitability group 4)

Kawkawlin loam, 2 to 6 percent slopes (KoB).—This soil occurs on low swells and ridges on uplands and on narrow toe slopes bordering areas of Sims soils. The surface layer is dominantly very dark grayish-brown loam and contains a medium amount of organic matter. Included in many of the areas mapped are small areas of Nester soils, which are on the crests of the low ridges and swells. Also included are small areas of Sims soils that occur at the margins of the Kawkawlin soils.

Most of this soil is cleared. Adequately drained areas are used mainly for corn, wheat, oats, white beans, and legume-grass hay or pasture. A few undrained areas are used for farm woodlots or permanent pasture. Excess wetness and moderately slow permeability are the major limitations. (Soil management unit 1.5bAB (IIw); woodland suitability group Z; wildlife suitability group 4)

Kawkawlin sandy loam, 0 to 2 percent slopes (KdA).—This soil occurs on narrow flat ridgetops and in small shallow swales on the uplands. It generally is associated with the Belding and Ubly soils but commonly occurs at slightly higher elevations than these soils. The surface layer is dominantly dark grayish-brown sandy loam and contains only a moderate amount of organic matter. Where the thickness of the surface layer approaches 18 inches, small areas of the Belding and Ubly soils are included in the areas mapped.

Most of this soil is cleared. Adequately drained areas are used principally for corn, wheat, oats, white beans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots or permanent pasture. Excess wetness and moderately slow permeability are the major limitations. (Soil management unit 1.5bAB (IIw); woodland suitability group Z; wildlife suitability group 4)

Kawkawlin sandy loam, 2 to 6 percent slopes (KdB).—This soil occurs on low swells and ridges on the uplands. It generally is associated with the Belding and Ubly soils and commonly is adjacent to these soils but at slightly higher elevations. The surface layer is dominantly dark grayish-brown sandy loam and contains only a moderate amount of organic matter. Where the thickness of the surface layer approaches 18 inches, small areas of the Belding and Ubly soils are included in the areas mapped.

Most of this soil is cleared. Adequately drained areas are used principally for corn, wheat, oats, white beans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots and permanent pasture. Excess wetness and moderately slow permeability are the major limitations. (Soil management unit 1.5bAB (IIw); woodland suitability group Z; wildlife suitability group 4)

Kendallville Series

Soils of the Kendallville series are well drained and formed in loamy deposits that contained a considerable amount of gravel and sand. These soils are underlain at a depth of 18 to 42 inches by loam to silty clay loam glacial till. They occur on the level to strongly sloping parts of moraines and till plains throughout the southern part of the county. The native vegetation was deciduous forest consisting mainly of oak, hickory, and maple.

Typical profile of Kendallville loam:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; moderately high organic-matter content; medium acid; abrupt, smooth boundary.

A2—7 to 11 inches, grayish-brown (10YR 5/2) loam; moderate, medium, granular structure; friable; medium acid; clear, wavy boundary.

B1—11 to 14 inches, brown (10YR 5/3) loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

IIB21—14 to 24 inches, brown (7.5YR 5/4) heavy gravelly loam; moderate, medium, angular blocky structure; firm; medium acid; clear, wavy boundary.

IIB22—24 to 38 inches, brown (7.5YR 4/4) sandy clay loam containing considerable gravel; strong, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

IIIC—38 inches +, brown (10YR 5/3) loam; weak, coarse, subangular blocky structure; friable; calcareous.

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The B21 and B22 horizons range from sandy loam to gravelly clay loam in texture. In most areas there is some fine gravel in the B21 horizon. The reaction of the B22 horizon ranges from slightly acid to medium acid. In a few areas a thin horizon of calcareous loamy material, in which there is a considerable amount of gravel and sand, occurs just above the IIIC horizon. The average depth to the calcareous loam to silty clay loam till is 35 inches.

Surface runoff is slow on the milder slopes and rapid on the stronger ones. Permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Kendallville soils are underlain by loam to silty clay loam, whereas the Fox soils are underlain by sand and gravel.

Kendallville loam, 0 to 2 percent slopes (KeA).—This soil occurs on narrow smooth ridgetops on the uplands. The depth to the limy bottom layer approaches the maximum depth of 42 inches. Where this soil is adjacent to broad natural drainageways, the mapped areas include small areas of Fox soils. Small areas of Cadmus soils are also included in some of the mapped areas.

All of this soil is cultivated. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. The limitations are minor. (Soil management unit 3/2aA (I); woodland suitability group U; wildlife suitability group 1)

Kendallville loam, 2 to 6 percent slopes (KeB).—This soil occurs on undulating uplands. Small areas of Cadmus soils are included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, and legume-grass hay or pasture. A few areas are in farm woodlots. Slope and susceptibility to erosion are the major limitations. (Soil management unit 3/2aB (IIe); woodland suitability group U; wildlife suitability group 1)

Kendallville loam, 2 to 6 percent slopes, moderately eroded (KeB2).—This soil occurs on undulating uplands. Part of the original surface layer has been removed by erosion, and the present surface layer is predominantly dark grayish-brown to brown loam. It contains only a moderate amount of organic matter. Where the slope is 2 or 3 percent, small areas of Cadmus soil are included in many of the areas mapped.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 3/2aB (IIe); woodland suitability group U; wildlife suitability group 1)

Kendallville loam, 6 to 12 percent slopes, moderately eroded (KeC2).—This soil occurs on the short rounded slopes of ridges and swells on the uplands. Most of the original surface layer has been removed by erosion, and the present surface layer is dark grayish-brown to brown loam. It contains only a moderate amount of organic matter. Where the slope is 6 to 8 percent, small seepy areas of Macomb and Cadmus soils are included in the areas mapped.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major

limitations. (Soil management unit 3/2aC (IIIe); woodland suitability group U; wildlife suitability group 1)

Kendallville sandy clay loam, 6 to 12 percent slopes, severely eroded (KgC3).—This soil occurs on the short rounded slopes of ridges and swells on the uplands. All of the original surface layer has been removed by erosion. The present surface layer is brown sandy clay loam and is low in organic-matter content. In many areas the depth to the limy bottom layer approaches the minimum of 18 inches. Gullies that can be crossed with farm machinery are common, and in a few places there are numerous stones on the surface.

Most of this soil is cleared. Although some areas are used for corn, wheat, oats, and hay, most areas are idle or in permanent pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aC3 (IVe); woodland suitability group U; wildlife suitability group 1)

Kendallville sandy loam, 2 to 6 percent slopes (KhB).—This soil occurs on undulating uplands. The surface layer is dark grayish-brown sandy loam and contains only a moderate amount of organic matter. The fourth and fifth layers are predominantly loam and sandy clay loam. Included in the areas mapped are a few areas that are level.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 3/2aB (IIe); woodland suitability group U; wildlife suitability group 1)

Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded (KhB2).—This soil occurs on undulating uplands. The original surface layer has been removed by erosion, and the present surface layer is grayish-brown sandy loam. It is moderately low in organic-matter content. The fourth and fifth layers are predominantly loam and sandy clay loam. The average depth to the limy bottom layer is about 30 inches.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 3/2aB (IIe); woodland suitability group U; wildlife suitability group 1)

Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded (KhC2).—This soil occurs on the short rounded slopes of potholes and basins and on sloping ridges on the uplands. The original surface layer has been removed by erosion. The present surface layer is grayish-brown sandy loam and contains little organic matter. The fourth and fifth layers are predominantly loam and sandy clay loam. The average depth to the limy bottom layer is about 30 inches. Where the slope is between 6 and 8 percent, small seepy areas of Macomb and Cadmus soils are included in the areas mapped.

Most of this soil is used for corn, wheat, oats, and legume-grass hay or pasture. Some areas are in permanent pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group U; wildlife suitability group 1)

Kendallville sandy loam, 12 to 18 percent slopes, moderately eroded (KhD2).—This soil occurs on the short side slopes of valley walls and on strongly sloping ridges. The surface layer is grayish brown and contains little organic matter. The fourth and fifth layers are predominantly loam and sandy clay loam. The average depth to the limy bottom layer is about 25 inches. Included in the areas mapped are small seepy areas of the moderately well drained Cadmus soils, in which the fourth and fifth layers are mottled. Also included are a few small areas in which the surface layer is loam.

Most of this soil is used for pasture. A few areas are idle or in farm woodlots. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aD (IVe); woodland suitabilty group U; wildlife suitability group 1)

Kent Series

The Kent series consists of well drained and moderately well drained soils that formed in reddish or pinkish calcareous clay or silty clay till. These soils are on the nearly level to strongly sloping parts of till plains and moraines throughout the northern third of the county. They developed under mixed stands of hardwoods and conifers consisting mainly of elm, maple, beech, and some hemlock and white pine.

Typical profile of Kent silt loam:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A21—6 to 9 inches, pale-brown (10YR 6/3) silt loam; weak, fine, subangular blocky structure; friable; slightly acid; clear, irregular boundary.

B21&A22—9 to 13 inches, dark-brown (7.5YR 4/4) silty clay (representing the B21 horizon); thick coats of pale-brown (10YR 6/3) silt loam (representing the A22 horizon) are on individual ped surfaces, on surfaces of cracks, and on walls of old root channels; the B21 material has moderate, fine, angular blocky structure and is very firm; the A22 material has weak, coarse, granular structure and is friable; slightly acid; gradual, wavy boundary.

B22—13 to 22 inches, dark-brown (7.5YR 4/4) silty clay; strong, medium, angular blocky structure; very firm; few, thin, reddish-brown (5YR 4/4) clay coats on some ped surfaces; neutral; abrupt, wavy boundary.

C—22 inches +, dark reddish-gray (5YR 4/2) silty clay; strong, medium, angular blocky structure; very firm; calcareous.

Gray and yellowish mottles occur in the lower part of the B1 horizon of the moderately well drained soils. The depth to the C horizon ranges from 18 to 30 inches.

Surface runoff is medium on the mild slopes and rapid on the strong slopes. Permeability is slow, and natural fertility is medium. The available moisture capacity ordinarily is high, but during long dry periods crops may be damaged because of lack of moisture.

The Kent soils are in the drainage sequence that includes the somewhat poorly drained Selkirk soils and the very poorly drained Bergland soils. They are finer textured throughout the solum than the Nester soils.

Kent soils, 2 to 6 percent slopes (KkB).—These soils are on gently undulating uplands, generally adjacent to broad drainageways. The surface layer is dark grayish-brown sandy loam or silt loam and contains only a moderate amount of organic matter. In many places it is as much

as 8 inches thick. The second layer is pale-brown sandy loam or loam and typically is 3 or 4 inches thick. The third layer is silty clay and occurs at a depth of about 11 to 12 inches. Where these soils occur on high uplands, adjacent to broad drainageways, they commonly are associated with the Mancelona soils, loamy substratum, which are at slightly lower elevations. Within the areas mapped are small shallow depressions in which the Selkirk soils occur.

Most of this acreage is cultivated. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. A few areas are in farm woodlots. Slow permeability is the major limitation. (Soil management unit laBC (IIIe); woodland suitability group B; wildlife suitability group 3)

Kent soils, 6 to 12 percent slopes (KkC).—These soils are on the short rounded slopes of ridges and swells on the uplands and on isolated ridges surrounded by low swampy areas and areas of deep sand. In most areas the surface layer is brown or dark brown. The first two layers typically are sandy loam. The third layer is silty clay or clay and occurs at a depth of about 9 to 10 inches. These soils commonly are associated with the Montcalm and Mancelona soils and with the Mancelona soils, loamy substratum. Included in many areas of the areas mapped are small areas of Mancelona soils.

Most of this acreage is used for corn, wheat, oats, and legume-grass hay or pasture. A few areas are in farm woodlots or permanent pasture. Slope, susceptibility to erosion, and slow permeability are the major limitations. (Soil management unit laBC (IIIe); woodland suitability group B; wildlife suitability group 3)

Kent soils, 12 to 18 percent slopes (KkD).—These soils are on strongly sloping ridges and short slopes on the uplands and on isolated ridges surrounded by wet areas of sand. The surface layer is brown or dark-brown silty clay loam or sandy loam. Small areas of Nester and Montcalm soils and of Mancelona soils, loamy substratum, were included in many of the areas mapped.

Most of this acreage is used for wheat, oats, and legume-grass hay or pasture. Slope and susceptibility to erosion are major limitations. (Soil management unit 1.5aD (IVe); woodland suitability group B; wildlife suitability group 3)

Kent silty clay, 6 to 12 percent slopes, severely eroded (KlC3).—This soil is on the short rounded slopes of ridges and swells on the uplands and on isolated ridges surrounded by low swampy areas. The original surface layer and the pale-brown second layer have been removed by erosion. The present surface layer is silty clay and contains little organic matter. Gullies shallow enough to be crossed with farm machinery have formed in many areas.

This soil is used for corn, wheat, oats, and legume-grass hay or pasture. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 1.5aC3 (IVe); woodland suitability group B; wildlife suitability group 3)

Kerston Series

Soils of the Kerston series are dark colored and very poorly drained. These soils formed in alternate layers of organic and mineral soil materials, mainly in level areas and in depressions along streams. Although they are widely distributed throughout the county, the major part of the total acreage is in the southern part. The present vegetation consists principally of elm, ash, red maple, willow, poplar, alder, and an understory of water-tolerant shrubs, sedges, and grasses.

Typical profile of Kerston muck:

1—0 to 10 inches, black (10YR 2/1) muck; moderate, fine, granular structure; friable; neutral; clear, wavy boundary.
2—10 to 12 inches, dark grayish-brown (10YR 4/2) loamy sand; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; neutral; clear, wavy boundary.
3—12 to 18 inches, very dark gray (10YR 3/1) muck; weak, medium, granular structure; friable; neutral; clear, wavy boundary.
4—18 to 22 inches, grayish-brown (2.5Y 5/2) loamy sand; single grain; loose; mildly alkaline; clear, wavy boundary.
5—22 to 28 inches, very dark grayish-brown (10YR 3/2) peat; massive; friable; calcareous; clear, wavy boundary.
6—28 inches +, grayish-brown (2.5Y 5/2) loamy sand; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; calcareous.

The thickness of the organic and mineral layers varies. In some places the layers are thin near the surface and are from 6 to 12 inches thick at a greater depth. In places the texture of the mineral layers is sand or sandy loam.

Surface runoff is very slow or ponded, permeability is moderately rapid, the available moisture capacity is high, and natural fertility is medium. Wind erosion is a hazard if these soils are cleared and drained.

The Kerston soils formed in alternate layers of organic and mineral materials, whereas the Sloan, Cohoctah, and Glendora soils formed in mineral material, and the Carlisle, Tawas, Linwood, Willette, and Lupton soils in organic material.

Kerston muck (0 to 1 percent slopes) (Km).—This soil is in level areas or depressions on the flood plains. It commonly occupies old shallow channels and oxbows. It is closely associated with the Cohoctah and Glendora soils, and small areas of those soils were included in some of the areas mapped. Also included were some small depressions in which the Tawas soils occur.

Although most of this soil is idle, a few areas are used for corn, soybeans, mint, and truck crops. Excess wetness, susceptibility to wind erosion, and medium natural fertility are the major limitations. (Soil management unit L–4cA (IIIw); woodland suitability group J; wildlife suitability group 8)

Kibbie Series

The Kibbie series consists of somewhat poorly drained soils that formed in deep, stratified, calcareous silt, very fine sand, and fine sand. These soils are on level to gently sloping parts of lake plains, deltas, and outwash plains throughout the southern two-thirds of the county. The native vegetation consisted mainly of maple, beech, elm, and basswood.

Typical profile of Kibbie loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—7 to 12 inches, pale-brown (10YR 6/3) very fine sandy loam; few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, thin, platy structure; friable; slightly acid; clear, smooth boundary.

B1—12 to 18 inches, brown (10YR 5/3) loam; many, medium, distinct, brown (7.5YR 5/4) mottles; weak, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B2g—18 to 34 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, brown (7.5YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

C—34 inches +, grayish-brown (10YR 5/2) silt and very fine sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; stratified; calcareous.

In some areas the A2 horizon has weak, fine, subangular blocky structure. The texture of the B2 horizon ranges from sandy loam to heavy sandy loam, heavy fine sandy loam, light clay loam, light silty clay loam, or silt loam, depending on the thickness and sequence of the layers of silt, fine sand, and very fine sand in the C horizon. The texture of the C horizon ranges from stratified silt, fine sand, and very fine sand to dominantly silt, very fine sand, or fine sand. The depth to the C horizon ranges from 24 to 42 inches.

Surface runoff is slow, permeability and the available moisture capacity are moderate, and natural fertility is medium.

The Kibbie soils are in the drainage sequence that includes the moderately well drained Tuscola soils and the poorly drained and very poorly drained Colwood soils. They have a coarser textured B horizon and have more fine sand throughout the solum than the Conover soils, which formed in loam, silt loam, or light clay loam. The B horizon of the Kibbie soils is more variable than that of the Locke soils.

Kibbie loam, 0 to 2 percent slopes (KnA).—This soil is on valley plains and lake plains. The surface layer is very dark grayish brown and is moderately high in organic-matter content. It is dominantly loam but ranges from fine sandy loam to silt loam in texture. In some areas medium sand and gravel occur in the bottom layer. Within the areas mapped are small areas of the Tuscola soils that are on slight rises and swells. Also included are small depressions in which the Colwood soils occur.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 2.5bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Kibbie loam, 2 to 6 percent slopes (KnB).—This soil occurs on undulating swells and rises on valley plains and uplands. The texture of the surface layer is dominantly loam but ranges from fine sandy loam to silt loam. In some areas, medium sand and fine gravel occur in the bottom layer. Within the areas mapped are small areas of the Tuscola soils that are on slight rises and swells.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A small acreage is in farm woodlots. Excess wetness and, to less extent, susceptibility to erosion are the major limitations. (Soil management unit 2.5bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Kokomo Series

Soils of the Kokomo series formed in calcareous loam, silt loam, or light clay loam till. They occur in level or nearly level areas and in depressions on till plains and low moraines throughout the southern two-thirds of the county. The native vegetation was deciduous forest consisting mainly of elm, soft maple, basswood, ash, and a ground cover of marsh grasses.

Typical profile of Kokomo clay loam:

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

A12—8 to 18 inches, very dark gray (10YR 3/1) clay loam; weak, fine, subangular blocky structure; firm; neutral; clear, wavy boundary.

B21g—18 to 30 inches, dark-gray (10YR 4/1) clay loam; few, fine, distinct, mottles of yellowish brown (10YR 5/6–5/8) in lower 2 to 4 inches; weak, coarse, prismatic structure breaks to coarse, angular blocky structure; firm; thin to medium clay films on numerous peds; thin coats of very dark gray (10YR 3/1) on ped faces and in cracks in upper 3 or 4 inches; mildly alkaline; gradual, wavy boundary.

B22g—30 to 48 inches, gray (N 5/0) clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; moderate, coarse, angular blocky structure; thin to medium clay films on numerous peds; firm; mildly alkaline; abrupt, irregular boundary.

C—48 inches +, grayish-brown (10YR 5/2) heavy loam; many coarse, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; calcareous.

The total thickness of the Ap and A1 horizons ranges from 15 to about 24 inches. A thin layer of muck occurs on the surface of some undisturbed areas. The upper part of the B horizon is dominantly gray and in some areas contains a few mottles. The depth to the C horizon ranges from 36 to more than 60 inches.

Surface runoff is very slow or ponded, permeability is moderately slow, and the available moisture capacity and natural fertility are high.

The Kokomo soils are in the drainage sequence that includes the well drained Miami soils, the moderately well drained Celina soils, the somewhat poorly drained Conover soils, and the poorly drained and very poorly drained Brookston soils. They have a thicker A1 horizon than the Brookston soils and are dominantly gray instead of mottled in the upper part of the B horizon. The Kokomo soils have a thicker A1 horizon than the Pewamo soils and coarser textured B and C horizons.

Kokomo clay loam (0 to 1 percent slopes) (Ko).—This soil is on broad flats and in shallow basins and swales. In some small areas there is a thin deposit, 2 to 4 inches thick, of moderately dark colored soil material on the surface. A thin layer of muck occurs on the surface of some undisturbed areas, and in a few places the texture of the surface layer is loam. Small areas of Linwood muck and of the Brookston soils were included in many of the mapped areas.

Most of this soil is cleared. Adequately drained areas are used mainly for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Poor drainage is the

major limitation. (Soil management unit 2.5cA (I); woodland suitability group P; wildlife suitability group 2)

Landes Series

The Landes series consists of well drained and moderately well drained soils that formed in stratified fine sandy loam and heavy loamy fine sand on level or nearly level bottom lands. These soils are scattered throughout the county, but the areas generally are small. The native vegetation consisted mainly of elm, ash, red maple, and sycamore.

Typical profile of Landes loam:

Ap—0 to 9 inches, very dark brown (10YR 2/2) loam; weak, fine, granular structure; friable; moderately high organic-matter content; mildly alkaline; abrupt, smooth boundary.

C1—9 to 18 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, fine, granular structure; friable; calcareous; gradual, wavy boundary.

C2—18 to 42 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, fine, granular structure; very friable; calcareous; gradual, wavy boundary.

C3—42 inches +, dark yellowish-brown (10YR 4/4) sandy loam; weak, fine, granular structure; very friable; calcareous.

The Ap horizon ranges from very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2) or dark brown (10YR 4/2) in color and from neutral to calcareous in reaction. The organic-matter content of the Ap horizon ranges from moderate to moderately high. The texture of the C horizon is mainly fine sandy loam, but in some areas it is heavy loamy fine sand or sandy loam. In many areas there are thin layers of very dark brown (10YR 2/2) loamy fine sand or sandy loam, relatively high in organic-matter content, in the C horizon. In moderately well drained areas, yellowish-brown (10YR 5/6) to pale-brown (10YR 6/3) mottles occur below a depth of 20 inches. In places thin layers or lenses of fine sand and gravel occur in the C2 and C3 horizons.

Surface runoff is very slow, permeability is moderately rapid, the available moisture capacity is moderately low, and natural fertility is medium.

The Landes soils are in the drainage sequence that includes the somewhat poorly drained Ceresco soils and the poorly drained and very poorly drained Cohoctah soils. They are finer textured than the Abscota soils but are coarser textured than the Genesee and Eel soils.

Landes-Eel loams (0 to 1 percent slopes) (La).—This complex occurs in level or nearly level areas and in slight depressions on bottom lands. For the most part, the areas mapped include both the Landes soil and the Eel soil, but there are some areas in which only one soil occurs.

The Landes soil is moderately well drained. Below a depth of 8 to 10 inches, the dominant texture of the Landes soil is fine sandy loam, and the dominant texture of the Eel soil is loam. In some small areas, at a depth below 8 to 10 inches, the texture is loamy fine sand, sandy loam, silt loam, light clay loam, or light silty clay loam. In a few places the surface layer is silt loam. Included in the areas mapped are small areas of the darker colored, somewhat poorly drained Ceresco and Shoals soils. The Eel soil is described in detail under the heading "Eel Series."

Most of this acreage is used for corn and legume-grass hay or pasture. Some areas are used for oats and soybeans, and a few are in farm woodlots or permanent pasture. The major limitations are occasional flooding and, in some of the sandier areas, moderately low available moisture capacity. (Soil management unit L–2aA (IIw); woodland suitability group P; wildlife suitability group 1)

Landes-Eel sandy loams (0 to 1 percent slopes) (Le).—This complex occurs in level or nearly level areas and depressions on bottom lands. For the most part, the areas mapped include both the Landes soil and the Eel soil, but there are some small areas in which only one soil occurs. Below a depth of 8 to 10 inches, the dominant texture of the Landes soil is fine sandy loam, and the dominant texture of the Eel soil is loam. In a few small areas, at a depth below 8 to 10 inches, the texture is sandy loam, light clay loam, or light silty clay loam. Within the areas mapped are small depressions in which the darker colored Ceresco or Shoals soils occur. The Eel soil is described in detail under the heading "Eel Series."

Most of this acreage is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few areas are in farm woodlots or permanent pasture. The major limitations are occasional flooding and, in some of the sandier areas, moderately low available moisture capacity. (Soil management unit L–2aA (IIw); woodland suitability group O; wildlife suitability group 1)

Landes-Genesee loams (0 to 1 percent slopes) ((lg).—This complex is on nearly level or level bottom lands along rivers and creeks. For the most part, the areas mapped include both the Landes soil and the Genesee soil, but there are some small areas in which only one soil occurs. Below a depth of 8 to 10 inches, the dominant texture of the Landes soil is fine sandy loam and the dominant texture of the Genesee soil is loam. In a few small areas, at a depth below 8 to 10 inches, the texture is sandy loam, light clay loam, or light silty clay loam. Within the areas mapped are slight depressions in which the darker colored Ceresco or Shoals soils occur. The Genesee soil is described in detail under the heading "Genesee Series."

Most of this acreage is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few areas are in farm woodlots or permanent pasture. The major limitations are occasionl flooding and, in some of the sandier areas, moderately low available moisture capacity. (Soil management unit L–2aA (IIw); woodland suitability group O; wildlife suitability group 1)

Landes-Genesee sandy loams (0 to 1 percent slopes) (lh).—This complex is on level bottom lands along rivers and creeks. In places the surface layer is fine sandy loam. In some areas thin layers of fine sand occur below a depth of 8 to 10 inches. Within the areas mapped are small depressions in which the darker colored Ceresco and Shoals soils occur. The Genesee soil is described in detail under the heading "Genesee Series."

Most of this acreage is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few areas are in farm woodlots or permanent pasture. The major limi-

tations are occasional flooding and, in some of the sandier areas, moderately low available moisture capacity. (Soil management unit L–2aA (IIw); woodland suitability group O; wildlife suitability group 1)

Lapeer Series

The Lapeer series consists of well-drained soils that formed in calcareous sandy loam till. These soils are on nearly level to steep parts of moraines and till plains. The native vegetation consisted mainly of oak, hickory, beech, sugar maple, and other hardwoods.

Typical profile of Lapeer sandy loam:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—7 to 11 inches, brown (10YR 5/3) sandy loam; weak, fine, granular structure; friable; slightly acid; clear, wavy boundary.

B1—11 to 17 inches, brown (10YR 4/3) heavy sandy loam; moderate, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B2—17 to 34 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; medium acid; abrupt, irregular boundary.

C—34 inches +, brown (10YR 5/3) sandy loam; massive; friable; calcareous.

The B horizon ranges from medium acid to neutral in reaction. The depth to the C horizon ranges from 20 to 42 inches. The texture of the B2 horizon ranges from sandy clay loam to heavy loam or light clay loam.

Surface runoff is slow on the milder slopes and rapid on the steep slopes. Permeability and the available moisture capacity are moderate, and natural fertility is medium.

The Lapeer soils are in the drainage sequence that includes the moderately well drained Dryden soils, the somewhat poorly drained Locke soils, and the poorly drained and very poorly drained Barry soils. They have coarser textured B and C horizons than the Miami soils and have a thicker, finer textured B horizon than the Spinks soils, which are underlain by loamy sand.

Lapeer loam, 0 to 2 percent slopes (LlA).—This soil occurs on broad smooth ridgetops on the uplands, generally in association with the Dryden soils. In most areas the depth to the limy sandy loam bottom layer is nearly 42 inches. Within the areas mapped are some small slight depressions in which the Dryden or Locke soils occur and some isolated slight ridges on which the Spinks soils occur.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. The major limitation is medium natural fertility. (Soil management unit 3aA (IIs); woodland suitability group U; wildlife suitability group 1)

Lapeer loam, 2 to 6 percent slopes (LlB).—This soil occurs on broad undulating low ridges, mainly on the uplands. The surface layer is dark-brown loam and generally is low in organic-matter content. In a few areas, the depth to the limy bottom layer is about 42 inches. This soil is closely associated with the wetter more nearly level Dryden and Locke soils, and some small slight depressions in which the Locke soils occur were included in the areas mapped.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, beans, and legume-grass hay or pasture. A few areas are forested, and some small areas are in farm woodlots. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Lapeer loam, 2 to 6 percent slopes, moderately eroded (LlB2).—This soil occurs on undulating uplands. Part of the original surface layer has been removed by erosion, and the present surface layer is dominantly grayish-brown or brown loam that is low in organic-matter content. In some small areas the dark yellowish-brown fourth layer is exposed. In places the depth to the limy sandy loam bottom layer is about 42 inches. Within some of the areas mapped are slight rises on which the more strongly sloping, moderately eroded Lapeer soil occurs and some small depressions in which the Locke soils occur.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Lapeer loam, 6 to 12 percent slopes, moderately eroded (LlC2).—This soil occurs on the short rounded slopes of potholes and basins, and on sloping swells and ridges on the uplands. The surface layer generally is brown or grayish-brown loam. In some small areas the dark yellowish-brown fourth layer is exposed. Included in the areas mapped are small severely eroded areas in which the surface layer is sandy clay loam. Also included are some small areas of the less sloping, moderately eroded Lapeer soils that are on narrow ridgetops and benches.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy clay loam, 6 to 12 percent slopes, severely eroded (LmC3).—This soil occurs on the short, rounded slopes of potholes and basins, and on sloping swells and ridges on the uplands. On much of the acreage, the first three layers all have been removed by erosion, and the present surface layer is dominantly sandy clay loam. The content of organic matter is low. Gullies that can be crossed with farm machinery have formed in some places. Small areas of the less sloping, moderately eroded Lapeer soil, on narrow benches, were included in some of the areas mapped.

Most of this acreage is idle or in pasture or hay. A few areas are used for cultivated crops. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aC3 (IVe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy clay loam, 12 to 18 percent slopes, severely eroded (LmD3).—This soil occurs on short side slopes along valley walls, and on strongly sloping ridges. On much of the acreage, the first three layers all have been removed by erosion, and the present surface layer is dominantly sandy clay loam. The organic-matter content is low. The depth to the limy sandy loam bottom layer ranges from 20 to 30 inches. Scattered throughout most

of the areas mapped are small moderately eroded areas in which the surface layer is loam or sandy loam.

Most of this soil is used for pasture. Many areas are idle or in second-growth forest and shrubs. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aD3 (VIe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy clay loam, 18 to 40 percent slopes, severely eroded (LmF3).—This soil occurs on the short side slopes of draws and ravines. On much of the acreage, the first three layers have been removed by erosion, and the present surface layer is dominantly sandy clay loam. The organic-matter content is low. The limy sandy loam bottom layer is at a depth of 20 to 30 inches. Scattered throughout the areas mapped are small areas of moderately eroded Lapeer sandy loam.

This soil is either idle or in second-growth forest and shrubs. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aEF3 (VIIe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy loam, 0 to 2 percent slopes (LnA).—This soil occurs on broad, smooth ridgetops on the uplands and is commonly associated with the Dryden sandy loams. The surface layer contains a moderate amount of organic matter. The depth to the limy sandy loam bottom layer generally is about 42 inches. Within many of the areas mapped are slight depressions in which the Dryden soils occur.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Medium natural fertility and moderate available moisture capacity are the major limitations. (Soil management unit 3aA (IIs); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy loam, 2 to 6 percent slopes (LnB).—This soil occurs on undulating uplands. The surface layer is dark grayish-brown sandy loam and is moderate in organic-matter content. In some areas, the depth to the limy sandy loam bottom layer approaches 42 inches. This soil is associated with the wetter Locke soils, which occur in slight depressions. Small areas of slightly eroded Locke soils that have a slope range of 0 to 2 percent were included in many of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded (LnB2).—This soil is on undulating uplands. It has a predominantly grayish-brown or brown surface layer that is low in organic-matter content. It is associated with the wetter Locke soils, which occupy shallow swales and depressions. Small areas of the Locke soils were included in some of the areas mapped. Also included were small scattered areas of slightly eroded Lapeer sandy loam, 0 to 2 percent slopes, and Lapeer sandy loam, 2 to 6 percent slopes.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded (LnC2).—This soil occurs on sloping hills and ridges. Much of the original surface layer has been removed by erosion, and the present surface layer is dark-brown sandy loam. The organic-matter content is low. The depth to the limy sandy loam bottom layer ranges from 20 to 30 inches. This soil is closely associated with the Spinks soils, which generally occur at slightly higher elevations, and small areas of these soils were included in many of the areas mapped. Also included were some small shallow depressions in which the Locke soils occur and a few small areas of an uneroded darker colored soil.

Most of this soil is used for hay and pasture. Susceptibility to erosion and medium natural fertility are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded (LnD2).—This soil occurs on short side slopes, along valley walls and ridges. The surface layer is mainly dark-brown sandy loam and is low in organic-matter content. This soil is closely associated with the Spinks soils, and small areas of moderately steep, moderately eroded Spinks soils were included in some of the areas mapped. Also included were small areas of Lapeer soils that have a loam surface layer, and a few areas of an uneroded darker colored soil.

Most of this soil is idle or in second-growth forest and shrubs. A few areas are used for pasture. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aD (IVe); woodland suitability group U; wildlife suitability group 1)

Lapeer sandy loam, 18 to 40 percent slopes, moderately eroded (LnF2).—This soil occurs on the short side slopes of draws and ravines. Most of the first two layers have been removed by erosion, and the present surface layer consists mainly of material from the third layer. It is brown or yellowish-brown sandy loam and is low in organic-matter content. The depth to the limy sandy loam bottom layer ranges from 20 to 30 inches. A few uneroded areas were included in the areas mapped.

Most of this soil is idle. Natural reforestation has begun in some places but is progressing at a slow rate. Medium natural fertility and susceptibility to erosion are the major limitations. (Soil management unit 3aEF (VIIe); woodland suitability group U; wildlife suitability group 1)

Linwood Series

Soils of the Linwood series developed in organic deposits that consisted largely of woody materials, reeds, sedges, and grasses. These soils range from 12 to 42 inches in thickness over sandy loam, loam, silt loam, light clay loam, or light silty clay loam. They occur mainly in level areas and slight depressions on lake plains, outwash plains, till plains, and moraines. Although the Linwood soils are widely distributed throughout the county, a large part of the acreage is in the southern part. The native vegetation consisted mainly of elm, ash, and birch and an understory of reeds, grasses, sedges, willows, dogwood, and alder.

Typical profile of Linwood muck:

1—0 to 8 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; contains mixed woody and fibrous organic matter; slightly acid; clear, wavy boundary.
2—8 to 20 inches, very dark gray (10YR 3/1) muck; moderate, medium, granular structure; friable; organic matter derived from fibrous organic remains that contained a few fragments of woody material; slightly acid; clear, wavy boundary.
3—20 to 34 inches, dark-brown (7.5YR 3/2) peat; weak, thick, platy structure; friable; slightly acid; abrupt, wavy boundary.
IIC—34 inches +, grayish-brown (2.5Y 5/2) sandy loam; common, medium, distinct mottles of dark yellowish brown (10YR 4/4); massive; friable; calcareous.

Horizon No. 3 is muck in some areas. In places the IIC horizon is light brownish gray (10YR 6/2) in color. It ranges from slightly acid to calcareous in reaction.

Surface runoff is very slow or ponded, permeability is moderate, and the available moisture capacity is high. Natural fertility is only moderately high because of the unbalanced proportions of essential plant nutrients. Wind erosion is a hazard if these soils are cultivated.

The Linwood soils differ from the Carlisle in that they formed in organic materials that are 12 to 42 inches thick over a mineral substratum, whereas the Carlisle soils formed in organic materials that are more than 42 inches thick. The Linwood soils are underlain by loams, and the Tawas and Willette soils are underlain by sands and clays, respectively.

Linwood muck (0 to 1 percent slopes) (Lo).—This soil occurs in potholes and swales on the uplands, and in swampy flats on the lowlands. Some areas are around the margins of shallow lakes and ponds, and a few areas are on gentle slopes, where the soil formed in organic material that accumulated because of ground water seepage. Included in the areas mapped are small areas of Carlisle soils, which vary greatly in depth to the underlying mineral material, and small areas of Edwards soils, which are underlain by marl.

Most of the acreage is cleared of timber. The main cultivated crops are onions, potatoes, and other truck crops, and corn, soybeans, and mint. Excess wetness, wind erosion, and unbalanced natural fertility are the major limitations. (Soil management unit M/4cA (IVw); woodland suitability group J; wildlife suitability group 8)

Locke Series

The Locke series consists of somewhat poorly drained soils that formed in calcareous sandy loam till. These soils are on the level to gently sloping parts of till plains and low moraines, principally in the southern part of the county. The native vegetation consisted mainly of mixed stands of hickory, elm, ash, basswood, and other hardwoods.

Typical profile of Locke sandy loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.
A2—7 to 12 inches, pale-brown (10YR 6/3) sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, granular structure; friable; medium acid; abrupt, wavy boundary.
B21—12 to 15 inches, brown (10YR 5/3) heavy sandy loam; common, fine, distinct, dark-brown (10YR 4/3) mottles; moderate, fine, subangular blocky structure; friable; medium acid; gradual, wavy boundary.
B22—15 to 32 inches, brown (10YR 5/3) sandy clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles, and few, fine, faint, light yellowish-brown (10YR 6/4) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.
C—32 inches +, pale-brown (10YR 6/3) sandy loam; few, fine, faint, brown (10YR 5/3) mottles; weak, coarse, subangular blocky structure; friable; calcareous.

The B21 horizon ranges from sandy loam to sandy clay loam in texture, and the B22 horizon from heavy sandy loam to heavy loam, sandy clay loam, or light clay loam. In some areas the C horizon contains thin strata of loamy sand, 1 or 2 inches thick. The depth to the C horizon ranges from 20 to 42 inches.

Surface runoff is slow, permeability is moderate, and natural fertility is medium. In drained areas, the available moisture capacity is moderate.

The Locke soils have a coarser textured B horizon than the Conover soils and a less gravelly B horizon than the Matherton soils. They are in the drainage sequence that includes the well drained Lapeer soils, the moderately well drained Dryden soils, and the poorly drained and very poorly drained Barry soils.

Locke sandy loam, 0 to 2 percent slopes (LsA).—This soil occurs in shallow swales on gently undulating uplands. It is associated with the Conover and Barry soils, and small areas of these soils were included in some of the areas mapped. In a few areas the surface layer is loam.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Poor drainage and medium natural fertility are the major limitations. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Locke sandy loam, 2 to 6 percent slopes (LsB).—This soil occurs in undulating to gently sloping areas. In some areas the surface layer is loam. The depth to the limy sandy loam bottom layer ranges from 20 to 35 inches. Small areas of Dryden soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Somewhat poor drainage and medium natural fertility are the major limitations. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Lupton Series

The Lupton series consists of very poorly drained or ponded soils that formed in deep, neutral to moderately alkaline, mixed woody and fibrous organic materials. These soils are in small level areas and depressions on outwash plains, lake plains, till plains, and moraines. They are widely scattered throughout the county. The native vegetation consisted mainly of elm, ash, birch, soft maple, and aspen.

Typical profile of Lupton muck:

1—0 to 10 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; mixed woody and fibrous organic materials; neutral; clear, smooth boundary.

2—10 to 29 inches, very dark brown (10YR 2/2) muck; moderate, medium, granular structure; friable; few to many, small wood fragments and some undecomposed fibrous organic materials; mildly alkaline; gradual, wavy boundary.
3—29 to 42 inches +, dark yellowish-brown (10YR 4/4) peat; weak, thick, platy structure; undecomposed fibrous organic materials; mildly alkaline.

The color of the No. 1 horizon is very dark brown in some areas. The reaction of the solum ranges from neutral to moderately alkaline.

Surface runoff is very slow or ponded, permeability is moderately rapid, and the available moisture capacity is high. In most areas the water table is at or near the surface. Natural fertility is only moderately high because of the unbalanced proportions of essential plant nutrients. Wind erosion is a hazard in drained areas.

The Lupton soils are neutral to moderately alkaline in reaction, whereas the Carlisle soils range from slightly acid to strongly acid.

Lupton muck (0 to 1 percent slopes) (Lt).—A profile of this soil is like the one described as representative of the series. Small areas of Carlisle soils, which are acid in reaction, were included in some of the areas mapped.

Most of this soil is wooded. A few areas are used for corn, mint, onions, and potatoes. Poor drainage, susceptibility to wind erosion, and unbalanced fertility are the major limitations. (Soil management unit McA (IIIw); woodland suitability group G; wildlife suitability group 8)

Macomb Series

In the Macomb series are somewhat poorly drained soils that formed in loamy deposits that contained a considerable amount of gravel and sand. These soils are underlain at a depth of 18 to 42 inches by loam to clay loam. They occur on the level to gently sloping parts of till plains and low moraines throughout the southern part of the county. The native vegetation was hardwood forest consisting mainly of elm, red maple, ash, and basswood.

Typical profile of Macomb loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.
A2—7 to 11 inches, pale-brown (10YR 6/3) heavy sandy loam; many, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; slightly acid; clear, wavy boundary.
B21—11 to 13 inches, pale-brown (10YR 6/3) loam; many, fine, faint, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.
B22—13 to 32 inches, brown (10YR 5/3) gravelly sandy clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; medium acid; abrupt, wavy boundary.
IIC—32 inches +, dark grayish-brown (10YR 4/2) loam; many, medium, faint, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; calcareous.

The B horizon ranges from heavy sandy loam to gravelly clay loam or clay loam. It contains various amounts of gravel.

Surface runoff is slow, permeability is moderate or moderately slow, and the available moisture capacity and natural fertility are moderately high.

The Macomb soils are in the drainage sequence that includes the well drained Kendallville soils, the moderately well drained Cadmus soils, and the poorly drained and very poorly drained Berville soils. They are finer textured throughout the solum than the Metamora soils, and they are less gravelly than the Matherton soils, which are underlain by sand and gravel.

Macomb loam, 0 to 2 percent slopes (MaA).—This soil occurs on broad flats and in small shallow swales on gently undulating uplands. Although the surface layer is dominantly loam, there are a few areas in which it is sandy loam. The texture of the third and fourth layers generally is gravelly sandy clay loam or clay loam but in some areas is sandy clay loam. On the broad flats, this soil is closely associated with the Conover soils, and some small areas of these soils were included in the areas mapped.

Most of this soil is used for corn, wheat, soybeans, white beans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots or permanent pasture. Somewhat poor drainage is the major limitation. (Soil management unit 3/2bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Macomb loam, 2 to 6 percent slopes (MaB).—This soil occurs on low swells and ridges on undulating uplands. The surface layer is dominantly dark grayish-brown loam. In a few areas, however, it is sandy loam. The organic-matter content is moderate in most areas. Where this soil is on toe slopes, the surface layer is from 10 to 12 inches thick because of an accumulation of soil material that washed from surrounding uplands. Although the texture of the third and fourth layer commonly is gravelly sandy clay loam, in places it is clay loam or sandy clay loam. Small areas of the Metamora soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, soybeans, white beans, and legume-grass hay or pasture. Somewhat poor drainage is the major limitation. (Soil management unit 3/2bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Made Land

Made land (Mb).—This miscellaneous land type occurs throughout the county and consists of housing development areas, prospective factory sites, old city dumps, and refuse disposal areas. These areas either have been covered by fill material or have been scraped off to such a depth that the natural soil characteristics have been destroyed. They are not suited to farming use. (Soil management unit Sa (VIIIs))

Mancelona Series

The Mancelona series consists of well drained and moderately well drained soils that formed in sandy material that is from 18 to 42 inches thick over calcareous or neutral sand and gravel. In a few places loamy or clayey material underlies the lower layer of sand and gravel at a depth of 42 to 60 inches.

Typical profile of Mancelona loamy sand:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; very weak, fine, granular structure; very friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.
A2—8 to 11 inches, light brownish-gray (10YR 6/2) loamy sand; very weak, fine, granular structure; very friable; slightly acid; abrupt, wavy boundary.
Bir—11 to 18 inches, dark-brown (7.5YR 4/4) loamy sand; very weak, fine, subangular blocky structure; very friable; medium acid; clear, wavy boundary.
A'2—18 to 27 inches, brown (10YR 5/3) loamy sand; single grain; loose; medium acid; clear, wavy boundary.
B't—27 to 33 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.
IIC—33 inches +, light brownish-gray (10YR 6/2) sand and gravel; single grain; loose; calcareous.

In some areas the A2 horizon is mixed with the Ap horizon. The B't horizon ranges from sandy loam to sandy clay loam in texture and from a thin layer to a layer as much as 8 inches in thickness. The proportion of gravel in the solum and substratum varies. In some places there is none, and in others there is as much as 20 percent or more. Where the Mancelona soils are closely associated with the Chelsea, the B't horizon occurs at a depth near 42 inches and approaches the minimum thickness, and the IIC horizon is mostly coarse sand and contains only a small amount of gravel. The depth to the loose calcareous sand and gravel ranges from 18 to 42 inches. In a few places the sand and gravel are underlain at a depth of 42 to 60 inches by loamy or clayey material.

These soils are subject to both wind and water erosion if they are left without a cover of vegetation or if the surface layer becomes depleted of organic matter. Surface runoff is slow to rapid, permeability is moderately rapid, and natural fertility is moderately low.

The Mancelona soils are in the drainage sequence that includes the somewhat poorly drained Gladwin soils and the poorly drained and very poorly drained Epoufette soils. They are shallower to the neutral or calcareous material than the Chelsea soils and are underlain by coarse sand and gravel instead of sand. They are coarser textured throughout the solum than the Newaygo soils.

In Ionia County the Mancelona soils commonly are mapped as a complex with the Chelsea soils. These complexes are extensive throughout the northern half of the county.

Mancelona loamy sand, loamy substratum, 2 to 6 percent slopes (McB).—This soil occurs on undulating to gently sloping parts of till plains, moraines, and outwash plains. There are small areas in which the sandy loam horizon is thin or lacking.

Most of this soil is used for pasture. The major limitations are rapid permeability, moderately low fertility, and susceptibility to erosion. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Mancelona loamy sand, loamy substratum, 6 to 12 percent slopes, moderately eroded (McC2).—This soil occurs on the sloping parts of till plains, moraines, and outwash plains, generally adjacent to drainageways. The surface layer in most areas is dark yellowish-brown loamy sand and consists of a mixture of the dark-brown layer and the remaining surface soil. In some small areas the plow layer is composed almost entirely of material from the dark-brown layer. Included in the areas mapped are small areas of Menominee soils. These included areas are too small to materially affect use and management. Most of this soil is used for pasture. Rapid permeability, moderately low fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aC (IIIe); woodland suitability group M; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 0 to 2 percent slopes (MdA).—This complex is on the level or nearly level parts of outwash plains and in old glacial drainageways. The water table is nearer the surface in these soils than in the more sloping Mancelona-Chelsea loamy sands, and thus crops generally are less affected by the low moisture-supplying capacity. In some small areas the surface layer is sandy loam. In places these soils are only moderately well drained and are mottled below a depth of 25 to 30 inches. The Chelsea soil is described in detail under the heading "Chelsea Series."

Most of this acreage is used for corn, small grain, field beans, and hay. Many areas are in pasture. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 2 to 6 percent slopes (MdB).—The Mancelona soil generally is like the soil described as typical of the Mancelona series, and the Chelsea is like the soil described under the heading "Chelsea Series." In some small areas, however, the soils are moderately well drained and are mottled below a depth of 20 inches. In places as much as 10 inches of sandy material has accumulated on the surface, and in a few areas there are sufficient stones on the surface to hinder tillage.

Much of the acreage is used for corn, small grain, field beans, and hay. Many areas are used for pasture. The major limitations are moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion. (Soil management unit 4aB (IIIs); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 2 to 6 percent slopes, moderately eroded (MdB2).—This complex is on outwash plains and in old glacial drainageways. The present surface layer is yellowish-brown loamy sand. It consists of a mixture of remnants of the original surface layer and material from the subsurface layer and the upper part of the subsoil. In a few small areas rocks and cobblestones are scattered on the surface and throughout the soil material in sufficient numbers to make tillage difficult or, in places, impossible (fig. 4). The Chelsea soil is described in detail under the heading "Chelsea Series."

Except for the few stony areas, most of this acreage is used for general farm crops. The crops commonly grown are corn, small grain, field beans, and hay. A few areas are idle or in pasture. The major limitations are moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion. (Soil management unit 4aB (IIIs); woodland suitability group C; wildlife suitability group 5)

Figure 4.—**Corn on an area of the Mancelona-Chelsea complex. Stones hinder but do not prevent tillage.**

Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, moderately eroded (MdC2).—This complex is on moraines and high terraces along old glacial drainageways. A large part of the original surface layer has been removed by erosion. The present surface layer is a mixture of the remaining surface soil and material from the subsurface layer and the upper part of the subsoil. It is brown or yellowish-brown loamy sand. In a few small areas numerous stones and cobblestones are scattered on the surface and throughout the soil material, making plowing and cultivation impractical. The Chelsea soil is described in detail under the heading "Chelsea Series."

Although a large part of this acreage has been cultivated, most areas are now used for pasture. Most stony areas are idle. The major limitations are moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion. (Soil management unit 4aC (IIIe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, severely eroded (MdC3).—The original surface layer and subsurface layer have been removed from this complex by erosion, and the present surface layer consists mainly of brown to dark yellowish-brown subsoil material. Deep gullies and wind blowouts occur in places, and some areas are stony. The Chelsea soil is described under the heading "Chelsea Series."

A large part of this acreage has been abandoned and is in various stages of reforestation. Some small areas are used for small grain and hay. The rest of the acreage is used for pasture. The major limitations are susceptibility to erosion, moderately low available moisture capacity, and moderately low natural fertility. (Soil management unit 4aC3 (IVe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 12 to 18 percent slopes (MdD).—This complex occurs on moraines and kames. It is widely distributed throughout the northern part of the county. The individual horizons are thinner and the depth to the calcareous material is somewhat less than in the less sloping complexes. The Chelsea soil is described under the heading "Chelsea Series."

Most of this acreage remains forested. A few cleared areas are idle or in pasture. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aD (IVe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, moderately eroded (MdD2).—This complex occurs on kames and moraines in the northern part of the county. The present surface layer is dominantly yellowish-brown or brown loamy sand. In some areas most of the original surface layer has been lost through erosion, and the present surface layer consists of a mixture of the remaining surface soil and material from the subsurface layer and the upper part of the subsoil. The thickness of the individual horizons and, in most places, the depth to the calcareous material are less in this complex than in the less sloping complexes. The Chelsea soil is described under the heading "Chelsea Series."

Most of this complex has been cultivated, but a considerable acreage is now abandoned or is in permanent pasture. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aD (IVe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, severely eroded (MdD3).—This complex is on strongly sloping parts of moraines and eskers. Erosion has removed the original surface layer, the subsurface layer, and the upper part of the subsoil. In places the lower part of the subsoil is exposed. The present surface layer is dominantly yellowish-brown or dark-brown loamy sand. There are deep gullies and wind blowouts in some areas.

Most of this acreage is idle. Small areas are used for pasture and meadow or have been planted to pine. Susceptibility to erosion, moderately low moisture supplying capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4aD3 (VIe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, moderately eroded (MdE2).—A large part of the original surface layer has been removed by erosion. The present surface layer is yellowish-brown or brown loamy sand. It consists of a mixture of the remaining surface soil and material from the subsurface layer and the upper part of the subsoil.

Little of this acreage is cultivated. Many areas are idle, and others are used for pasture or have been planted to pine. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aE (VIe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, severely eroded (MdE3).—This complex occurs on moraines and kames. In most areas the upper part of the subsoil has been exposed by erosion, and the present surface layer is dark yellowish-brown loamy sand. Deep gullies and wind blowouts occur in some areas. In several small areas, there are sufficient stones and cobblestones scattered on the surface and throughout the soil material to interfere with tillage. The Chelsea soil is described under the heading "Chelsea Series."

Although pine has been planted in some areas, most of this acreage is idle. Some small areas provide limited pasture. Susceptibility to erosion, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4aE3 (VIIe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 25 to 40 percent slopes (MdF).—This complex occurs on the steep side slopes of moraines. The individual horizons are thinner, the depth to calcareous material is less, and the boundaries between the various horizons are less sharply defined than in the less sloping Mancelona and Chelsea loamy sands. The Chelsea soil is described under the heading "Chelsea Series."

All of this acreage has been left in forest. Moderately low available moisture capacity, moderately low natural fertility, and susceptibilty to erosion are the major limitations. (Soil management unit 4aF (VIIe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, moderately eroded (MdF2).—This complex is on the steep side slopes of moraines. Erosion has removed all of the original surface soil and part of the subsurface layer. The present surface layer is yellowish-brown or brown loamy sand. It consists of remnants of the light brownish-gray subsurface soil and material from the upper part of the dark-brown subsoil. The Chelsea soil is described under the heading "Chelsea Series."

Most of this acreage is idle. Some areas are in pasture, and others have been planted to pine. Moderately low available moisture capacity, moderately low natural fertility, and susceptibility to erosion are the major limitations. (Soil management unit 4aF (VIIe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, severely eroded (MdF3).—This complex is on the steep side slopes of moraines and is so severely eroded that, over much of the area, subsoil material is exposed. The present surface layer is dark yellowish-brown loamy sand. Deep gullies and wind blowouts occur in some areas. The Chelsea soil is described under the heading "Chelsea Series."

Most of this acreage is bare of vegetation. Pine has been established in some areas. Susceptibility to erosion, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4aF3 (VIIe); woodland suitability group C; wildlife suitability group 5)

Mancelona-Chelsea stony complex, 0 to 2 percent slopes (MeA).—This complex is on outwash plains and on high terraces in old glacial drainageways. Stones and cobblestones are scattered on the surface and throughout the soil material in sufficient numbers to make tillage impractical or, in places, impossible. The Chelsea soil is described under the heading "Chelsea Series."

Much of this acreage has been cleared, but most areas are now idle. Some are used for pasture. Moderately low available moisture capacity, moderately low natural fertility, and stoniness are the major limitations. (Soil management unit 4aABC (Vs); woodland suitability group C; wildlife suitability group 5)

Marlette Series

Soils of the Marlette series are well drained and moderately well drained. These soils formed in calcareous loam, silt loam, or light clay loam till on the level to steep parts of moraines and till plains. They are widely distributed throughout the northern part of the county. The native vegetation consisted chiefly of oak, hickory, maple, beech, and some scattered white pine and red pine.

Typical profile of Marlette loam:

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

Bir—7 to 11 inches, yellowish-brown (10YR 5/4) loam; weak, fine, granular structure; friable; slightly acid; clear, wavy boundary.

A'2—11 to 15 inches, pale-brown (10YR 6/3) light loam; weak, fine, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B't—15 to 32 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

C—32 inches +, brown (7.5YR 5/4) loam; weak, medium, subangular blocky structure; firm; calcareous.

The loamy sand and sandy loam types represent a thin overburden of sandy material. In many areas material from the A'2 horizon extends into the upper part of the B't horizon, either in cracks or as thick ped coats. A few, fine, faint, strong-brown (7.5YR 5/8) mottles occur below a depth of 20 inches in some areas. In places a weak fragipan has developed immediately above the mottling. The B't horizon ranges from sandy clay loam to clay loam. The reaction of the solum ranges from medium acid to neutral. The depth to the C horizon ranges from 20 to 42 inches.

Surface runoff is medium on the mild slopes and rapid on steep ones. Permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Marlette soils are coarser textured throughout the solum than the Nester soils and are finer textured than the McBride. They are in the drainage sequence that includes the somewhat poorly drained Capac soils and the poorly drained and very poorly drained Brookston soils.

Marlette clay loam, 6 to 12 percent slopes, severely eroded (MfC3).—This soil occurs on the short rounded slopes of potholes and basins and on ridges and swells on the uplands. The upper layers have been removed by erosion, and the present surface layer consists primarily of material from what was originally the fourth layer. It is brown clay loam and is low in organic-matter content. The depth to the limy bottom layer is about 25 inches. Runoff is rapid, and in most areas shallow gullies are common.

This soil has been used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. However, many areas are now idle or in second-growth forest and

shrubs. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 2.5aC3 (IVe); woodland suitability group D; wildlife suitability group 1)

Marlette clay loam, 12 to 18 percent slopes, severely eroded (MfD3).—This soil occurs on the strongly sloping ridges and short side slopes of draws and ravines. The upper layers have been removed by erosion, and the present surface layer consists primarily of material from what was originally the fourth layer. It is brown clay loam and contains little organic matter. The depth to the limy bottom layer generally is about 25 inches. Shallow gullies are common in most areas, and deep gullies that expose the limy bottom layer have formed in a few small areas.

This soil has been used for general farm crops, but now most of the acreage is used either for legume-grass hay and pasture or for second-growth forest, or it is idle. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 2.5aD3 (VIe); woodland suitability group D; wildlife suitability group 1)

Marlette clay loam, 18 to 25 percent slopes, severely eroded (MfE3).—This soil occurs on the short side slopes of draws and ravines and along valley walls. The present surface layer is brown clay loam and contains little organic matter. Shallow gullies are common in most areas.

Most of this soil is idle or in second-growth forest. A few areas are used for permanent pasture but afford only limited grazing. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 2.5aE (VIe); woodland suitability group D; wildlife suitability group 1)

Marlette loam, 0 to 2 percent slopes (MgA).—This soil occurs on broad smooth ridgetops on the uplands. The very dark grayish-brown surface layer is high in organic-matter content. In a few areas there is a slightly compact layer in the upper part of the fourth layer, and the soil is mottled below a depth of 20 inches. Within many of the areas mapped are small swales and depressions in which the Capac soils occur.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. The limitations are minor. (Soil management unit 2.5aA (I); woodland suitability group D; wildlife suitability group 1)

Marlette loam, 2 to 6 percent slopes (MgB).—This soil occurs on undulating uplands. The organic-matter content of the surface layer is moderately high. The surface layer is dominantly loam but in some areas is sandy loam. Included in the areas mapped are a few small, moderately eroded areas in which the surface layer is pale brown or yellowish brown. Also included are small areas of Capac soils in the small swales and depressions.

This soil is used mostly for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Marlette loam, 2 to 6 percent slopes, moderately eroded (MgB2).—This soil occurs on undulating uplands. Most of the original surface layer has been removed, and the present surface layer is pale-brown to yellowish-brown loam and contains only a moderate amount of organic matter. Included in the areas mapped are a few small areas of Marlette soils that have 6 to 12 percent slopes. Also included are some small severely eroded areas in which the dark-brown fourth layer is exposed.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Marlette loam, 6 to 12 percent slopes, moderately eroded (MgC2).—This soil is on the short rounded slopes of ridges and swells on the uplands. The surface layer is pale-brown or yellowish-brown loam and is moderately low in organic-matter content. In some small seepy spots, the soil is mottled below a depth of 20 inches. A few shallow gullies have formed in some areas. Included in the areas mapped are small areas of uneroded soils.

This soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Slope, susceptibility to erosion, and, to a lesser extent, droughtiness are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Marlette loam, 12 to 18 percent slopes, moderately eroded (MgD2).—This soil occurs on strongly sloping ridges and on the short side slopes of draws and ravines. Most of the original surface layer has been lost through erosion, and the present surface layer is dominantly pale-brown or yellowish-brown loam and contains little organic matter. In some areas the surface layer is sandy loam. Included in the areas mapped are some small uneroded areas.

This soil is used mainly for wheat, oats, and legume-grass hay or pasture. A few areas are in corn, white beans, and soybeans. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aD (IVe); woodland suitability group D; wildlife suitability group 1)

Marlette loam, 18 to 25 percent slopes, moderately eroded (MgE2).—This soil occurs on short side slopes of draws and ravines and along valley walls adjacent to natural drainageways. In most areas the original surface layer has been removed by erosion, and the present surface layer is pale-brown or yellowish-brown loam that contains little organic matter. In a few areas the surface layer is sandy loam. Shallow gullies have formed in many areas, and in places the dark-brown clay loam layer is exposed.

Although this soil has been used for cultivated crops, most of the acreage is now idle or in second-growth forest and shrubs. A few areas have been planted to trees. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 2.5aE (VIe); woodland suitability group D; wildlife suitability group 1)

Marlette loam, 25 to 40 percent slopes, moderately eroded (MgF2).—This soil occurs on the short steep slopes of draws and ravines and along valley walls adjacent to natural drainageways. Erosion has occurred where this soil has been cultivated.

Most of this soil is forested. A few areas are used for permanent pasture. Steep slopes, susceptibility to erosion, and droughtiness are the major limitations.

(Soil management unit 2.5aF (VIIe); woodland suitability group D; wildlife suitability group 1)

Marlette loamy sand, 2 to 6 percent slopes (MhB).—This soil occurs on gently undulating or undulating uplands. Small areas of the Ubly and Menominee soils were included in some of the areas mapped.

Most of this soil is used for farm woodlots. A few areas are in corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. The limitations are minor. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Marlette loamy sand, 2 to 6 percent slopes, moderately eroded (MhB2).—This soil is on undulating uplands. Most of the original surface layer has been removed by erosion, and the present surface layer is dominantly dark-brown loamy sand. The organic-matter content is low. Included in some of the areas mapped are small areas of the Menominee and Ubly soils, which are at lower elevations.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Marlette loamy sand, 6 to 12 percent slopes, moderately eroded (MhC2).—This soil is on the short rounded slopes of potholes and basins and on sloping ridges on the uplands. A few small areas are forested. The rest of the acreage has been cultivated. In these areas most of the original surface layer has been removed by erosion, and the present surface layer is dark-brown loamy sand. The organic-matter content is low.

This soil is used mainly for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Marlette sandy loam, 0 to 2 percent slopes (MkA).—This soil is on narrow smooth ridgetops on the uplands. In most areas it has a very dark grayish-brown surface layer that is moderately high in organic-matter content. In a few areas, the surface layer is dark brown or yellowish brown. In places there is a slightly compact layer in the upper part of the third layer, and the soil is mottled below a depth of 20 inches. In some places the fourth layer is sandy clay loam. Within the areas mapped are small depressions in which the Capac soils occur.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. A few small areas are in farm woodlots. The limitations are minor. (Soil management unit 2.5aA (I); woodland suitability group D; wildlife suitability group 1)

Marlette sandy loam, 2 to 6 percent slopes (MkB).—This soil is on undulating uplands. The surface layer is dark grayish-brown sandy loam, and the fourth layer is dark-brown sandy clay loam. Small areas of the McBride soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. A small acreage is in farm woodlots. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Marlette sandy loam, 2 to 6 percent slopes, moderately eroded (MkB2).—This soil is on the undulating uplands. Most of the original surface layer has been removed by erosion, and the present surface layer is pale-brown or yellowish-brown sandy loam. The organic-matter content is low. In places the dark-brown fourth layer is sandy clay loam. Small shallow gullies have formed in some areas. Included throughout many of the areas mapped are small areas of the McBride soils.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Marlette sandy loam, 6 to 12 percent slopes, moderately eroded (MkC2).—This soil is on the short rounded slopes of ridges and swells on the uplands. Erosion has removed most of the original surface layer. The present surface layer is pale-brown or yellowish-brown sandy loam that is low in organic-matter content. In some areas the fourth layer is sandy clay loam. Included throughout many of the areas mapped are small areas of the McBride soils.

Most of this soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Marlette sandy loam, 12 to 18 percent slopes, moderately eroded (MkD2).—This soil is on strongly sloping ridges and on the short side slopes of draws and ravines. Erosion has removed most of the original surface layer. The present surface layer is pale-brown or yellowish-brown sandy loam and contains only a small amount of organic matter. In some areas the fourth layer is sandy clay loam. Included in the areas mapped are a few small areas of the Dighton soils that are underlain by sand and loamy sand at a depth of about 50 inches.

Most of this soil is idle or in permanent pasture. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 2.5aD (IVe); woodland suitability group D; wildlife suitability group 1)

Marlette sandy loam, 18 to 25 percent slopes (MkE).—This soil occurs on the short strong slopes of draws and ravines and along the valley walls adjacent to natural drainageways. The surface layer is dark grayish-brown sandy loam and contains only a moderate amount of organic matter. In some areas the fourth layer is sandy clay loam.

Most areas are in farm woodlots. A few areas are in permanent pasture. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 2.5aE (VIe); woodland suitability group D; wildlife suitability group 1)

Matherton Series

The Matherton series consists of somewhat poorly drained soils that formed in silty and loamy outwash materials that contained some gravel. These soils are underlain at a depth of 24 to 42 inches by stratified calcareous sand and gravel. They occur on the level to gently sloping parts of outwash plains, valley trains, and

kames and are widely distributed throughout the southern two-thirds of the county. The native vegetation was mainly hardwood forest consisting chiefly of elm, ash, swamp white oak, and hickory.

Typical profile of Matherton loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2g—8 to 12 inches, grayish-brown (10YR 5/2) loam; few, medium, distinct, brown (10YR 4/3) mottles; moderate, fine, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B21g—12 to 17 inches, grayish-brown (10YR 5/2) light clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; medium acid; gradual, wavy boundary.

B22g—17 to 34 inches, light brownish-gray (10YR 6/2) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mettles; moderate, medium, subangular blocky structure; firm; medium acid; abrupt, irregular boundary.

IIC—34 inches +, grayish-brown (10YR 5/2) gravel and sand; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; calcareous.

The color of the Ap horizon ranges from very dark grayish brown (10YR 3/2) to very dark gray (10YR 3/1). The texture of the B22g horizon ranges from sandy clay loam to gravelly clay loam or clay loam. The basic color of the B22g ranges from light brownish gray (10YR 6/2) to dark grayish brown (10YR 4/2). Tongues of the B22g horizon, 2 to 12 inches wide, extend from a few inches to as much as 2 feet or more into the IIC horizon.

Surface runoff is slow, and permeability is moderate in the solum and rapid in the substratum. The available moisture capacity is moderate, and natural fertility is moderately high.

The Matherton soils are finer textured throughout the solum than the Wasepi, and they are similar to but have more gravel throughout the solum than the Macomb. They are in the drainage sequence that includes the well drained Fox soils, the moderately well drained Ionia soils, and the poorly drained and very poorly drained Sebewa soils.

Matherton loam, 0 to 2 percent slopes (MlA).—This soil occurs on broad flats and in shallow swales on valley plains and high terraces. The surface layer is moderately high in organic-matter content. In a few areas the fourth layer is as much as 25 or 30 inches thick. Small areas of the Sebewa soils, which are in slight depressions, were included in the areas mapped. Also included were small areas of the sandier Wasepi soils.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Matherton loam, 2 to 6 percent slopes (MlB).—This soil occurs on undulating valleys plains and high terraces. The surface layer is moderately high in organic-matter content. In a few places the third and fourth layers are silty clay loam. The limy sand and gravel bottom layer occurs at a depth of slightly more than 42 inches in some small areas. Included in the areas mapped were small areas of the Ionia and Wasepi soils.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Matherton sandy loam, 0 to 2 percent slopes (MmA).—This soil is on broad flats and in shallow swales on valley plains and high terraces. The surface layer is moderately high in organic-matter content. In most areas the fourth layer is sandy clay loam or gravelly clay loam. Within the areas mapped are slight depressions in which the Sebewa soils occur. Small areas of the sandier Wasepi soils were also included in mapping.

A large acreage is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Matherton sandy loam, 2 to 6 percent slopes (MmB).—This soil is on undulating valley plains and high terraces. The surface layer contains only a moderate amount of organic matter. In a few areas the original surface layer has been removed by erosion, and the present surface layer is grayish brown and is low in organic-matter content. In some scattered areas the depth to the bottom layer is slightly more than 42 inches. Small areas of the Sebewa and Wasepi soils were included in many of the areas mapped. Also included were a few small areas in which there are numerous stones on the surface.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas are in farm woodlots. Excess wetness is the major limitation. (Soil management unit 3bAB (IIw); woodland suitability group G; wildlife suitability group 2)

McBride Series

The McBride series is made up of well drained and moderately well drained soils that formed in calcareous sandy loam till. These soils are on the level to steep parts of moraines and till plains. The native vegetation was hardwood forest consisting mainly of oak, beech, sugar maple, and some white pine and red pine.

Typical profile of McBride sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; moderately high organic-matter content; medium acid; abrupt, smooth boundary.

Bir—8 to 12 inches, yellowish-brown (10YR 5/4–5/6) sandy loam; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

A'21—12 to 14 inches, very pale-brown (10YR 7/4) light sandy loam; weak, thin, platy structure; slightly compact when moist; medium acid; abrupt, wavy boundary.

A'22x—14 to 17 inches, light-gray (10YR 7/2) light sandy loam; moderately compact, brittle fragipan; weakly vesicular; medium acid; clear, wavy boundary.

B'21t—17 to 30 inches, strong-brown (7.5YR 5/6) sandy clay loam; light-gray (10YR 7/1) coats on cleavage faces in the upper part of the horizon; moderate, coarse, subangular blocky structure; firm; very strongly acid; clear, wavy boundary.

B'22t—30 to 38 inches, strong-brown (7.5YR 5/6) heavy sandy loam; weak, coarse, subangular blocky structure; friable; very strongly acid; clear, wavy boundary.

B3—38 to 48 inches, strong-brown (7.5YR 5/6) sandy loam; weak, coarse, subangular blocky structure; friable; medium acid in upper part, grading to slightly acid in the lower part; abrupt, irregular boundary.

C—48 inches +, brown (7.5YR 5/4) sandy loam; massive; friable; calcareous.

The thickness of the A'22x horizon ranges from 2 to 6 inches. The B'21t horizon is reddish brown (5YR 4/3) in some areas. The texture of the B'21t horizon ranges from sandy loam to sandy clay loam. In some areas the upper part of the B'21t horizon is a brittle fragipan. The degree of development of the fragipan ranges from weak to moderate. Thin bands of loamy sand, 1 to 2 inches thick, occur throughout the profile in some areas. The depth to the calcareous C horizon ranges from 32 to about 56 inches.

Surface runoff ranges from slow on the mild slopes to rapid on the steep slopes. Permeability depends to a great extent on the thickness and development of the fragipan but commonly is moderate. The available moisture capacity is moderately low, and natural fertility is medium.

The McBride soils have a thicker, finer textured B horizon than the Montcalm soils, which developed in loamy sand and sand. They have a thinner, coarser textured B horizon than the Marlette soils. The McBride soils are in the drainage sequence that includes the somewhat poorly drained Coral soils and the poorly drained and very poorly drained Ensley soils.

McBride loamy sand, 0 to 2 percent slopes (MnA).—This soil is on broad smooth hilltops on the uplands. In many areas thin layers of loamy sand, 1 to 2 inches thick, occur throughout the profile. The fifth, sixth, and seventh layers generally are sandy loam. The depth to the limy sandy loam bottom layer is about 50 inches. Small areas of the Montcalm and Coral soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Moderate or moderately slow permeability and moderately low available moisture capacity are the major limitations. (Soil management unit 3aA (IIs); woodland suitability group A; wildlife suitability group 1)

McBride loamy sand, 2 to 6 percent slopes (MnB).—This soil is on undulating uplands. In many areas thin layers of loamy sand, 1 to 2 inches thick, occur throughout the profile. The fifth, sixth, and seventh layers generally are sandy loam. Small areas of the Montcalm and Coral soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Moderate or moderately slow permeability and moderately low available moisture capacity are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group A; wildlife suitability group 1)

McBride loamy sand, 2 to 6 percent slopes, moderately eroded (MnB2).—This soil is on undulating uplands. Most of the original surface layer has been removed by erosion, and the present surface layer is brown or pale-brown loamy sand. In many areas thin layers of loamy sand, 1 to 2 inches thick, occur throughout the profile. The fifth, sixth, and seventh layers generally are sandy loam. Small areas of Montcalm soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Moderate or moderately slow permeability, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group A; wildlife suitability group 1)

McBride loamy sand, 6 to 12 percent slopes, moderately eroded (MnC2).—This soil is on the short rounded slopes of potholes and basins and on sloping swells and ridges on the uplands. Erosion has removed most of the original surface layer, and over much of the acreage the present surface layer is brown or pale-brown loamy sand. In many areas, especially where this soil is closely associated with the Montcalm soils, there are thin layers of loamy sand, 1 to 2 inches thick, throughout the profile. The fifth, sixth, and seventh layers generally are sandy loam. Small areas of the Montcalm soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Moderate or moderately slow permeability, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy clay loam, 2 to 6 percent slopes, severely eroded (MoB3).—This soil is on undulating uplands. The surface layer of sandy clay loam contains little organic matter. In most areas the depth to the limy sandy loam bottom layer is about 32 to 38 inches. Shallow gullies are common. This soil generally is well drained, but there are small areas that are only moderately well drained. In these the soil is mottled below a depth of 20 inches. Small areas of the Marlette soils were included in some of the areas mapped.

This soil is used mainly for corn, wheat, oats, beans, and legume-grass hay or pasture. Susceptibility to erosion, moderate or moderately slow permeability, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aB3 (IIIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy clay loam, 6 to 12 percent slopes, severely eroded (MoC3).—This soil is on the short rounded slopes of potholes and basins and on sloping swells and ridges. The surface layer of sandy clay loam contains little organic matter. Shallow gullies are common. In most areas the limy sandy loam bottom layer occurs at a depth of 32 to 38 inches. Small areas of Marlette soils were included in some of the areas mapped.

This soil has been used for cultivated crops, but most areas are now used for hay and pasture. Some areas are idle or in second-growth forest. Rapid runoff, susceptibility to erosion, and moderately low available moisture capacity are the major limitations. (Soil management

unit 3aC3 (IVe); woodland suitability group A; wildlife suitability group 1)

McBride sandy clay loam, 12 to 18 percent slopes, severely eroded (MoD3).—This soil is on short side slopes along valley walls and ridges. The surface layer of sandy clay loam contains little organic matter. Shallow gullies and a few deep gullies have formed in some areas. The limy sandy loam bottom layer occurs at a depth of 32 to 35 inches.

Most of this soil is idle or in second-growth forest and shrubs. Some areas have been planted to trees. Rapid runoff, susceptibility to erosion, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aD3 (VIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy clay loam, 18 to 25 percent slopes, severely eroded (MoE3).—This soil is on the short sharp slopes of valley walls, on the sides of draws and ravines, and on ridges. The surface layer of sandy clay loam is low in organic-matter content. Shallow gullies have formed in many areas, and there are a few deep gullies. The limy sandy loam bottom layer occurs at a depth of 32 to 35 inches.

Most of this soil is idle or in second-growth forest and shrubs. Rapid runoff, susceptibility to erosion, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aEF3 (VIIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 0 to 2 percent slopes (MpA).—This soil is on broad smooth hilltops on the uplands. In some areas the subsoil is mottled below a depth of 20 inches. Where this soil is closely associated with the Marlette soils, small areas of the Marlette soils were included in mapping. Also included in some of the areas mapped were small seepy areas of the Coral soils.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. A few areas are in farm woodlots. Moderate or moderately slow permeability and moderately low available moisture capacity are the major limitations. (Soil management unit 3aA (IIs); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 2 to 6 percent slopes (MpB).—This soil is on undulating uplands. In places it is mottled below a depth of 20 inches. Where this soil is closely associated with the Marlette soils, small areas of the Marlette soils were included in mapping.

This soil is extensive in the northern part of the county. Most of the acreage is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Moderate or moderately slow permeability, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 2 to 6 percent slopes, moderately eroded (MpB2).—This soil is on undulating uplands. Most of the original surface layer has been removed by erosion. The present surface layer is brown or pale-brown sandy loam and is low in organic-matter content. Where this soil is closely associated with the Marlette soils, small areas of the Marlette soils were included in the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Susceptibility to erosion, moderate or moderately slow permeability, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 6 to 12 percent slopes (MpC).—This soil is on the short rounded slopes of potholes and basins and on sloping swells and ridges on the uplands. Where this soil is closely associated with the Marlette soils, small areas of the Marlette soils were included in the areas mapped.

Most of this acreage is in farm woodlots. A few areas are in pasture. Moderate or moderately slow permeability, susceptibility to erosion, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 6 to 12 percent slopes, moderately eroded (MpC2).—This soil is on the short rounded slopes of potholes and basins and on sloping swells and hills on the uplands. Most of the original surface layer has been removed by erosion. The present surface layer is brown or pale-brown sandy loam and contains little organic matter. Small areas of the Marlette soils were included in some of the areas mapped.

This soil is widely distributed throughout the northern part of the county. Most of the acreage is used for corn, wheat, oats, beans, and legume-grass hay or pasture. Susceptibility to erosion, moderate or moderately slow permeability, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 12 to 18 percent slopes, moderately eroded (MpD2).—This soil occurs on short sharp slopes along valley walls and hills. Most of the original surface layer has been removed by erosion. The present layer is brown or pale-brown sandy loam and is low in content of organic matter. In many areas, the limy sandy loam bottom layer occurs at a depth of 40 to 45 inches. In some areas the surface layer is loamy sand. Included in the areas mapped are a few uneroded areas.

Most of this soil has been used for general farm crops, but most areas are now idle or in legume-grass hay and pasture. A few areas are used for wheat and oats. Slope, susceptibility to erosion, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aD (IVe); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 18 to 25 percent slopes, moderately eroded (MpE2).—This soil is on the short sharp slopes of valley walls, on the sides of draws and ravines, and on ridges. Erosion has removed most of the original surface layer. The present surface layer is brown or pale-brown sandy loam and contains little organic matter. The depth to limy sandy loam bottom layer ranges from 40 to 45 inches.

Most of this soil has been cleared, but much of the acreage is now idle or in second-growth forest and shrubs. Slope, susceptibility to erosion, and moderately low available moisture capacity are the major limitations.

(Soil management unit 3aE (VIe); woodland suitability group A; wildlife suitability group 1)

McBride sandy loam, 25 to 40 percent slopes, moderately eroded (MpF2).—This soil is on the short steep slopes of valley walls, on the sides of draws and ravines, and on steep ridges. Most of the original surface layer has been lost through accelerated erosion. The present surface layer is brown or pale-brown sandy loam and contains little organic matter. The limy sandy loam bottom layer occurs at a depth of about 35 inches.

Most of this soil is now idle or in second-growth forest and shrubs. Slope, rapid runoff, susceptibility to erosion, and moderately low available moisture capacity are the major limitations. (Soil management unit 3aEF (VIIe); woodland suitability group A; wildlife suitability group 1)

Menominee Series

The Menominee series consists of well drained and moderately well drained soils that formed in sand and loamy sand and are underlain by loam to silty clay loam at a depth of 18 to 42 inches. These soils are on nearly level to gently sloping outwash plains and old glacial drainageways and on the nearly level to strongly sloping parts of moraines. They are widely distributed throughout the northern part of the county. The native vegetation consisted mainly of mixed stands of hardwoods and some pine.

Typical profile of Menominee loamy sand:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; medium organic-matter content; slightly acid; abrupt, smooth boundary.

A2—8 to 9 inches, light-gray (10YR 7/2) loamy sand; single grain; loose; medium acid; abrupt, irregular boundary.

B21ir—9 to 12 inches, strong-brown (7.5YR 5/6) loamy sand; weak, fine, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B22ir—12 to 14 inches, strong-brown (7.5YR 5/8) loamy sand; single grain; loose; medium acid; gradual, wavy boundary.

B23ir—14 to 18 inches, yellowish-brown (10YR 5/6) sand; single grain; loose; slightly acid; gradual, wavy boundary.

B3—18 to 30 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; slightly acid; abrupt, wavy boundary.

IIB't—30 to 34 inches, brown (7.5YR 5/4) silty clay loam; few, fine, faint, reddish-yellow (7.5YR 7/8) mottles; strong, medium, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

IIC—34 inches +, brown (7.5YR 5/4) loam; weak, medium, subangular blocky structure; firm; calcareous.

Where the Ap horizon is as much as 10 inches thick, the A2 horizon is very thin or is lacking in some areas. The texture of the horizons in the upper part of the solum ranges from sand to loamy sand. The texture of the IIB't horizon ranges from clay loam to silty clay loam. In several areas a light brownish-gray (10YR 6/2) A'2 horizon, 1 to 4 inches thick, occurs above the IIB't horizon. The texture of the IIC horizon ranges from loam to silty clay loam.

Surface runoff ranges from slow on the mild slopes to rapid on the moderately steep slopes. Permeability is rapid in the sandy material and slow in the finer textured material. The available moisture capacity and natural fertility are low.

The Menominee soils are in the drainage sequence that includes the somewhat poorly drained Iosco soils and the poorly drained and very poorly drained Brevort soils. They are coarser textured throughout the solum than the Ubly soils, and they are similar to the Grayling soils but have a browner Bir horizon and are underlain at a depth of 18 to 42 inches by loam to silty clay loam instead of sand.

Menominee loamy sand, 0 to 2 percent slopes (MrA).—This soil is on nearly level uplands. The surface layer of loamy sand is relatively high in organic-matter content. In a few areas the surface layer is sand. Small areas of Ubly and Iosco soils were included in some of the areas mapped.

This soil is used mainly for corn, small grain, beans, hay, and pasture. A few areas are forested. Low natural fertility and low available moisture capacity are the major limitations. (Soil management unit 4/2aAB (IIIs); woodland suitability group C; wildlife suitability group 5)

Menominee loamy sand, 2 to 6 percent slopes (MrB).—This soil occurs mainly on narrow hilltops on the uplands. In most areas it is similar to the soil described as typical of the series. In some small areas, the surface layer is sand. If undisturbed, the surface layer is moderately high in organic-matter content. Small areas of the finer textured Ubly soils were included in the areas mapped.

This soil is used for corn, small grain, beans, hay, pasture, and other general farm crops. The major limitations are low natural fertility and low available moisture capacity. (Soil management unit 4/2aAB (IIIs); woodland suitability group C; wildlife suitability group 5)

Menominee loamy sand, 2 to 6 percent slopes, moderately eroded (MrB2).—This soil is on undulating and gently sloping till plains on the uplands, largely on the narrow hilltops. The original surface layer has been lost through erosion. The present surface layer is brown loamy sand and is low in organic-matter content. There are a few small areas in which the surface layer is sand. Small areas of the finer textured Ubly soils were included in some of the areas mapped.

This soil is used for corn, small grain, beans, hay, and other general farm crops. Many areas are used for pasture. Low natural fertility and low available moisture capacity are the major limitations. (Soil management unit 4/2aAB (IIIs); woodland suitability group C; wildlife suitability group 5)

Menominee loamy sand, 6 to 12 percent slopes, moderately eroded (MrC2).—This soil is on short convex slopes on the uplands and on short slopes adjacent to narrow valleys. The original surface layer has been lost through erosion. The present surface layer is brown loamy sand and is low in organic-matter content. There are a few small areas in which the surface layer is sand. Small areas of the finer textured Ubly soils were included in mapping.

Most of this soil is used for pasture or hay. Some areas have been planted to trees. Low available moisture capacity and low natural fertility are the major limita-

tions. (Soil management unit 4/2aC (IIIe); woodland suitability group C; wildlife suitability group 5)

Menominee loamy sand, 6 to 12 percent slopes, severely eroded (MrC3).—This soil is on short convex slopes on the uplands and on short rounded slopes adjacent to narrow valleys. The upper soil layers have been lost through erosion, and the present surface layer is yellowish-brown loamy sand. It contains little organic matter. There are a few small areas in which the surface layer is sand. Included in the areas mapped are some small areas of the finer textured Ubly soils.

Most of this acreage is idle. A few areas are used for pasture or hay. Susceptibility to erosion, low natural fertility, and low available moisture capacity are the major limitations. (Soil management unit 4/2aC3 (IVe); woodland suitability group C; wildlife suitability group 5)

Menominee loamy sand, 12 to 18 percent slopes, moderately eroded (MrD2).—This soil is on narrow short slopes on the uplands and on sharply cut valley slopes. The surface layer is brown or yellowish-brown loamy sand and contains little organic matter. Small areas of the Grayling soils were included in mapping.

Although some of this soil is used for pasture or hay, many areas are idle or in second-growth forest. Slope, susceptibility to erosion, low natural fertility, and low available moisture capacity are the major limitations. (Soil management unit 4/2aDE (VIe); woodland suitability group C; wildlife suitability group 5)

Menominee loamy sand, 12 to 18 percent slopes, severely eroded (MrD3).—This soil is on narrow short slopes on the uplands and on sharply cut valley slopes. The surface layer is yellowish-brown loamy sand and contains little organic matter. The firm, finer textured lower layers commonly are exposed at the bottom of gullies that have formed in many areas. Small areas of the Grayling soils were included in mapping.

Most of this soil is idle or in natural second-growth forest and shrubs. Susceptibility to erosion, low available moisture capacity, low natural fertility, and slope are the major limitations. (Soil management unit 4/2aDE (VIe); woodland suitability group C; wildlife suitability group 5)

Menominee loamy sand, 18 to 25 percent slopes, moderately eroded (MrE2).—This soil is on short side slopes on the uplands and on sharply cut valley slopes. Over much of the acreage the surface layer is yellowish-brown loamy sand. The depth to the firm, finer textured layer ranges from 18 inches to about 30 inches. Included in the areas mapped are some small uneroded areas and a few severely eroded areas. Also included are some small areas of the Grayling soils.

Most of the acreage is idle or in second-growth forest and shrubs. Pine has been planted in a few areas. Slope, susceptibility to erosion, low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 4/2aDE (VIe); woodland suitability group C; wildlife suitability group 5)

Metamora Series

The Metamora series consists of somewhat poorly drained soils that formed in 18 to about 42 inches of sandy loam outwash or till over loam or light clay loam till. The solum extends into the loam or the light clay loam till. These soils are on the nearly level to undulating or gently sloping parts of till plains and moraines. They are widely distributed throughout the central and southern parts of the county. The native vegetation was hardwood forest consisting chiefly of elm, hickory, ash, basswood, and maple.

Typical profile of Metamora sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2g—8 to 12 inches, grayish-brown (10YR 5/2) sandy loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, granular structure; friable; slightly acid; gradual, wavy boundary.

B1—12 to 30 inches, brown (10YR 5/3) sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; medium acid; abrupt, wavy boundary.

IIB2—30 to 44 inches, brown (10YR 5/3) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

IICg—44 inches +, grayish-brown (10YR 5/2) loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; calcareous.

In undisturbed areas the A1 horizon is very dark gray (10YR 3/1) and is from 2 to 5 inches thick. The color of the Ap horizon ranges from very dark grayish brown (10YR 3/2) to very dark gray (10YR 3/1) or dark grayish brown (10YR 5/1). The depth to mottling ranges from 6 to about 15 inches. In some areas the texture of the IIB2 horizon is silty clay loam.

Surface runoff is slow, permeability is moderate, the available moisture capacity is moderate, and natural fertility is medium.

The Metamora soils are coarser textured in the upper part of the B horizon than the Conover soils, and they are finer textured in the lower part of the B horizon than the Locke soils.

Metamora sandy loam, 0 to 2 percent slopes (MsA).—This soil is on narrow flats and in small shallow swales on gently undulating uplands. In some small areas the surface layer is from 10 to 12 inches thick because of an accumulation of soil material that washed from surrounding more sloping areas.

Most of this soil is used for corn, wheat, oats, white beans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots. Wetness and the moderate available moisture capacity are the major limitations. (Soil management unit 3/2bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Metamora sandy loam, 2 to 6 percent slopes (MsB).—This soil is on low ridges and swells on undulating uplands. In a few areas some of the original surface layer has been lost through erosion, and the present surface layer is grayish brown and is moderately low in organic-matter content. There are also a few small areas in which the surface soil is loamy sand.

Most of this soil is used for corn, wheat, oats, white beans, and legume-grass hay or pasture. Some small undrained areas are in farm woodlots or permanent pasture. Wetness and the moderate available moisture ca-

pacity are the major limitations. (Soil management unit 3/2bAB (IIw); woodland suitability group G; wildlife suitability group 2)

Miami Series

In the Miami series are well-drained soils that formed in calcareous loam, silt loam, or light clay loam till. These soils are on the level to steep parts of moraines and till plains throughout the county. The native vegetation was principally hardwood forest consisting of maple, elm, ash, hickory, white oak, and red oak.

Typical profile of Miami loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—8 to 11 inches, brown (10YR 5/3) loam; moderate, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B21—11 to 15 inches, yellowish-brown (10YR 5/4) clay loam; strong, medium, subangular blocky structure; firm; strongly acid; clear, wavy boundary.

B22—15 to 26 inches, dark-brown (10YR 4/3) clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B23—26 to 34 inches, brown (10YR 5/3) clay loam; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

C—34 inches +, yellowish-brown (10YR 5/4) loam; weak, coarse, subangular blocky structure; friable; calcareous.

The texture of the B horizon ranges from clay loam to heavy silty clay loam, and that of the C horizon from light loam to silt loam or light clay loam. The depth to the C horizon ranges from 24 to 42 inches. The color of the B and C horizons ranges to hues of 7.5YR and 5YR.

Runoff is medium on the mild slopes and rapid on the steep slopes. Permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Miami soils are finer textured throughout the solum than the Lapeer and Fox soils and coarser textured than the Morley soils. They are in the drainage sequence that includes the moderately well drained Celina soils, the somewhat poorly drained Conover soils, the poorly drained and very poorly drained Brookston soils, and the very poorly drained Kokomo soils.

Miami clay loam, 2 to 6 percent slopes, severely eroded (MtB3).—This soil is on gently undulating uplands. The clay loam surface layer contains only a small amount of organic matter. Shallow gullies are common. In some places, the depth to the limy underlying layer is only about 25 inches. Where this soil is adjacent to broad drainageways, small areas of the Kendallville and Celina soils were included in some of the areas mapped.

At one time all of this soil was used for general farm crops. Although much of the acreage is still intensively cultivated, many areas now are in pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aC3 (IIIe); woodland suitability group D; wildlife suitability group 1)

Miami clay loam, 6 to 12 percent slopes, severely eroded (MtC3).—This soil is on the short rounded slopes of potholes and basins and on ridges and swells on the uplands. The former upper layers have been removed by erosion, and the present surface layer consists of yellowish-brown material from what was the fourth and fifth layers. The organic-matter content generally is low. In a few places, the surface layer is stony, and cultivation is impractical. Shallow gullies are common, and there are some deep gullies in which the limy bottom layer is exposed (fig. 5). The depth to the limy bottom layer commonly is about 25 inches.

At one time this soil was used mainly for general farm crops, and some of the acreage is still used for cultivated crops, but many areas are now in pasture and hay. Slope, susceptibility to erosion, and moderately rapid runoff are the major limitations. (Soil management unit 2.5aC3 (IIIe); woodland suitability group D; wildlife suitability group 1)

Miami clay loam, 12 to 18 percent slopes, severely eroded (MtD3).—This soil is on strongly sloping ridges and on short side slopes of draws and ravines. The former upper layers have been removed by erosion, and the present surface layer consists primarily of yellowish-brown material from what was the fourth and fifth layers. The organic-matter content generally is low. Shallow gullies are common, and there are a few deep gullies. In most areas the depth to the limy bottom layer is about 25 inches.

Most of the acreage is used for permanent pasture. Some of the more severely eroded areas are idle. Slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 2.5aD3 (VIe); woodland suitability group D; wildlife suitability group 1)

Miami clay loam, 18 to 25 percent slopes, severely eroded (MtE3).—This soil is on the short side slopes of draws and ravines and along valley walls. The former upper layers have been removed by erosion, and the present surface layer consists primarily of material from the fourth and fifth layers. It is low in organic-matter content. Shallow gullies are common, and in some areas there are deep gullies in which the limy bottom layer is exposed. The depth to the bottom layer generally is

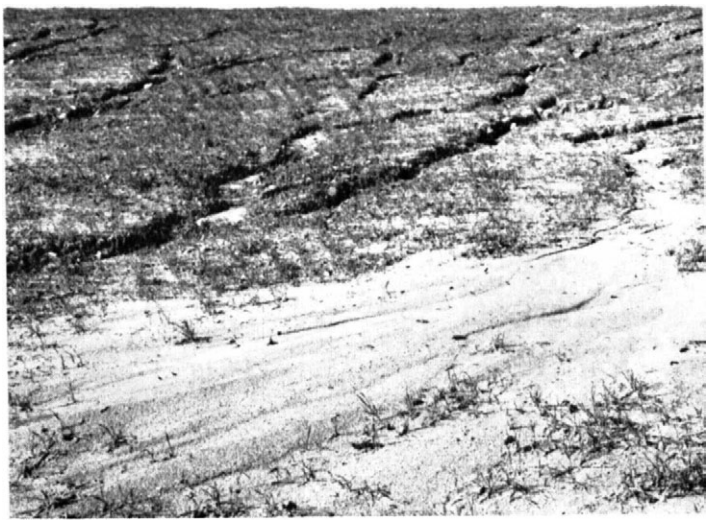

Figure 5.—**Sheet and gully erosion in a field of sloping Miami soils.**

about 24 inches. Included in some of the areas mapped are small areas of the Morley soils.

Most of the acreage is in permanent pasture or it is idle. Slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 2.5aE (VIe); woodland suitability group D; wildlife suitability group 1)

Miami clay loam, 25 to 40 percent slopes, severely eroded (MtF3).—This soil is on the short steep slopes of ridges, draws, and ravines and along valley walls. The present surface layer is yellowish-brown clay loam and consists primarily of material from what was the fourth and fifth layers. It contains little organic matter. Shallow gullies have formed in most areas, and in some places there are deep gullies. Small areas of the Morley soils were included in some of the areas mapped.

Most of the acreage is idle or in second-growth forest. Slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 2.5aF (VIIe); woodland suitability group D; wildlife suitability group 1)

Miami loam, 0 to 2 percent slopes (MuA).—This soil is on smooth ridgetops on the uplands. It is relatively high in organic-matter content. The depth to the limy bottom layer approaches the maximum depth of 42 inches. Small areas of the Celina and Conover soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small areas are in farm woodlots. The limitations are minor. (Soil management unit 2.5aA (I); woodland suitability group D; wildlife suitability group 1)

Miami loam, 2 to 6 percent slopes (MuB).—This soil is on undulating uplands. It is relatively high in organic-matter content. In several small areas that are on toe slopes, the very dark grayish-brown surface layer is from 10 to 12 inches thick because of an accumulation of soil material that washed from adjacent steeply sloping soils. The depth to the limy bottom layer is about 35 to 40 inches. Small areas of the Celina soils were included in many of the areas mapped.

Most areas of this soil are used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Several small areas are in farm woodlots. Susceptibility to erosion is a moderate limitation. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Miami loam, 2 to 6 percent slopes, moderately eroded (MuB2).—This soil is on undulating uplands. Part of the original surface layer has been removed by erosion. The present surface layer is brown loam and contains only a moderate amount of organic matter. In a few small areas there are numerous stones in the surface layer, and consequently tillage of intertilled crops is difficult.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. The stony areas are used mostly for pasture. Susceptibility to erosion is a moderate limitation. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Miami loam, 6 to 12 percent slopes (MuC).—This soil is on the short rounded slopes of ridges and swells on the uplands. Small areas of the Morley soils were included in some of the areas mapped.

Most of the acreage is in farm woodlots. A few areas are in pasture. Slope and susceptibility to erosion are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Miami loam, 6 to 12 percent slopes, moderately eroded (MuC2).—This soil is on the short rounded slopes of ridges and swells on the uplands. Part of the original surface layer has been removed by erosion. The present surface layer is brown or yellowish-brown loam and contains only a moderate amount of organic matter. Small wet seepy areas were included in some of the areas mapped, particularly in those where the length of the slope is greater than 100 feet.

This soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Slope, susceptibility to erosion, and, to some extent, rapid runoff are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Miami loam, 12 to 18 percent slopes, moderately eroded (MuD2).—This soil is on strongly sloping ridges and the short side slopes of draws and ravines. The surface layer is brown or yellowish-brown loam and contains only a moderate amount of organic matter.

Most of the acreage is in pasture or hay. A few small areas are used for wheat or oats. Slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 2.5aD (IVe); woodland suitability group D; wildlife suitability group 1)

Miami loam, 18 to 25 percent slopes, moderately eroded (MuE2).—This soil is on the short moderately steep slopes of draws and ravines and along valley walls adjacent to natural drainageways. Most of the original surface layer has been lost through erosion, and the present surface layer is brown or yellowish-brown loam. It is low in organic-matter content. Small areas of the Morley soils were included in some of the mapped areas, particularly those along valley walls adjacent to natural drainageways.

Most of the acreage is idle or in permanent pasture. Slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 2.5aE (VIe); woodland suitability group D; wildlife suitability group 1)

Miami loam, 25 to 40 percent slopes (MuF).—This soil is on the short steep slopes of draws and ravines and along valley walls adjacent to natural drainageways. Small areas of the Morley and Kendallville soils that are along valley walls adjacent to natural drainageways were included in mapping. Also included were a few moderately eroded areas in which the soils are lighter colored and lower in fertility than this soil.

Most of the acreage is in farm woodlots. Slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 2.5aF (VIIe); woodland suitability group D; wildlife suitability group 1)

Miami sandy loam, 2 to 6 percent slopes (MvB).—This soil is on undulating uplands. Stones occur on the surface of several small areas but are not sufficient to interfere

greatly with tillage. The depth to the limy bottom layer is about 35 to 40 inches. Small areas of the Lapeer, Celina, and Owosso soils were included in many of the areas mapped.

Most of the acreage is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A small acreage is in farm woodlots. The limitations are minor. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Miami sandy loam, 2 to 6 percent slopes, moderately eroded (MvB2).—This soil is on undulating uplands. Most of the original surface layer has been removed by erosion, and the present surface layer is brown or yellowish-brown sandy loam. The organic-matter content is moderate. Shallow gullies have formed in a few small areas. Included in many of the areas mapped are small areas of the Lapeer, Celina, and Owosso soils.

This soil is used for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Slope and susceptibility to erosion are slight limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Miami sandy loam, 6 to 12 percent slopes, moderately eroded (MvC2).—This soil is on the short rounded slopes of potholes and basins and on sloping ridges on the uplands. In most areas much of the original surface layer has been removed by erosion, and the present surface layer is brown or yellowish-brown sandy loam. It contains only a moderate amount of organic matter. Small areas of the Lapeer and Owosso soils were included in many of the areas mapped.

This soil is used mainly for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Several small areas are in farm woodlots. Slope, susceptibility to erosion, and, to some extent, medium surface runoff are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Miami sandy loam, 12 to 18 percent slopes, moderately eroded (MvD2).—This soil is on strongly sloping ridges and on short side slopes of draws and ravines. The surface layer is brown or yellowish-brown sandy loam and is moderately low in organic-matter content. Small areas of the Lapeer and Owosso soils were included in many of the areas mapped.

This soil is used mostly for pasture. Some areas are idle. Slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 2.5aD (IVe); woodland suitability group D; wildlife suitability group 1)

Miami-Owosso sandy loams, 0 to 2 percent slopes (MwA).—This complex is on nearly level to gently undulating uplands. Although most areas include both soils, the Miami soil is dominant. Included in mapping were small areas of Miami and Owosso soils that have a slope range of 2 to 6 percent, and small areas of Conover and Metamora sandy loams that generally are in slight depressions.

Most of this complex is used for corn, small grain, soybeans, field beans, and a mixture of legumes and grass. A small acreage is in forest or permanent pasture. The limitations are minor. (Soil management unit 2.5aA (I); woodland suitability group D; wildlife suitability group 1)

Miami-Owosso sandy loams, 2 to 6 percent slopes (MwB).—This complex consists of small, irregularly shaped areas of Miami sandy loam and Owosso sandy loam. Although most areas include both soils, the Miami soil is dominant. This complex is closely associated with the less sloping and more strongly sloping Miami and Owosso sandy loams, and small areas of these associated soils were included in the areas mapped. In some places the surface layer is brown.

Most of this complex is used for corn, small grain, soybeans, field beans, and a mixture of legumes and grass. A small acreage is in forest or permanent pasture. Susceptibility to erosion and, to some extent, moderate fertility are the major limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Miami-Owosso sandy loams, 2 to 6 percent slopes, moderately eroded (MwB2).—This complex is on undulating or gently sloping uplands. Although most areas include both soils, the Miami soil is dominant. The present surface layer over most of the acreage is brown sandy loam. It consists largely of material from what was originally the second layer. Small shallow rills and gullies have formed in some places. This complex is closely associated with the less sloping and more strongly sloping Miami and Owosso sandy loams, and small areas of these soils were included in mapping.

Most of this complex is used for corn, small grain, soybeans, field beans, and a mixture of legumes and grass. A few areas are in permanent pasture. Susceptibility to erosion and, to some extent, moderate fertility are the major limitations. (Soil management unit 2.5aB (IIe); woodland suitability group D; wildlife suitability group 1)

Miami-Owosso sandy loams, 6 to 12 percent slopes, moderately eroded (MwC2).—This complex is on sloping uplands. Although most areas include both soils, the Miami soil is dominant. The present surface layer over most of the acreage is brown sandy loam. It consists largely of material from what was originally the second layer. In a few small areas the surface layer is dark grayish brown or very dark gray. This complex is closely associated with less sloping and more strongly sloping Miami and Owosso sandy loams, and small areas of these soils were included in mapping.

Most of this complex is used for corn, small grain, soybeans, field beans, and a mixture of legumes and grass. A small acreage is in permanent pasture, and a few small areas are forested. Susceptibility to erosion, medium or rapid surface runoff, and moderate fertility are the major limitations. (Soil management unit 2.5aC (IIIe); woodland suitability group D; wildlife suitability group 1)

Miami-Owosso sandy loams, 12 to 18 percent slopes, moderately eroded (MwD2).—This complex is on strongly sloping uplands, commonly adjacent to drainageways. Although most areas include both soils, the Miami soil is dominant. The surface layer is commonly brown sandy loam and consists largely of material from what was originally the second layer. In a few areas it is dark grayish brown or very dark gray. Short shallow gullies have formed in some places. Included in mapping were some small areas of the Miami and Owosso soils that have a slope range of 6 to 12 percent, and some

that have a slope of more than 18 percent. Also included were small areas of the Morley soils.

Some areas are used for corn, small grain, and hay crops, a few small areas are forested, and a considerable acreage is idle or in permanent pasture. Susceptibility to erosion, rapid runoff, and moderate fertility are the major limitations. (Soil management unit 2.5aD (IVe); woodland suitability group D; wildlife suitability group 1)

Montcalm Series

The Montcalm series consists of well drained and moderately well drained soils that formed in loamy sand and sand. These soils are on level to gently sloping till plains and on the level to steep parts of moraines throughout the northern half of the county. They developed under forest consisting mainly of oak, hickory, sugar maple, elm, and white pine.

Typical profile of Montcalm loamy sand:

Ap—0 to 8 inches, dark-brown (10YR 3/3) loamy sand; weak, fine, granular structure; very friable; slightly acid; medium organic-matter content; abrupt, smooth boundary.

Bir—8 to 16 inches, strong-brown (7.5YR 5/6) loamy sand; weak, fine, granular structure; very friable; strongly acid; gradual, wavy boundary.

A'2—16 to 24 inches, light yellowish-brown (10YR 6/4) loamy sand; very weak, fine, subangular blocky structure; very friable; medium acid; abrupt, wavy boundary.

B'21t—24 to 31 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; slightly firm; medium acid; abrupt, wavy boundary.

A'2&B'22t—31 to 72 inches, very pale brown (10YR 7/3) fine sand (representing the A'2 horizon) alternating with thin, ½- to 4-inch bands of dark-brown (7.5YR 4/4) heavy loamy sand (representing the B'22t horizon); the A'2 material is single grain and loose; the B'22t material has weak, coarse, subangular blocky structure and is friable; medium acid; boundary between last B'22t horizon and the C horizon is abrupt and wavy.

C—72 inches +, very pale brown (10YR 7/3) light loamy sand; single grain; loose; slightly acid.

In some areas there is a light brownish-gray (10YR 6/2) A2 horizon, 1 to 4 inches thick, below the Ap horizon. The color of the Bir horizon ranges to yellowish brown (10YR 5/6), and that of the B't horizon to reddish brown (5YR 4/4). The depth to the first B'21t horizon ranges from 20 to 32 inches. The texture of the B'22t horizon in the A'2&B'22t sequence ranges from heavy loam sand to light sandy loam. The solum ranges from medium acid to strongly acid. The depth to the C horizon ranges from 48 to 78 inches. The C horizon ranges from medium to light loamy sand or sand in texture and from slightly acid to neutral in reaction.

Surface runoff is medium on the mild slopes and rapid on the steep slopes. Permeability is moderately rapid. The available moisture capacity is moderately low, and in dry years yields of field crops are adversely affected. Natural fertility is also moderately low. Both wind and water erosion are hazards if these coarse-textured soils are left without a cover of vegetation, or if the surface layer is depleted of organic matter.

The Montcalm soils are in the drainage sequence that includes the somewhat poorly drained Otisco soils and the poorly drained and very poorly drained Edmore soils. They have a coarser textured solum than the McBride soils, and their B horizon is nearer the surface and is finer textured and thicker than that of the Chelsea soils.

Montcalm loamy sand, 0 to 2 percent slopes (MxA).—In most areas a profile of this soil is like the one described as typical of the series. Included in many of the areas mapped are small isolated areas of Chelsea loamy sand.

Most of this soil is used for such field crops as corn, small grain, field beans, and hay. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 2 to 6 percent slopes (MxB).—This soil is on undulating or gently sloping uplands. In most areas a profile of this soil is like the one described as typical of the series. In some small areas, however, the surface layer is thicker and darker colored than that of the typical soil, and it contains more organic matter. In a few small areas there are numerous stones in the surface layer. Small areas of Chelsea loamy sand were included in some of the areas mapped. These included areas occur as isolated pockets and do not materially affect the use and management of this soil.

Most of this soil is used for such general field crops as corn, small grain, field beans, and hay. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 2 to 6 percent slopes, moderately eroded (MxB2).—This soil is on undulating or gently sloping uplands. The present surface layer is yellowish-brown loamy sand that contains less organic matter than that of the soil described as typical of the series. In some small areas, it consists almost entirely of material from the strong-brown layer. In places there are numerous stones in the surface layer. Some small scattered areas of Chelsea loamy sand, which generally is coarser textured throughout than this soil, were included in mapping. These included areas are small and do not greatly influence use and management.

Most of this soil is used for such general field crops as corn, small grain, field beans, and hay. Moderately low natural fertility, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 6 to 12 percent slopes, moderately eroded (MxC2).—This soil is on sloping uplands. The present surface layer in most areas consists partly of material from the strong-brown layer. It is browner in color and contains less organic matter than that of the soil described as typical of the series. Included in some of the areas mapped are small areas of McBride and Chelsea soils. Also included are a few areas of an uneroded Montcalm soil that has a darker colored surface layer than the eroded soil.

A large acreage is used for pasture. A smaller acreage is used for small grain and hay. Moderately low natural fertility, moderately low available moisture capacity, and erosion are the major limitations. (Soil

management unit 4aC (IIIe); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 6 to 12 percent slopes, severely eroded (MxC3).—This soil is on sloping uplands. In most areas the present surface layer consists largely of material from the strong-brown layer. In a few small areas it is mixed with material from the light yellowish-brown layer. The organic-matter content is low. Small scattered areas of the McBride and Chelsea soils were included in some of the areas mapped.

Most of this soil is idle or in second-growth forest. Moderately low available moisture capacity, moderately low natural fertility, susceptibility to erosion, and medium runoff are the major limitations. (Soil management unit 4aC3 (IVe); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 12 to 18 percent slopes, moderately eroded (MxD2).—This soil is on strongly sloping uplands. In most areas the present surface layer consists partly of soil material from the strong-brown layer. Thus, it is browner in color and contains less organic matter than that of the soil described as typical of the series. In addition, the individual horizons are thinner, and the depth to the coarse loamy sand bottom layer is less. In a few areas the surface layer is sandy loam. Small scattered areas of Chelsea and McBride soils were included in mapping. Also included were small areas of an uneroded soil that has a darker colored surface layer and contains more organic matter than this soil.

Most of the acreage is idle or in pasture. Moderately low available moisture capacity, moderately low natural fertility, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 4aD (IVe); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 12 to 18 percent slopes, severely eroded (MxD3).—This soil is on strongly sloping uplands. All or nearly all of the original surface layer has been lost through erosion, and the present surface layer consists primarily of material from the former strong-brown layer and the light yellowish-brown third layer. It is brown loamy sand and contains little organic matter. The depth to the coarse loamy sand bottom layer is less than that of the soil described as typical. Shallow wind blowouts occur in several small areas, and in a few places the light yellowish-brown layer is exposed. In a few small areas the surface layer is sandy loam. Small scattered areas of McBride and Chelsea soils were included in some of the areas mapped. However, the total acreage is small and does not greatly influence use and management.

Most of this soil is idle. White pine or red pine has been planted in some small areas. Moderately low natural fertility, moderately low available moisture capacity, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 4aD3 (VIe); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 18 to 25 percent slopes, moderately eroded (MxE2).—This soil is on side slopes on the uplands, commonly adjacent to drainageways. Strong-brown material from the second layer is mixed with the present surface layer. Consequently, the surface layer is browner and contains less organic matter than that of the soil described as typical of the series. Scattered areas of Chelsea and McBride soils were included in some of the areas mapped. These included areas are small and do not significantly influence use and management. Also included were a few small areas of an uneroded soil that has a darker colored surface layer and contains more organic matter than this soil.

Most of this soil is idle or used for pasture. Moderately low available low moisture capacity, moderately low natural fertility, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 4aE (VIe); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 18 to 25 percent slopes, severely eroded (MxE3).—This severely eroded soil is on side slopes on the uplands, commonly adjacent to drainageways. The present surface layer of brown loamy sand consists almost entirely of material from what was the strong-brown second layer. The organic-matter content is considerably less than that of the soil described as typical, and the depth to the bottom layer is much less. In places the light yellowish-brown layer is exposed. In a few areas the surface layer is sandy loam. Included in the areas mapped are small scattered areas of McBride and Chelsea soils.

Most of this soil is idle. However, red pine or white pine has been planted in some small areas. Moderately low available moisture capacity, moderately low natural fertility, susceptibility to erosion, and rapid runoff are the principal limitations. (Soil management unit 4aE3 (VIIe); woodland suitability group C; wildlife suitability group 5)

Montcalm loamy sand, 25 to 40 percent slopes, moderately eroded (MxF2).—This soil is on steep uplands, commonly adjacent to drainageways. In most places strong-brown material from the second layer is mixed with the surface soil. Consequently, the present surface layer is browner and lower in organic-matter content than that of the soil described as typical of the series, and the depth to the bottom layer is less. In several small areas the surface layer is sandy loam. Included in the areas mapped are small scattered areas of Chelsea and McBride soils.

Most of the acreage is idle. Moderately low available moisture capacity, moderately low natural fertility, slope, susceptibility to erosion, and rapid runoff are the major limitations. (Soil management unit 4aF (VIIe); woodland suitability group C; wildlife suitability group 5)

Montcalm sandy loam, 0 to 2 percent slopes (MyA).—This soil is on nearly level or undulating uplands. The surface layer commonly is finer textured than that of the soil described as typical of the series, the depth to the dark-brown layer is slightly less, and the total thickness of the sandy loam layer generally is greater. In some small areas, the dark-brown surface layer is thicker than 8 inches and is moderately high in organic-matter content. Small scattered areas of McBride soils were included in the areas mapped.

Most of this soil is used for such field crops as corn, small grain, field beans, and hay. Moderately low natural fertility and moderately low available moisture ca-

pacity are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group C; wildlife suitability group 5)

Montcalm sandy loam, 2 to 6 percent slopes (MyB).—This soil is on undulating to gently sloping uplands. The surface layer is finer textured than that of the soil described as typical of the series, and the depth to the first subsoil layer generally is greater. Small scattered areas of McBride soils were included in the areas mapped.

Most of this soil is used for such field crops as corn, small grain, field beans, and hay. Moderately low natural fertility and moderately low available moisture supplying capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group C; wildlife suitability group 5)

Montcalm sandy loam, 2 to 6 percent slopes, moderately eroded (MyB2).—This soil is on undulating to gently sloping uplands. The surface layer is dark yellowish-brown sandy loam and is moderately low in organic-matter content. Included in the areas mapped were small areas of McBride soils.

Most of this soil is used for such general field crops as corn, small grain, field beans, and hay. Moderately low natural fertility, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group C; wildlife suitability group 5)

Montcalm sandy loam, 6 to 12 percent slopes, moderately eroded (MyC2).—This soil is on sloping uplands, commonly adjacent to drainageways. Over most of the acreage, some of the original surface layer has been lost through erosion, and the present surface layer consists partly of material from the strong-brown layer. It is dark yellowish-brown sandy loam and is moderately low in organic-matter content. Included in some of the areas mapped are small scattered areas of the McBride soils.

Most of this soil is used for such field crops as corn, small grain, field beans, and hay. Some areas are used for pasture. Moderately low natural fertility, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 4aC (IIIe); woodland suitability group C; wildlife suitability group 5)

Morley Series

In the Morley series are well drained and moderately well drained soils that formed in calcareous silty clay loam or clay loam till. These soils are on the nearly level to moderately steep parts of till plains and moraines. They developed under mixed stands of northern hardwoods, consisting mainly of sugar maple, elm, and beech.

Typical profile of Morley loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, yellowish-brown (10YR 5/4) loam; moderate, coarse, granular structure; friable; strongly acid; clear, smooth boundary.

B21—12 to 16 inches, light yellowish-brown (10YR 6/4) clay loam; strong, medium, subangular blocky structure; firm; strongly acid; clear, smooth boundary.

B22—16 to 22 inches, yellowish-brown (10YR 5/4) heavy clay loam; strong, medium, subangular blocky structure; firm; medium acid; gradual, smooth boundary.

B23—22 to 30 inches, dark-brown (7.5YR 4/4) heavy clay loam; common, medium, distinct, brown (10YR 5/3) mottles; strong, medium, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

C—30 inches +, brown (7.5YR 5/4) clay loam; weak, coarse, subangular blocky structure; firm; calcareous.

The texture of the B horizon ranges from clay loam to light silty clay or heavy silty clay loam, and the color ranges to a hue of 5YR. The thickness of the solum ranges from 20 to 35 inches. The depth to mottling ranges from 16 to 32 inches or more. The sandy loam type represents soils on which sandy material has accumulated.

Runoff is medium on the mild slopes and rapid on the strong and moderately steep slopes. Permeability is moderately slow, and the available moisture capacity and natural fertility generally are moderately high. Where runoff is rapid, however, the available moisture capacity is not readily replenished, and crops are likely to be damaged during long dry periods.

The Morley soils are finer textured throughout the solum than the Celina and Miami soils. They are in the drainage sequence that includes the somewhat poorly drained Blount soils and the poorly drained and very poorly drained Pewamo soils.

Morley clay loam, 6 to 12 percent slopes, severely eroded (MzC3).—This soil is on the short rounded slopes of potholes, basins, and ridges on the uplands, generally adjacent to broad drainageways. All of the original surface layer has been removed by erosion, and the present surface layer is light yellowish-brown clay loam. It contains little organic matter. In most areas the depth to the limy bottom layer is only about 20 inches. Small areas of slightly lower lying Miami soils were included in many of the areas mapped, particularly in those areas that are near the base of slopes.

Much of this soil is idle. However, some areas are used for corn, wheat, oats, and legume-grass hay or pasture. Rapid runoff, susceptibility to erosion, and moderately slow permeability are the major limitations. (Soil management unit 1.5aC3 (IVe); woodland suitability group B; wildlife suitability group 5)

Morley clay loam, 12 to 18 percent slopes, severely eroded (MzD3).—This soil is on ridges and on the short side slopes of draws and ravines, generally near broad drainageways. The original surface layer has been removed by erosion, and the present surface layer is light yellowish-brown clay loam. It contains little organic matter. In many areas the limy bottom layer is at a depth of only about 20 inches. Shallow gullies are common, and in places the yellowish-brown fourth layer is exposed. Where this soil occurs near the base of slopes, small areas of the Miami soils were included in mapping.

Although much of this soil is idle, some areas are used for corn, wheat, oats, and legume-grass hay or pasture. Rapid runoff, susceptibility to erosion, low content of organic matter, and moderately slow permeability are the major limitations. (Soil management unit 1.5aDE3 (VIe); woodland suitability group B; wildlife suitability group 3)

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Morley loam, 0 to 2 percent slopes (MzaA).—This soil is on narrow smooth ridgetops on the uplands. It generally is associated with the Miami and Celina soils that are at slightly lower elevations. The surface layer is very dark grayish-brown loam and is moderately high in organic-matter content. Included in many of the areas mapped were small areas of Blount soils, which are in slight depressions and swales, and small areas of Celina and Conover soils.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small areas are in farm woodlots. Moderately slow permeability is the major limitation. (Soil management unit 1.5aA (I); woodland suitability group B; wildlife suitability group 3)

Morley loam, 2 to 6 percent slopes (MzaB).—This soil is on undulating uplands. It generally is associated with the Miami and Celina soils that are at slightly lower elevations. The surface layer is dark grayish-brown loam and is moderately high in organic-matter content. Within many of the areas mapped are slight depressions and swales in which the Blount soils occur, and small areas of Celina and Miami soils.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small areas are in farm woodlots. Moderately slow permeability and susceptibility to erosion are the major limitations. (Soil management unit 1.5aB (IIe); woodland suitability group B; wildlife suitability group 3)

Morley loam, 2 to 6 percent slopes, moderately eroded (MzaB2).—This soil is on undulating uplands. It is generally associated with the Miami and Celina soils that are at slightly lower elevations. The surface layer in most areas is yellowish-brown loam and is moderately low in organic-matter content. Shallow gullies have formed in a few small areas and exposed the light yellowish-brown third layer. Included in many of the areas mapped are slight depressions and swales in which the Blount soils occur, and small areas of the Miami and Celina soils.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas are idle or in permanent pasture. Susceptibility to erosion and moderately slow permeability are the major limitations. (Soil management unit 1.5aB (IIIe); woodland suitability group B; wildlife suitability group 3)

Morley loam, 6 to 12 percent slopes, moderately eroded (MzaC2).—This soil is on the short rounded slopes of potholes, basins, and ridges on the uplands, generally adjacent to broad drainageways. Most of the original surface layer has been removed by erosion, and the present surface layer is yellowish-brown or light yellowish-brown loam. It is moderately low in organic-matter content. Where this soil is adjacent to the Miami soils near the base of slopes, small areas of the Miami soils were included in many of the areas mapped.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. Slope, susceptibility to erosion, and moderately slow permeability are the major limitations. (Soil management unit 1.5aC (IIIe); woodland suitability group B; wildlife suitability group 3)

Morley loam, 12 to 18 percent slopes, moderately eroded (MzaD2).—This soil is on the short rounded slopes of potholes, basins, and ridges on the uplands, generally adjacent to broad drainageways. Most of the original surface layer has been removed by erosion, and the present surface layer is yellowish-brown or light yellowish-brown loam. It is moderately low in organic-matter content. This soil is commonly associated with the Miami and Celina soils, which are at slightly lower elevations. Small areas of the Miami soils, near the base of the slopes, were included in many of the areas mapped.

Most of this acreage is in farm woodlots or permanent pasture. A few areas are used for such crops as corn, wheat, oats, and legume-grass hay or pasture. Slope, susceptibility to erosion, and moderately slow permeability are the major limitations. (Soil management unit 1.5aD (IVe); woodland suitability group B; wildlife suitability group 3)

Morely sandy loam, 2 to 6 percent slopes (MzbB).—This soil generally is adjacent to broad drainageways, on undulating uplands. The dark grayish-brown or brown surface layer contains a moderate amount of organic matter. The second layer is sandy loam or loam. This soil is commonly associated with the Lapeer, Kendallville, and Cadmus soils, which are at lower elevations. Included within the areas mapped are small slight depressions and pockets in which the Macomb and Metamora soils occur.

Most of this soil is cultivated. The crops generally grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas remain in farm woodlots. Susceptibility to erosion and moderately slow permeability are the major limitations. (Soil management unit 1.5aB (IIe); woodland suitability group B; wildlife suitability group 3)

Morley sandy loam, 2 to 6 percent slopes, moderately eroded (MzbB2).—This soil is on undulating or gently sloping uplands, generally adjacent to broad drainageways. Most of the original surface layer has been lost through erosion, and the present surface layer is yellowish-brown sandy loam. It is moderately low in organic-matter content. In most places this soil is associated with the Lapeer, Kendallville, and Cadmus soils, which are at lower elevations. Within many of the areas mapped are small slight depressions and pockets in which the Macomb and Metamora soils occur.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas remain in farm woodlots. Susceptibility to erosion and moderately slow permeability are the major limitations. (Soil management unit 1.5aB (IIIe); woodland suitability group B; wildlife suitability group 3)

Morley sandy loam, 6 to 12 percent slopes, moderately eroded (MzbC2).—This soil is on the short rounded slopes of ridges and swells, adjacent to broad drainageways on the uplands. Most of the original surface layer has been lost through erosion. The present surface layer is yellowish-brown sandy loam and is moderately low in organic-matter content. In most areas the second layer is lacking. The depth to the clay loam is about 8 or 9

inches. This soil commonly is associated with the Lapeer, Kendallville, and Cadmus soils, which are at lower elevations. Small areas of the Miami soils were included in many of the areas mapped.

Most of the acreage is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Slope, susceptibility to erosion, and moderately slow permeability are the major limitations. (Soil management unit 1.5aC (IIIe); woodland suitability group B; wildlife suitability group 3)

Nester Series

In the Nester series are well drained and moderately well drained soils that formed in calcareous silty clay loam or clay loam till on undulating to moderately steep parts of till plains and moraines. These soils are fairly widely distributed throughout the northern third of the county. They developed under mixed stands of hardwoods and conifers consisting mainly of maple, elm, beech, oak, and some white pine.

Typical profile of Nester loam:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; high content of organic matter; neutral; abrupt, smooth boundary.

A2—7 to 11 inches, grayish-brown (10YR 5/2) loam; moderate, medium, granular structure; friable; slightly acid; gradual, irregular boundary.

B21&A2—11 to 14 inches, dark yellowish-brown (10YR 4/4) clay loam (representing the B21 horizon); grayish-brown (10YR 5/2) loam (representing the A2 horizon) occurs as coats on the individual ped surfaces and on the surfaces of cracks and walls of old root channels; the B21 material has moderate, fine, subangular blocky structure and is firm; the A2 material has moderate, medium, granular structure and is friable; neutral; clear, wavy boundary.

B22—14 to 30 inches, dark yellowish-brown (10YR 4/4) heavy clay loam; strong, medium, angular blocky structure; firm; neutral; abrupt, irregular boundary.

C—30 inches +, brown (10YR 5/3) clay loam; moderate, coarse, angular blocky structure; firm; calcareous.

In some areas the B21&A2 horizon is as much as 4 inches thick. In others it is weakly represented, and there are only a few, faint, grayish-brown coats in the uppermost 1 or 2 inches of the dark yellowish-brown B21 horizon. In moderately well drained areas, gray and yellowish mottles occur in the lower part of the B22 horizon. The texture of the B2 horizon ranges from clay loam to silty clay loam or light silty clay. The depth to the C horizon ranges from 20 to 40 inches. In some areas pockets and thin discontinuous strata of coarser textured material occur in the B and C horizons.

Surface runoff is medium on the mild slopes and rapid on the strong and moderately steep slopes. Permeability is moderately slow, and the available moisture capacity and natural fertility are moderately high. Where runoff is rapid, however, the available moisture is not readily replenished, and crops are likely to be damaged during long dry periods.

The Nester soils have a coarser textured B horizon than the Kent soils and are finer textured throughout the solum than the Marlette soils. They are in the drainage sequence that includes the somewhat poorly drained Kawkawlin soils and the poorly drained and very poorly drained Sims soils.

Nester clay loam, 2 to 6 percent slopes, severely eroded (NcB3).—This soil is on undulating uplands. All of the original surface layer has been removed by erosion, and the present surface layer is dark-brown or dark yellowish-brown clay loam. It contains little organic matter. Shallow gullies that can be crossed with farm machinery have formed in some places. In many areas the depth to the limy bottom layer is only about 20 inches. Small scattered areas of Marlette soils were included in mapping.

This soil is used mainly for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Susceptibility to erosion and moderately slow permeability are the major limitations. (Soil management unit 1.5aB (IIIe); woodland suitability group B; wildlife suitability group 3)

Nester clay loam, 6 to 12 percent slopes, severely eroded (NcC3).—This soil is on the short rounded slopes of potholes, basins, and ridges on the uplands. All of the original surface layer has been removed by erosion. The present surface layer is dark-brown or dark yellowish-brown clay loam and contains little organic matter. The depth to the limy bottom layer is about 20 inches. Shallow gullies are common. Narrow areas of Marlette soils were included in many of the mapped areas that are near the base of slopes.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, and legume-grass hay or pasture. Some areas are idle or in permanent pasture. Slope, rapid runoff, susceptibility to erosion, and moderately slow permeability are the major limitations. (Soil management unit 1.5aC3 (IVe); woodland suitability group B; wildlife suitability group 3)

Nester clay loam, 12 to 18 percent slopes, severely eroded (NcD3).—This soil is on strongly sloping ridges and on the short side slopes of draws and ravines. All of the original surface layer has been removed by erosion, and the present surface layer is dark-brown or dark yellowish-brown clay loam. It contains little organic matter. The depth to the limy bottom layer is about 20 inches. Shallow gullies that can be crossed with farm machinery are common.

Most of this soil has been cultivated at one time, but many areas are now idle or in permanent pasture. Some areas occur in fields that are, for the most part, less sloping than this soil. These areas are cultivated with the rest of the field. The crops commonly grown are corn, wheat, oats, and legume-grass hay or pasture. The major limitations are slope, susceptibility to erosion, rapid surface runoff, and moderately slow permeability. (Soil management unit 1.5aDE3 (VIe); woodland suitability group B; wildlife suitability group 3)

Nester clay loam, 18 to 25 percent slopes, severely eroded (NcE3).—This soil is on the short side slopes of ridges and ravines and along valley walls adjacent to broad drainageways. All of the original surface layer has been removed by erosion, and the present surface layer is dark yellowish-brown clay loam. It contains little organic matter. The depth to the limy bottom layer is only about 20 inches. Shallow gullies are common.

This soil has been cultivated, but most areas are now idle or in permanent pasture. The major limitations are

slope, rapid runoff, susceptibility to erosion, and moderately slow permeability. (Soil management unit 1.5aDE3 (VIe); woodland suitability group B; wildlife suitability group 3)

Nester loam, 2 to 6 percent slopes (NeB).—This soil is on undulating uplands. The surface layer of dark grayish-brown loam is high in organic-matter content. In many areas gray and yellowish mottles occur in the lower part of the fourth layer, and in places there are pockets and scattered horizontal layers of loamy sand and sandy loam, ½ inch to 2 inches thick, in the fourth layer and in the limy bottom layer. Within the areas mapped are small flat areas and slight depressions in which the Kawkawlin soils occur.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas are in farm woodlots or permanent pasture. Moderately slow permeability and susceptibility to erosion are the major limitations. (Soil management unit 1.5aB (IIe); woodland suitability group B; wildlife suitability group 3)

Nester loam, 2 to 6 percent slopes, moderately eroded (NeB2).—This soil is on undulating uplands. Most of the original surface layer has been removed by erosion, and the present surface layer is grayish-brown loam. It contains only a moderate amount of organic matter. In some areas gray and yellowish mottles occur in the lower part of the fourth layer, and in places there are horizontal layers of loamy sand and sandy loam, ½ inch to 2 inches thick, in the fourth layer and in the limy bottom layer. Within the areas mapped are small flat areas and slight depressions in which the Kawkawlin soils occur.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas are in permanent pasture. Susceptibility to erosion and moderately slow permeability are the major limitations. (Soil management unit 1.5aB (IIIe); woodland suitability group B; wildlife suitability group 3)

Nester loam, 6 to 12 percent slopes, moderately eroded (NeC2).—This soil is on the short rounded slopes of potholes, basins, and hills on the uplands. Most of the original surface layer has been removed by erosion. The present first layer is grayish-brown or brown loam and contains only a moderate amount of organic matter. Shallow gullies have formed in some places.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Some small areas are in farm woodlots. Slope, susceptibility to erosion, and moderately slow permeability are the major limitations. (Soil management unit 1.5aC (IIIe); woodland suitability group B; wildlife suitability group 3)

Nester sandy loam, 2 to 6 percent slopes (NsB).—This soil is on gently undulating to undulating uplands, commonly adjacent to broad drainageways. The surface layer is dark grayish-brown sandy loam and contains a moderate amount of organic matter. In some areas the second layer is also sandy loam. In places there is some loamy and sandy material in the fourth layer and in the limy bottom layer. Where this soil is at the higher elevations adjacent to major drainageways, it is closely associated with the slightly lower lying Ubly and Belding soils. Small areas of Kawkawlin and Belding soils, in shallow depressions, were included in the areas mapped.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. A minor acreage is in farm woodlots or permanent pasture. Susceptibility to erosion and moderately slow permeability are the major limitations. (Soil management unit 1.5aB (IIe); woodland suitability group B; wildlife suitability group 3)

Nester sandy loam, 2 to 6 percent slopes, moderately eroded (NsB2).—This soil is on undulating uplands, commonly adjacent to broad drainageways. Most of the original surface layer has been removed by erosion, and the present surface layer is grayish-brown or brown sandy loam. It contains only a moderate amount of organic matter. Pockets or thin horizontal layers of loamy sand and sandy loam occur in the fourth layer and in the limy bottom layer. Where this soil is at the higher elevations adjacent to major drainageways, it is closely associated with the slightly lower lying Ubly and Belding soils. Small areas of Kawkawlin and Belding soils, in small swales and flats, were included in the areas mapped.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Susceptibility to erosion and moderately slow permeability are the major limitations. (Soil management unit 1.5aB (IIIe); woodland suitability group B; wildlife suitability group 3)

Nester sandy loam, 6 to 12 percent slopes, moderately eroded (NsC2).—This soil is on the short rounded slopes of ridges and swells on uplands, generally adjacent to broad drainageways. Most of the original surface layer has been removed by erosion. The present first layer is grayish-brown or brown sandy loam and is moderately low in organic-matter content. In some areas sandy material occurs in the fourth and fifth layers. Included in the areas mapped were some small areas of Ubly soils and a few uneroded soils in which the surface layer is darker colored than that of this soil.

Most of this soil is cultivated. The crops commonly grown are corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few areas are idle. Slope, susceptibility to erosion, rapid runoff, and moderately slow permeability are the major limitations. (Soil management unit 1.5aC (IIIe); woodland suitability group B; wildlife suitability group 3)

Nester sandy loam, 12 to 18 percent slopes (NsD).—This soil is on the strongly sloping ridges and short side slopes of draws and ravines. The surface layer is dark grayish-brown sandy loam and contains a moderate amount of organic matter. Pockets or thin layers of loamy sand and sandy loam occur in the fourth and fifth layers. Small areas of Ubly soils were included in some of the areas mapped.

Most of this acreage is in farm woodlots. A few areas are used for permanent pasture. Slope, susceptibility to erosion, rapid runoff, and moderately slow permeability are the major limitations. (Soil management unit 1.5aD (IVe); woodland suitability group B; wildlife suitability group 3)

Newaygo Series

The Newaygo series consists of well drained and moderately well drained soils that formed in sandy loam and loam outwash that is from 24 to 42 inches thick over calcareous stratified gravel and sand. These soils are on the level to steep parts of outwash plains, valley trains, terraces, and moraines throughout the northern third of the county. The native vegetation was principally hardwood forest consisting mainly of sugar maple, elm, yellow beech, and some white pine and red pine.

Typical profile of Newaygo sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; friable; medium organic-matter content; slightly acid; abrupt, smooth boundary.

Bir—8 to 16 inches, yellowish-brown (10YR 5/6) sandy loam; moderate, medium, granular structure; friable; slightly acid; clear, wavy boundary.

B'21t—16 to 32 inches, reddish-brown (5YR 4/4) loam; weak, fine, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B'22t—32 to 38 inches, reddish-brown (5YR 4/4) sandy clay loam; moderate, coarse, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIC—38 inches +, light yellowish-brown (10YR 6/4) stratified sand and gravel; single grain; loose; calcareous.

The texture of the Bt horizon commonly ranges from heavy sandy loam in areas where the depth to the IIC horizon approaches 42 inches, to sandy clay loam or gravelly clay loam, 12 inches or more thick, in areas where the depth to the IIC horizon approaches the minimum of 24 inches. In some areas a grayish-brown (10YR 5/2) A'2 horizon, 1 to 3 inches thick, occurs above the B'21t horizon, and in places there is a considerable amount of gravel throughout the solum.

Surface runoff ranges from slow on the mild slopes to rapid on the steep slopes. Permeability and the available moisture capacity are moderate, and natural fertility is medium.

The Newaygo soils have a thicker, finer textured B horizon than the Mancelona soils, and they are coarser textured throughout the solum and contain more gravel than the Dighton.

Newaygo sandy clay loam, 6 to 12 percent slopes, severely eroded (NwC3).—This soil is on the short slopes of high terraces, along river valleys and broad drainageways. The original surface layer has been removed by erosion, and the present surface layer is dark-brown or dark yellowish-brown sandy clay loam. It is low in organic-matter content. Numerous shallow gullies have formed in most areas, and in many places the reddish-brown third layer is exposed. Small areas of the Mancelona soils were included in most of the areas mapped.

Many areas occur in fields that are, for the most part, less sloping than this soil. These areas are cultivated with the rest of the field. The crops commonly grown are corn, wheat, soybeans, white beans, and legume-grass hay or pasture. Some areas are idle or in permanent pasture. Slope, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aC3 (IVe); woodland suitability group A; wildlife suitability group 1)

Newaygo sandy clay loam, 12 to 18 percent slopes, severely eroded (NwD3).—This soil is on the short slopes of high terraces, along river valleys and broad drainageways. All of the original surface layer has been removed by erosion, and the present surface layer is dark yellowish-brown or dark-brown sandy clay loam. It is low in organic-matter content. The limy bottom layer commonly occurs at a depth of about 30 inches, and shallow gullies are common. Small areas of the sandier Mancelona soils were included in many of the areas mapped.

Most of this acreage is idle or in permanent pasture. A few areas of this soil occur in fields that are, for the most part, less sloping. These areas are cultivated with the rest of the field. The crops commonly grown are corn, wheat, soybeans, white beans, and legume-grass hay or pasture. Slope, rapid runoff, susceptibility to erosion, and droughtiness are the major limitations. (Soil management unit 3aD3 (VIe); woodland suitability group A; wildlife suitability group 1)

Newaygo sandy loam, 0 to 2 percent slopes (NyA).—This soil is on broad flats on the valley plains and on the flat tops of terraces on the uplands. The surface layer is moderately high in organic-matter content and commonly is very dark brown in color. In some areas, the depth to the limy bottom layer is about 42 inches. Included in the areas mapped are small wet depressions in which the Sebewa and Gladwin soils occur.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. A few small areas are in farm woodlots. Droughtiness, in extremely dry years, is the major limitation. (Soil management unit 3aA (IIs); woodland suitability group A; wildlife suitability group 1)

Newaygo sandy loam, 2 to 6 percent slopes (NyB).—This soil is on undulating valley plains and on gently sloping high terraces. In some areas the combined thickness of the third and fourth layers is as much as 30 inches. In these areas, the depth to the limy bottom layer ordinarily is slightly more than 42 inches. Small areas of the sandier Mancelona soils were included in many of the areas mapped.

Most of this soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Some small areas are in farm woodlots. Slope, susceptibility to erosion, and droughtiness, in extremely dry years, are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group A; wildlife suitability group 1)

Newaygo sandy loam, 2 to 6 percent slopes, moderately eroded (NyB2).—This soil is on undulating valley plains and on gently sloping high terraces. Most of the original surface layer has been lost through erosion, and the present surface layer is dark grayish-brown sandy loam. It is somewhat low in organic-matter content. In a few areas, the surface layer is dark brown or dark yellowish brown, and shallow gullies have formed. Small areas of the Mancelona soils were included in many of the areas mapped.

The soil is used for corn, wheat, oats, soybeans, white beans, and legume-grass hay or pasture. Slope, susceptibility to erosion, and droughtiness, in extremely dry years, are the major limitations. (Soil management unit 3aB (IIe); woodland suitability group A; wildlife suitability group 1)

Newaygo sandy loam, 6 to 12 percent slopes, moderately eroded (NyC2).—This soil is on sloping terraces along river valleys and broad drainageways. Most of the original surface layer has been removed by erosion, and the present first layer is dark grayish-brown to yellowish-brown sandy loam. It is low in organic-matter content. In a few areas, the total thickness of the third and fourth layers is about 30 inches, and the depth to the limy bottom layer commonly is slightly more than 42 inches. Small areas of the sandier Mancelona soils were included in most of the areas mapped.

This soil is used mainly for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. A few small areas are forested. Slope, susceptibility to erosion, and droughtiness, in extremely dry years, are the major limitations. (Soil management unit 3aC (IIIe); woodland suitability group A; wildlife suitability group 1)

Newaygo sandy loam, 12 to 18 percent slopes, moderately eroded (NyD2).—This soil is on the short side slopes of high terraces, along the river valleys and broad drainageways. Most of the original surface layer has been removed by erosion, and the present surface layer is yellowish-brown to dark-brown sandy loam. It is low in organic-matter content and, in places, contains a number of large stones and some coarse gravel. In many places the depth to the limy bottom layer is about 30 inches. Small areas of the Mancelona soils were included in many of the areas mapped.

This soil has been cleared, but most areas are now idle or in permanent pasture. A few areas have been planted to trees. Slope, rapid runoff, susceptibility to erosion, and droughtiness, in dry years, are the major limitations. (Soil management unit 3aD (IVe); woodland suitability group A; wildlife suitability group 1)

Newaygo sandy loam, 18 to 40 percent slopes, moderately eroded (NyF2).—This soil is on the short side slopes of draws and ravines and along the valley walls of high terraces that are adjacent to river valleys and broad drainageways. The surface layer over much of the acreage is yellowish-brown or dark-brown sandy loam that is low in organic-matter content. Numerous shallow gullies have formed in many areas, and in places the reddish-brown third layer is exposed. Small areas of the sandier Mancelona soils were included in many of the areas mapped.

This soil has been cleared, but most areas are now idle or in permanent pasture. A few areas have been planted to trees. Slope, susceptibility to erosion, rapid runoff, and droughtiness are the major limitations. (Soil management unit 3aE (VIe); woodland suitability group A; wildlife suitability group 1)

Otisco Series

In the Otisco series are somewhat poorly drained soils that formed in loamy sand glacial drift, on the level to gently sloping parts of till plains and moraines. These soils occur mainly in the northern part of the county. They developed under forest consisting mostly of northern hardwoods and some white pine.

Typical profile of Otisco loamy sand:

Ap—0 to 8 inches, dark-brown (10YR 4/3) loamy sand; weak, fine, granular structure; very friable; medium organic-matter content; medium acid; abrupt, wavy boundary.

A2—8 to 11 inches, grayish-brown (10YR 5/2) loamy sand; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

B21ir—11 to 14 inches, yellowish-brown (10YR 5/6) loamy sand; common, medium, faint, brownish-yellow (10YR 6/8) mottles; weak, medium, granular structure; very friable; medium acid; gradual, wavy boundary.

B22ir—14 to 18 inches, brownish-yellow (10YR 6/6) loamy sand; common, medium, faint, yellow (10YR 7/8) mottles; weak, medium, granular structure; very friable; slightly acid; clear, wavy boundary.

A'2—18 to 31 inches, brown (10YR 5/3) loamy sand; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, medium, granular structure; very friable; medium acid; abrupt, wavy boundary.

B't—31 to 40 inches, dark yellowish-brown (10YR 4/4) sandy loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, medium, subangular blocky structure; firm; neutral; abrupt, irregular boundary.

C—40 inches +, brownish-yellow (10YR 6/6) loamy sand; common, medium, faint, light yellowish-brown (10YR 6/4) mottles; single grain; loose; neutral.

In undisturbed areas there is a 1- to 3-inch very dark gray (10YR 3/1) A1 horizon and a 4- to 8-inch grayish-brown (10YR 5/2) or gray (10YR 5/1) A2 horizon. In some plowed areas the upper part of the A2 horizon is mixed with the surface layer. The B't horizon commonly occurs as thin, discontinuous, ¼- to 5-inch bands, separated by A'2 horizons. The texture of the B't horizon ranges from heavy loamy sand to sandy clay loam. The depth to calcareous material ranges from 32 to 80 inches.

Permeability is moderately rapid in these soils. During wet periods in spring and in fall, however, crops may be damaged because the water table is relatively high. Surface runoff is slow, the available moisture capacity is moderately low in drained areas, and natural fertility is moderately low.

The Otisco soils are finer textured throughout the solum than the Au Gres soils, and they have a B't horizon, which is lacking in the Au Gres soils. They are coarser textured than the Coral soils, which formed in sandy loam. The Otisco soils are in the drainage sequence that includes the well drained and moderately well drained Montcalm soils and the poorly drained and very poorly drained Edmore soils.

Otisco loamy sand, 0 to 2 percent slopes (OcA).—This soil is on nearly level uplands. In some small areas, the surface layer is thicker, darker colored, and somewhat higher in organic-matter content than that of the soil described as typical of the series. Within some of the areas mapped are small depressions in which the Edmore soils occur.

A large acreage is used for such crops as corn, small grain, beans, and hay. The rest is in permanent pasture or farm woodlots. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Otisco loamy sand, 2 to 6 percent slopes (OcB).—This soil is on undulating to gently sloping uplands. In most areas the slope is less than 4 percent. In places material from the grayish-brown subsurface layer is mixed with the surface soil. Small areas of Otisco loamy sand, 0 to 2 percent slopes, were included in some of the areas mapped.

Most of this soil is used for crops. The crops commonly grown are corn, small grain, beans, and hay. The rest of the acreage is in pasture or farm woodlots. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Otisco sandy loam, 0 to 2 percent slopes (OtA).—This soil is on nearly level uplands. The surface layer is finer textured than that of the soil described as typical of the series, and in some small areas it is thicker, darker colored, and somewhat higher in organic-matter content. Included in some of the areas mapped are small depressions in which the poorly drained and very poorly drained Edmore soils occur.

A large acreage is used mainly for corn, small grain, beans, and hay. The rest is in permanent pasture or farm woodlots. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Otisco sandy loam, 2 to 6 percent slopes (OtB).—This soil is on undulating to gently sloping uplands. It has a finer textured surface layer than the soil described as typical of the series, and in some places material from the grayish-brown subsurface layer is mixed with the surface soil. Small areas of Otisco sandy loam, 0 to 2 percent slopes, were included in some of the areas mapped.

Most of this soil is cultivated. The crops commonly grown are corn, small grain, beans, and hay. The remaining areas are in pasture or farm woodlots. Excess wetness, moderately low natural fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Owosso Series

The Owosso series consists of well drained and moderately well drained soils that formed in 18 to about 42 inches of sandy loam outwash or till over loam or light clay loam till. The solum extends into the loam or clay loam till. These soils are on the nearly level to strongly sloping parts of moraines and till plains. The native vegetation consisted chiefly of oak, hickory, beech, and maple.

Typical profile of Owosso sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) sandy loam; weak, coarse, granular structure; friable; medium acid; gradual, wavy boundary.

B1—12 to 32 inches, dark-brown (10YR 4/3) sandy loam; weak, coarse, granular structure; friable; medium acid; clear, wavy boundary.

IIBt—32 to 40 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, coarse, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

IIC—40 inches +, brown (10YR 5/3) loam; weak, coarse, subangular blocky structure; friable; calcareous.

In undisturbed areas there is a 2- to 4-inch very dark gray (10YR 3/1) A1 horizon. The Ap horizon ranges to very dark grayish brown (10YR 3/2) in color and from 6 to 10 inches in thickness. The color of the A2 horizon ranges to yellowish brown (10YR 5/4). In some areas the B1 horizon is brown (10YR 5/3), dark yellowish brown (10YR 4/4) or brown (7.5YR 4/4). The IIBt horizon ranges to brown (7.5YR 4/4) or yellowish brown (10YR 5/4) in color, and to silty clay loam in texture. The reaction of the solum ranges from slightly acid to strongly acid. The texture of the IIC horizon ranges to silt loam or light clay loam.

Surface runoff is medium on the mild slopes and rapid on the strong slopes. Permeability and the available moisture capacity are moderate, and natural fertility is medium.

The Owosso soils are in the drainage sequence that includes the somewhat poorly drained Metamora soils. They are coarser textured in the upper part of the B horizon than the Miami, Celina, and Kendallville soils, and they are finer textured in the lower part of the B horizon and in the C horizon than the Lapeer soils.

In Ionia County, the Owosso soils are mapped as complexes with the Miami soils.

Perrin Series

The Perrin series consists of moderately well drained soils that formed in sandy loam, loamy sand, and loam outwash. These soils are underlain at a depth of 24 to 42 inches by calcareous stratified sand and gravel. They occur on level to gently sloping outwash plains, mainly in the southern part of the county. The native vegetation was forest consisting largely of oak, beech, and hickory.

Typical profile of Perrin loamy sand:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loamy sand; very weak, fine, granular structure; friable; medium organic-matter content; medium acid; abrupt, smooth boundary.

A2—8 to 11 inches, brown (10YR 5/3) loamy sand; weak, fine, granular structure; very friable; medium acid; clear, smooth boundary.

B21—11 to 22 inches, brown (10YR 5/3) sandy loam; moderate, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B22—22 to 26 inches, brown (10YR 5/3) sandy loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B23—26 to 33 inches, yellowish-brown (10YR 5/4) sandy clay loam; common, medium, faint, brownish-yellow (10YR 6/8) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

IIC—33 inches +, light yellowish-brown (10YR 6/4) sand and fine gravel; common, fine, faint, yellowish-brown (10YR 5/8) mottles; single grain; loose; calcareous.

The texture of the B horizon ranges from sandy loam to heavy loamy sand or sandy clay loam. Where the B horizon is sandy clay loam, it is less than 10 inches thick.

Surface runoff is slow, permeability is moderately rapid, the available moisture capacity is moderately low, and natural fertility is medium.

The Perrin soils are in the drainage sequence that includes the well-drained Boyer soils, the somewhat poorly drained Wasepi soils, and the poorly drained and very poorly drained Gilford soils. They have a coarser textured B horizon than the Ionia soils, and they are sandier than the Cadmus soils, which are underlain by loam to silty clay loam.

Perrin loamy sand, 0 to 2 percent slopes (PdA).—This soil generally is similar to the soil described as typical of the series. It occurs on the level and nearly level tops of low hills and terraces, along rivers and creeks. In places there are sufficient stones and cobblestones to hinder tillage. These areas are indicated on the soil map by stone symbols. Included in several of the areas mapped are small areas of the Wasepi soils.

Most of this soil is used for corn, wheat, alfalfa, and pasture. A small acreage is in farm woodlots. Moderately low available moisture capacity and moderately rapid permeability are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group M; wildlife suitability group 5)

Perrin loamy sand, 2 to 6 percent slopes (PdB).—This soil is mainly on the gentle slopes of low hills and terraces, along rivers and creeks. In several small areas, the surface layer is thicker than 8 inches because of an accumulation of soil material that washed from higher areas. In places there are sufficient stones and cobblestones to hinder tillage. These areas are indicated on the soil map by stone symbols. Small areas of the Boyer soils are included in many of the areas mapped.

Most of this soil is used for corn, wheat, alfalfa, and pasture. A small acreage is in farm woodlots. Moderately rapid permeability and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Perrin loamy sand, 2 to 6 percent slopes, moderately eroded (PdB2).—This soil is on the gentle slopes of low hills and terraces, along rivers and creeks. Most of the original surface layer has been lost through erosion, and the present surface layer is brown loamy sand. In some areas there are sufficient stones and cobblestones to hinder tillage. These areas are indicated on the soil map by stone symbols. Included in many of the areas mapped are small areas of the Boyer soils.

Most of this soil is used for corn, wheat, alfalfa, and pasture. Moderately low available moisture capacity and moderately rapid permeability are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Perrin sandy loam, 0 to 2 percent slopes (PeA).—This soil is on the level tops of low hills and terraces, along rivers and creeks. In many areas the sandy clay loam fourth layer approaches 10 inches in thickness. Small areas of the Wasepi soils were included in several of the areas mapped.

Most of this soil is used for corn, wheat, alfalfa, and pasture. Moderately rapid permeability and moderately low available moisture capacity are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group M; wildlife suitability group 5)

Perrin sandy loam, 2 to 6 percent slopes (PeB).—This soil is on the gentle slopes of low hills and terraces, along rivers and creeks. In most areas, the sandy loam fourth layer approaches 10 inches in thickness. Small areas of the Boyer soils were included in many of the areas mapped.

Most of this soil is used for corn, wheat, alfalfa, and pasture. Moderately rapid permeability and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group M; wildlife suitability group 5)

Pewamo Series

Soils of the Pewamo series formed in calcareous clay loam or silty clay loam till in level areas and depressions on till plains and low moraines. These soils are widely distributed throughout the southern two-thirds of the county. The larger areas, however, occur in the eastern part. The native vegetation was hardwood forest consisting largely of water maple, elm, basswood, and ash.

Typical profile of Pewamo clay loam:

Ap—0 to 8 inches, very dark gray (10YR 3/1) clay loam; moderate, medium, granular structure; firm; high organic-matter content; neutral; abrupt, smooth boundary.

A12—8 to 12 inches, very dark gray (10YR 3/1) clay loam; few, medium, distinct, olive-brown (2.5Y 4/2) mottles; strong, medium, angular blocky structure; firm; mildly alkaline; clear, wavy boundary.

Bg—12 to 40 inches, grayish-brown (2.5Y 5/2) heavy clay loam; common, medium, distinct, olive-brown (2.5Y 4/4) mottles; strong, medium, angular blocky structure; firm; moderately alkaline; abrupt, wavy boundary.

C—40 inches +, olive-brown (2.5Y 4/4) clay loam; common, medium, faint, dark grayish-brown (2.5Y 4/2) mottles; weak, coarse, angular blocky structure; firm; calcareous.

The texture of the Bg horizon ranges from clay loam to silty clay loam or light silty clay. The solum ranges from slightly acid to mildly alkaline in reaction and from 30 to 60 inches in thickness.

Surface runoff is very slow or ponded, permeability is moderately slow, and the available moisture capacity and natural fertility are high.

The Pewamo soils are finer textured throughout the solum than the Brookston soils. They are in the drainage sequence that includes the well drained and moderately well drained Morley soils and the somewhat poorly drained Blount soils.

Pewamo clay loam (0 to 1 percent slopes) (Pm).—This soil is on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways. In some small areas moderately dark colored soil material that washed from surrounding more sloping soils has formed a thin surface layer only 2 to 6 inches thick. Included in many of the areas mapped are small scattered areas of the Brookston soils.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots or permanent pasture. Wetness and moderately slow permeability are limitations. (Soil management unit 1.5cA (I); woodland suitability group P; wildlife suitability group 4)

Pewamo loam (0 to 1 percent slopes) (Pn).—This soil is on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways. In some small areas moderately dark colored soil material that washed from surrounding more sloping soils has formed a thin surface layer only 2 to 6 inches thick. In some areas the surface layer is silt loam. Included in many of the areas mapped are small scattered areas of the Brookston soils.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots or permanent pasture. Wetness and moderately slow permeability are limitations. (Soil management unit 1.5cA (I); woodland suitability group P; wildlife suitability group 4)

Plainfield Series, Slightly Acid Variant

The Plainfield series, slightly acid variant, consists of well-drained soils that formed in deep, slightly acid to calcareous sands. These soils are on nearly level to gently sloping outwash plains or old glacial drainageways and on the nearly level to strongly sloping parts of moraines. Although they are widely distributed throughout the northern half of the county, the total acreage is small. The native vegetation consisted mainly of oaks and some scattered white pine and red pine.

Typical profile of Plainfield sand, slightly acid variant:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) sand; medium organic-matter content; single grain; loose; medium acid; abrupt, wavy boundary.
C1—9 to 12 inches, brown (10YR 5/3) sand; single grain; loose; slightly acid; gradual, wavy boundary.
C2—12 to 15 inches, yellowish-brown (10YR 5/4) sand; single grain; loose; slightly acid; gradual, wavy boundary.
C3—15 to 30 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; slightly acid; gradual, wavy boundary.
C4—30 to 48 inches, brownish-yellow (10YR 6/6) sand; single grain; loose; slightly acid; clear, wavy boundary.
C5—48 inches +, yellowish-brown (10YR 5/4) sand; single grain; loose; neutral.

The consistence of the C3 and C4 horizons ranges from very friable to loose. In some areas there is fine gravel in the lower horizons.

Surface runoff is very slow, permeability is very rapid, and natural fertility and the available moisture capacity are low.

The Plainfield soils, slightly acid variant, lack the thin and commonly discontinuous Bt horizons common to the Spinks soils.

Plainfield sand, slightly acid variant, 0 to 6 percent slopes (PoB).—This soil is on broad nearly level to undulating ridgetops and valley plains, on the uplands. In most areas it is similar to the soil described as typical of the series. In places, however, the surface layer contains slightly more organic matter than that of the soil described and is slightly darker colored. Some areas are stony. These areas are indicated on the soil map by stone symbols. Included in the areas mapped are small depressions in which the Granby soils occur and small areas of the Spinks soils.

This soil is used mainly for pasture or hay. A few small areas are used for corn, small grain, beans, and other general farm crops. Low natural fertility and low available moisture capacity are the major limitations. (Soil management unit 5aAB (IVs); woodland suitability group E; wildlife suitability group 7)

Plainfield sand, slightly acid variant, 6 to 12 percent slopes, moderately eroded (PoC2).—This soil is on short rounded slopes adjacent to rivers and creeks. In most areas the surface layer is pale-brown sand. There are a few areas in which it is loamy sand. Shallow gullies have formed in some places. Included in mapping were small areas of the Spinks soils.

Most of this acreage is idle or in second-growth forest and shrubs. Low natural fertility and low available moisture capacity are the major limitations. (Soil management unit 5aC (VIs); woodland suitability group E; wildlife suitability group 7)

Plainfield sand, slightly acid variant, 12 to 18 percent slopes, moderately eroded (PoD2).—This soil is on short convex slopes on the uplands, and on short slopes adjacent to valleys and lowlands. The surface layer commonly is pale-brown sand. However, in some small areas it is loamy sand, and in others the yellowish-brown layer is exposed over much of the area. Shallow gullies have formed in some places.

Most of this soil is idle or under a cover of wild vegetation. Low natural fertility and low available moisture capacity are the major limitations. (Soil management unit 5aD (VIIs); woodland suitability group E; wildlife suitability group 7)

Plainfield sand, slightly acid variant, 18 to 25 percent slopes, moderately eroded (PoE2).—This soil is on short convex slopes on the uplands, and on short slopes adjacent to rivers and creeks. The surface layer is pale-brown sand. Included in the areas mapped are small areas that have a gradient of more than 25 percent, and small areas of Spinks soils.

Most of this soil is idle. Trees have been planted in some areas. Low available moisture capacity, low natural fertility, and moderately steep slopes are the major limitations (Soil management unit 5aEF (VIIs); woodland suitability group E; wildlife suitability group 7)

Rifle Series

In the Rifle series are soils that formed in deep, medium to very strongly acid organic deposits consisting largely of woody materials, reeds, sedges, and grasses. These soils occur in small level areas and in slight depressions on outwash plains, lake plains, till plains, and moraines. They are widely distributed throughout the county. The native vegetation consisted mainly of elm, ash, tamarack, red maple, white cedar, aspen, and willow.

Typical profile of Rifle muck:

1—0 to 10 inches, black (10YR 2/1) muck; weak, medium, granular structure; friable; mixed woody and fibrous materials; slightly acid; gradual, wavy boundary.
2—10 to 19 inches, dark-brown (10YR 4/2) peat; moderate, medium, granular structure; friable; mixed woody and fibrous materials; strongly acid; clear, wavy boundary.
3—19 to 24 inches, yellowish-brown (10YR 5/4) fibrous peat; weak, thick, platy structure; friable; medium acid.

The combined thickness of the No. 1 and No. 2 horizons ranges from 4 to 20 inches. These horizons generally contain a large amount of woody material, and in many places there are partly decomposed logs. In some areas, however, the amount of woody material in the No. 1 and No. 2 horizons is small.

Unless the Rifle soils are artificially drained, the water table remains near the surface much of the time. Surface runoff is very slow or ponded, permeability is moderate, and the available moisture capacity is high. Nat-

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ural fertility is only moderately high because of the unbalanced proportions of essential plant nutrients. Wind erosion is a hazard if these soils are cleared.

The Rifle soils differ from the Tawas, Linwood, and Willette soils in that they are less decomposed, slightly more strongly acid, and thicker than 42 inches to the mineral substratum. They are more strongly acid and less decomposed than the Carlisle and Lupton soils.

Rifle muck (Rm).—This soil is on swampy flats on the lowlands. In places, it is closely associated with Carlisle muck, and small areas of the Carlisle soil were included in a few of the areas mapped.

Drained areas are used for onions and potatoes. A large acreage is wooded, and a small acreage is in hay. Excess wetness, wind erosion, and unbalanced natural fertility are the major limitations. (Soil management unit McA (IIIw); woodland suitability group J; wildlife suitability group 8)

Saranac Series

The Saranac series consists of poorly drained and very poorly drained soils that formed in deep, medium or heavy clay loam or silty clay loam alluvium that washed from calcareous glacial drift. These soils are relatively extensive along the Grand and Maple Rivers.

Typical profile of Saranac clay loam:

Ap—0 to 8 inches, very dark gray (10YR 3/1) clay loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A12—8 to 10 inches, very dark gray (10YR 3/1) clay loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; firm; calcareous; gradual, wavy boundary.

Bg—10 to 20 inches, dark-gray (N 4/0) silty clay loam; common, medium, distinct, dark-brown (7.5YR 4/4) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; firm; calcareous; diffused, smooth boundary.

Cg—20 to 66 inches +, gray (5Y 5/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4), strong-brown (7.5YR 5/6), and yellowish-red (5YR 5/8) mottles; weak, coarse, subangular blocky structure grades to massive in the lower part; firm; calcareous.

Unless the Saranac soils are drained, the water table is near the surface much of the time. Surface runoff is very slow or ponded. Flooding is a problem. Permeability is moderately slow, and the available moisture capacity and fertility are moderately high. These soils dry out slowly in spring, and farm machinery readily bogs down if the soils are farmed.

The Saranac soils formed in finer textured alluvium than the Sloan soils. They are in the drainage sequence that includes the somewhat poorly drained Shoals soils, heavy subsoil variant.

Saranac clay loam (0 to 1 percent slopes) (Sa).—This soil is on low-lying flats and in depressions on flood plains, along rivers and creeks. Although the surface layer is dominantly clay loam, in a few areas it is silty clay loam. Thin layers of sandy material commonly occur below a depth of 50 inches, and in some places there is a very dark gray buried layer below a depth of 40 inches. Included in the areas mapped are small slightly elevated swells or benches on which Shoals clay loam, heavy subsoil variant, occurs.

Most of this soil is cleared. Adequately drained areas are used principally for corn and soybeans. Some areas are used for hay or pasture, and small areas are in farm woodlots or permanent pasture. Excess wetness and occasional flooding are the major limitations. (Soil management unit L–2cA (IIIw); woodland suitability group O; wildlife suitability group 4)

Saranac silt loam (0 to 1 percent slopes) (Sc).—This soil is on low-lying flats and in depressions on flood plains, along rivers and creeks. The surface layer in most areas is silt loam. In a few small areas it is loam. Thin layers of sandy material commonly occur below a depth of 50 inches. In places there are sufficient stones to severely limit the use of this soil for crops. These areas are indicated on the soil map by stone symbols. Included in mapping were some low benches on which the lighter colored, somewhat poorly drained Shoals soils occur.

Most of this soil is cleared. Adequately drained areas are used principally for corn and soybeans. Some areas are used for hay or pasture, and small areas are in farm woodlots or permanent pasture. Excess wetness and occasional flooding are the major limitations. (Soil management unit L–2cA (IIIw); woodland suitability group O; wildlife suitability group 4)

Sebewa Series

The Sebewa series consists of poorly drained and very poorly drained soils that formed in calcareous silty and loamy outwash material that is from 24 to 42 inches thick over stratified calcareous sand and gravel. These soils are in level areas and depressions on outwash plains, valley trains, and moraines. They are fairly widely distributed throughout the southern two-thirds of the county. The native vegetation was hardwood forest consisting mainly of elm, ash, shagbark hickory, maple, and swamp white oak.

Typical profile of Sebewa loam:

Ap—0 to 10 inches, black (10YR 2/1) loam; moderate, fine, granular structure; friable; high organic-matter content; slightly acid; abrupt, smooth boundary.

B21g—10 to 13 inches, dark-gray (10YR 4/1) light clay loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; strong, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B22g—13 to 18 inches, dark grayish-brown (10YR 4/2) clay loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; thin clay films on numerous peds; neutral; gradual, wavy boundary.

B23g—18 to 36 inches, grayish-brown (2.5Y 5/2) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIC—36 inches +, grayish-brown (2.5Y 5/2) stratified sand and gravel; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; calcareous.

The color of the Ap horizon ranges from black (10YR 2/1) to very dark gray (10YR 3/1) or very dark brown (10YR 2/2). In some areas there is a very dark gray (10YR 3/1) A12 horizon, 2 to 5 inches thick, below the Ap horizon. The B21g horizon ranges from heavy loam to light clay loam or gravelly clay loam, the B22g horizon, from sandy clay loam to gravelly clay loam or clay loam; and the B23g horizon, from heavy sandy loam to

loam, gravelly clay loam, or clay loam. The texture of the IIC horizon ranges from stratified sand and gravel to dominantly sand or dominantly gravel.

Surface runoff is very slow or ponded. Permeability is moderate in the solum and rapid in the substratum. The available moisture capacity is moderate, and natural fertility is moderately high.

The Sebewa soils are in the drainage sequence that includes the well drained Fox soils, the moderately well drained Ionia soils, and the somewhat poorly drained Matherton soils. They are finer textured throughout the solum than the Gilford soils, and they contain more gravel than the Berville soils, which are underlain by loam to silty clay loam.

Sebewa loam (0 to 1 percent slopes) (Sd).—This soil is on broad flats or in basins and swales on the valley plains, and in swales and narrow depressions bordering natural drainageways on high terraces. The surface layer is dominantly loam. In some areas, however, it contains a high percentage of silt, and in others it is sandy loam. In a few small areas moderately dark-colored material that washed from surrounding more sloping soils has formed a surface layer only 2 to 6 inches thick, and in places there is a thin layer of black muck on the surface. Included in mapping were small areas of the more sandy Gilford soils.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, soybeans, white beans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots or permanent pasture. Excess wetness is a major limitation. (Soil management unit 3cA (IIw); woodland suitability group W; wildlife suitability group 2)

Selkirk Series

The Selkirk series consists of somewhat poorly drained soils that formed in reddish or pinkish calcareous silty clay or clay till. These soils are on the level to gently sloping parts of till plains and low moraines. They are fairly widely distributed throughout the northern third of the county. The native vegetation consisted of mixed stands of hardwoods and conifers, mainly maple, ash, beech, elm, ironwood, and some white cedar, white pine, and red pine.

Typical profile of Selkirk silt loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; friable; medium organic-matter content; slightly acid; abrupt, smooth boundary.

A2g—7 to 11 inches, light brownish-gray (10YR 6/2) silt loam; common, fine, faint, yellowish-brown (10YR 5/4) mottles in the lower part; moderate, medium, platy structure; friable; slightly acid; clear, wavy boundary.

Bt—11 to 21 inches, brown (7.5YR 5/4) silty clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; strong, medium, angular blocky structure; very firm; slightly acid; abrupt, irregular boundary.

Cg—21 to 66 inches, reddish-gray (5YR 5/2) silty clay; many, coarse, distinct, strong-brown (7.5YR 5/6) mottles; strong, medium, angular blocky structure; plastic when wet, very firm when moist, hard when dry; calcareous.

The depth to mottling ranges from 7 to 15 inches. The Bt horizon is reddish brown (5YR 5/4) in some areas. The depth to the Cg horizon ranges from 14 to 25 inches. The loamy sand type represents soils that have a thin deposit of loamy sand over the clay or silty clay.

Surface runoff is low, permeability is slow or very slow, natural fertility is moderately high, and the available moisture capacity is high.

The Selkirk soils are in the drainage sequence that includes the well drained and moderately well drained Kent soils and the very poorly drained Bergland soils. They are finer textured throughout the solum than the Kawkawlin soils.

Selkirk loamy sand, 0 to 2 percent slopes (SeA).—This soil is in narrow level or nearly level areas on the uplands. It commonly occurs as low isolated flats that are at slightly higher elevations than adjacent low swampy areas and areas of deep sand. The surface layer of loamy sand is from 7 to 12 inches thick over clay or silty clay. This soil commonly is associated with the Montcalm, Chelsea, and Mancelona soils. Included in the areas mapped are small shallow depressions in which the Bergland soils occur.

Most of this soil is cleared. Adequately drained areas are used principally for corn, wheat, oats, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness, a fluctuating water table, and slow or very slow permeability are the major limitations. (Soil management unit 1bAB (IIIw); woodland suitability group Z; wildlife suitability group 4)

Selkirk silt loam, 0 to 2 percent slopes (SfA).—This soil is on narrow flat ridgetops and in shallow swales on the uplands, generally adjacent to broad drainageways and low swampy areas. The surface layer commonly is very dark grayish-brown silt loam and contains a moderate amount of organic matter. In a few small areas it is loam. Included in most of the areas mapped are small areas of the Bergland soils that occur in small shallow depressions.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness, a fluctuating water table, and slow or very slow permeability are the major limitations. (Soil management unit 1bAB (IIIw); woodland suitability group Z; wildlife suitability group 4)

Shallow Sandy Land

Shallow sandy land (Sg).—This miscellaneous land type consists of well drained and moderately well drained soils that formed in loamy sand and sand, underlain by sandstone bedrock at a depth of 7 to 30 inches. The native vegetation consisted mainly of oaks and hickory. Only one area occurs in the county. This area is on gently sloping high terraces along the Grand River, about 3 miles east of the town of Ionia.

The individual layers of this soil are thin. Over much of the area the upper layers are loamy sand. These commonly are underlain at a depth of about 16 inches by light sandy loam. The upper part of the solum has weak granular structure, and in places contains numerous rounded stones and pebbles. The lower part is loose to massive. The color ranges from very dark gray in the

uppermost 2 inches to red at a depth of about 7 inches. The reaction ranges from neutral in the uppermost 2 inches to medium acid below a depth of about 4 inches. The depth to sandstone bedrock ranges from 7 to 30 inches but generally is about 24 inches. Where bedrock is at a depth of about 30 inches, there commonly is a perched water table. The sandstone ordinarily is soft and powdery in the uppermost 2 or 3 inches.

Surface runoff is slow or very slow, permeability is rapid, and the available moisture capacity and natural fertility are low.

All of this acreage is wooded. Droughtiness, low natural fertility, and shallowness to bedrock are the major limitations. (Soil management unit 4/RaB (IVs); woodland suitability group C; wildlife suitability group 5)

Shoals Series

The Shoals series consists of somewhat poorly drained soils that formed in deep stratified silt loam, light clay loam, or light silty clay loam on nearly level flood plains. These soils are widely scattered throughout the county, but most areas are small. The native vegetation consisted mainly of elm, ash, beech, sycamore, swamp white oak, and hickory.

Typical profile of Shoals loam:

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

C1—10 to 24 inches, dark yellowish-brown (10YR 4/4) silt loam; common, fine, distinct, light yellowish-brown (10YR 6/4) mottles; weak, medium, granular structure; friable; mildly alkaline; gradual, wavy boundary.

C2—24 to 36 inches, pale-brown (10YR 6/3) loam; common, fine, distinct, brownish-yellow (10YR 6/8) mottles; weak, fine, granular structure; friable; mildly alkaline; gradual, wavy boundary.

C3—36 to 49 inches, very pale brown (10YR 7/3) silt loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, fine, granular structure; friable; mildly alkaline; gradual, wavy boundary.

C4g—49 inches +, light brownish-gray (10YR 6/2) loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, fine, granular structure; friable; numerous very dark brown (10YR 2/2) organic concretions; calcareous.

In some areas the Ap horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2). Below the surface layer, the texture ranges from loam to silt loam, light clay loam, or light silty clay loam. The depth to the mottling ranges from 6 to 18 inches. In many areas there are very dark brown (10YR 2/2) organic concretions in the C horizon. The Ap and C horizons range from neutral to calcareous in reaction.

Surface runoff is very slow, permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Shoals soils are finer textured than the Ceresco soils. They are in the drainage sequence that includes the well drained Genesee soils, the moderately well drained Eel soils, and the poorly drained and very poorly drained Sloan soils.

In Ionia County, the Shoals soils are mapped as a complex with the Ceresco soils.

Shoals Soils, Heavy Subsoil Variant

Shoals soils, heavy subsoil variant, formed in medium or heavy clay loam or silty clay loam alluvium that washed from areas of highly calcareous glacial drift. These soils are somewhat poorly drained. They occur in level or nearly level areas and in slight depressions on bottom lands along rivers and creeks. Most of the acreage is along the Grand and Maple Rivers. The native vegetation consisted mainly of elm, swamp white oak, poplar, and water maple.

Profile of Shoals clay loam, heavy subsoil variant:

Ap—0 to 10 inches, very dark gray (10YR 3/1) clay loam; moderate, fine, granular structure; friable; mildly alkaline; abrupt, smooth boundary.

C1g—10 to 26 inches, grayish-brown (10YR 5/2) heavy silty clay loam; common, medium, distinct, weak-red (2.5YR 5/2), strong-brown (7.5YR 5/8), and olive (5Y 5/6) mottles; moderate, fine, subangular blocky structure; firm; calcareous; diffuse, wavy boundary.

C2g—26 to 50 inches, grayish-brown (10YR 5/2) heavy silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6–5/8) and yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; calcareous; diffuse, wavy boundary.

C3—50 inches +, light brownish-gray (10YR 6/2) heavy silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/8), yellowish-brown (10YR 5/6), and very pale brown (10YR 7/3) mottles; massive; firm; calcareous.

The depth to mottling ranges from 7 to about 15 inches. Thin strata of clay and loam occur at various depths in the C horizon, and in some areas there are thin strata of sandy material below a depth of 42 inches. Where these soils are closely associated with the typical Shoals soils, the C1g and C2g horizons are medium silty clay loam or medium clay loam and contain several thin layers of heavy loam or heavy silt loam.

Surface runoff is slow, permeability is moderately slow or slow, and natural fertility and the available moisture capacity are moderately high or high.

Shoals soils, heavy subsoil variant, are in the drainage sequence that includes the poorly drained and very poorly drained Saranac soils. They are developing in finer textured alluvium than the typical Shoals soils.

Shoals clay loam, heavy subsoil variant (0 to 1 percent slopes) (Sh).—This soil is on bottom lands along rivers and creeks, commonly on the floor of old oxbows and stream meanders. The surface layer in most places is clay loam. However, there are some small areas, generally slight depressions, in which the surface layer is silty clay loam. In some areas thin layers of sandy material occur below a depth of 42 inches. Included in mapping were some small depressions in which the wetter, darker colored Saranac soils occur.

Most of this soil is cleared. If drainage is adequate, the principal crops are corn, soybeans, and white beans. Oats, wheat, and hay are also grown. Some areas are in farm woodlots or permanent pasture. Excess wetness, lack of organic matter, and occasional flooding are the major limitations. (Soil management unit L–2cA (IIIw); woodland suitability group O; wildlife suitabilty group 4)

Shoals loam, heavy subsoil variant (0 to 1 percent slopes) (Sk).—This soil is on level bottom lands along rivers and creeks. Although the surface layer is dominantly

loam, in a few areas the texture is silt loam. In some areas thin layers of sandy material occur below a depth of 42 inches.

Where this soil is closely associated with the typical Shoals soil, small areas of the Shoals soil were included in mapping. Also included were small depressions in which the wetter, darker colored Saranac soils occur.

Most of this soil is cleared. If drainage is adequate the principal crops are corn, soybeans, and white beans. Oats, wheat, hay, and pasture crops are also grown. Small areas are in farm woodlots or permanent pasture. Excess wetness, lack of organic matter, and occasional flooding are the major limitations. (Soil management unit L–2cA (IIIw); woodland suitability group O; wildlife suitability group 4)

Shoals sandy loam, heavy subsoil variant (0 to 1 percent slopes) (Sl).—This soil is on level bottom lands along rivers and creeks. Some areas adjoin the rivers and creeks. The texture of the surface layer is dominantly sandy loam, but in a few areas it is fine sandy loam. The sandy material extends to a depth of 10 to 12 inches. The underlying layers are clay loam or silty clay loam. Within the areas mapped are small depressions in which the wetter, darker colored Saranac soils occur.

Most of this soil is cleared. If drainage is adequate, the principal crops are corn, soybeans, and white beans. However, this soil is also used for oats, wheat, hay, and pasture. Small areas are in farm woodlots or permanent pasture. Excess wetness, maintenance of organic matter in the surface layer, and occasional flooding are major management problems. (Soil management unit L–2cA (IIIw); woodland suitability group O; wildlife suitability group 4)

Sims Series

In the Sims series are poorly drained and very poorly drained soils that formed in clay loam and silty clay loam till in level and nearly level areas and in slight depressions, on till plains and moraines. These soils are widely distributed throughout the northern third of the county. They developed under hardwood forest consisting largely of water maple, elm, basswood, ash, and swamp white oak.

Typical profile of Sims clay loam:

Ap—0 to 8 inches, very dark brown (10YR 2/2) clay loam; moderate, medium, granular structure; firm; slightly acid; abrupt, smooth boundary.

B21g—8 to 13 inches, light brownish-gray (10YR 6/2) silty clay loam; few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; neutral; gradual, wavy boundary.

B22g—13 to 22 inches, gray (10YR 6/1) silty clay loam; common, medium, distinct, brownish-yellow (10YR 6/6) and yellowish-brown (10YR 5/8) mottles; strong, medium, angular blocky structure; firm; mildly alkaline; gradual, wavy boundary.

B23g—22 to 38 inches, gray (10YR 6/1) heavy silty clay loam; common, medium, distinct, brownish-yellow (10YR 6/6) and brown (10YR 5/3) mottles; strong, coarse, angular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

Cg—38 inches +, gray (10YR 6/1) silty clay loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; massive; firm; calcareous.

In places there is a very dark brown or black layer between the Ap horizon and the B21g horizon. This layer consists of that part of the A1 horizon that is not mixed with the Ap horizon. In some areas the texture of the B23g horizon is clay loam or light silty clay. The depth to the Cg horizon ranges from 20 to about 40 inches.

Surface runoff is very slow or ponded, permeability is moderately slow, and the available moisture capacity and natural fertility are moderately high.

The Sims soils are in the drainage sequence that includes the well drained and moderately well drained Nester soils and the somewhat poorly drained Kawkawlin soils. They have a coarser textured B horizon than the Bergland soils, which are underlain by silty clay or clay, and they are finer textured throughout the solum than the Brookston soils, which are underlain by loam or silt loam.

Sims clay loam (0 to 1 percent slopes) (Sm).—This soil is on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways. The texture of the surface layer is dominantly clay loam, but in some places moderately dark colored soil material that washed from surrounding more strongly sloping soils has formed a thin surface layer only 2 to 6 inches thick. This soil occurs mainly as small areas. Consequently, except for some small scattered areas of the Brookston soils, the areas mapped contain few inclusions of other soils.

Most of this soil is cleared. Adequately drained areas are used principally for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. A few undrained areas are in farm woodlots or permanent pasture. Excess wetness and moderately slow or slow permeability are the major limitations. (Soil management unit 1.5cA (I); woodland suitability group P; wildlife suitability group 4)

Sims loam (0 to 1 percent slopes) (Sn).—This soil is on broad flats, in shallow basins and swales, and in narrow depressions bordering natural drainageways. In some areas, moderately dark colored soil material that washed from surrounding more strongly sloping soils has formed a thin surface layer only 2 to 6 inches thick. The texture of the second and third layers is commonly clay loam. Some of the larger areas mapped include small scattered areas of the Brookston soils.

Most of this soil is cleared. Adequately drained areas are used principally for corn, wheat, oats, white beans, soybeans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness and moderately slow or slow permeability are the major limitations. (Soil management unit 1.5cA (I); woodland suitability group P; wildlife suitability group 4)

Sloan Series

The Sloan series consists of poorly drained and very poorly drained soils that formed in deep stratified loam, silt loam, light clay loam, and light silty clay loam in level or nearly level areas and depressions on bottom lands, along rivers and creeks. These soils are widely scattered throughout the county but are mostly along the Maple and Grand Rivers. The native vegetation consisted mainly of elm, ash, sycamore, and soft maple.

Typical profile of Sloan loam:

Ap—0 to 10 inches, very dark gray (10YR 3/1) loam; weak, fine, granular structure; friable; relatively high organic-matter content; mildly alkaline; abrupt, smooth boundary.

A12—10 to 18 inches, very dark grayish-brown (10YR 3/2) loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, granular structure; friable; mildly alkaline; gradual, wavy boundary.

Bg—18 to 36 inches, gray (10YR 5/1) loam; common, fine, distinct, olive-yellow (2.5Y 6/6) and brownish-yellow (10YR 6/8) mottles; weak, fine, granular structure; friable; mildly alkaline; gradual, wavy boundary.

C1g—36 to 54 inches, gray (10YR 5/1) silt loam; common, medium, distinct, light olive-brown (2.5Y 5/6) and brownish-yellow (10YR 6/8) mottles; weak, fine, granular structure; friable; mildly alkaline; gradual, wavy boundary.

C2g—54 inches +, gray (10YR 6/1) loam; common, medium, distinct, pale-yellow (2.5Y 7/4) and yellowish-brown (10YR 5/8) mottles; weak, fine, granular structure; friable; calcareous.

The combined thickness of the Ap and A12 horizons ranges from 8 to 18 inches. In some areas there are very dark gray (10YR 3/1) organic coats in the Bg horizon. The texture of the Cg horizon ranges from loam or silt loam to light clay loam or light silty clay loam. Thin strata of sand, sandy loam, heavy clay loam, or heavy silty clay loam occur below a depth of 30 inches in the C1g and C2g horizons. The reaction of the C1g and C2g horizons ranges from mildly alkaline to calcareous.

Surface runoff is very slow or ponded, permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Sloan soils are finer textured than the Cohoctah soils and are coarser textured than the Saranac. They are in the drainage sequence that includes the well drained Genesee soils, the moderately well drained Eel soils, and the somewhat poorly drained Shoals soils.

In Ionia County the Sloan soils are mapped as complexes with the Cohoctah soils.

Spinks Series

In the Spinks series are well-drained soils that formed in calcareous or neutral loamy sand, fine sand, and sand drift. These soils are in nearly level or gently sloping areas on outwash plains or old glacial drainageways and on the nearly level to steep parts of moraines. They are widely distributed throughout the southern part of the county, generally below a line southwest across the county, along the Maple and Grand Rivers. The native vegetation was forest consisting mostly of northern hardwoods and some white pine.

Typical profile of Spinks loamy sand:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; medium organic-matter content; slightly acid; abrupt, smooth boundary.

A2—7 to 25 inches, brown (10YR 5/3) loamy sand; single grain; loose; slightly acid; abrupt, irregular boundary.

B21t—25 to 30 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, irregular boundary.

A2&B2t—30 to 55 inches, light yellowish-brown (10YR 6/4) fine sand (representing the A2 horizon) alternating with thin, ½- to 4-inch, discontinuous bands of dark yellowish-brown (10YR 4/4) heavy loamy sand or light sandy loam (representing the B2 horizon); the A2 material is single grain and loose; the B2 material is massive and friable; slightly acid; clear, wavy boundary.

C—55 inches +, light yellowish-brown (10YR 6/4) loamy sand; single grain; loose; neutral.

The depth to the B21t horizon ranges from 20 to 55 inches but is dominantly between 24 and 40 inches. The combined thickness of the B2t horizons ranges from 3 to 20 inches. The solum ranges from medium acid to mildly alkaline in reaction, and the C horizon from neutral to calcareous. The depth to the C horizon ranges from 30 to 66 inches.

Surface runoff is slow to medium, permeability is moderately rapid or rapid, the available moisture capacity is moderately low or low, and natural fertility is low.

The Spinks soils are associated with the Boyer and Lapeer soils and with the Plainfield soils, slightly acid variant. They have a coarser textured, less developed B horizon than the Boyer and are underlain by loamy sand or fine sand instead of stratified sand and gravel. The Spinks soils are coarser textured throughout the solum than the Lapeer soils, which are underlain by sandy loam. They are finer textured than the Plainfield soils, slightly acid variant.

Spinks loamy sand, 0 to 2 percent slopes (SpA).—This soil is on outwash plains and in old glacial drainageways (fig. 6). The water table is nearer the surface in this soil than in the more strongly sloping Spinks soils. Consequently, in dry years, crops ordinarily are less affected by the moderately low available moisture capacity.

Most of this soil is used for corn, small grain, field beans, meadow crops, and other general farm crops. A few small areas are forested. Moderately low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aA (IIIs); woodland suitability group E; wildlife suitability group 5)

Spinks loamy sand, 2 to 6 percent slopes (SpB).—A profile of this soil is like the one described as typical of the series. This soil occurs mainly on outwash plains and moraines.

Most of the acreage is cultivated, some areas are used for pasture, and a few areas are forested. The crops commonly grown are corn, small grain, field beans, and meadow crops. Low natural fertility and moderately low available moisture capacity are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group E; wildlife suitability group 5)

Spinks loamy sand, 2 to 6 percent slopes, moderately eroded (SpB2).—This soil occurs mainly on outwash plains and moraines. The present surface layer consists of a mixture of remnants of the original dark grayish-brown surface soil and material from the brown subsurface layer. It is more yellow in color and contains less organic matter than that of the soil described as typical of the series. In some small areas, shallow gullies have formed, and in these the brown subsurface layer is exposed.

Most of this soil is used for corn, small grain, field beans, meadow crops, and other general farm crops. Moderately low available moisture capacity and low natural fertility are the major limitations. (Soil management unit 4aB (IIIs); woodland suitability group E; wildlife suitability group 5)

Spinks loamy sand, 6 to 12 percent slopes, moderately eroded (SpC2).—This soil occurs on the sloping parts of moraines. The slopes are irregular and are seldom more

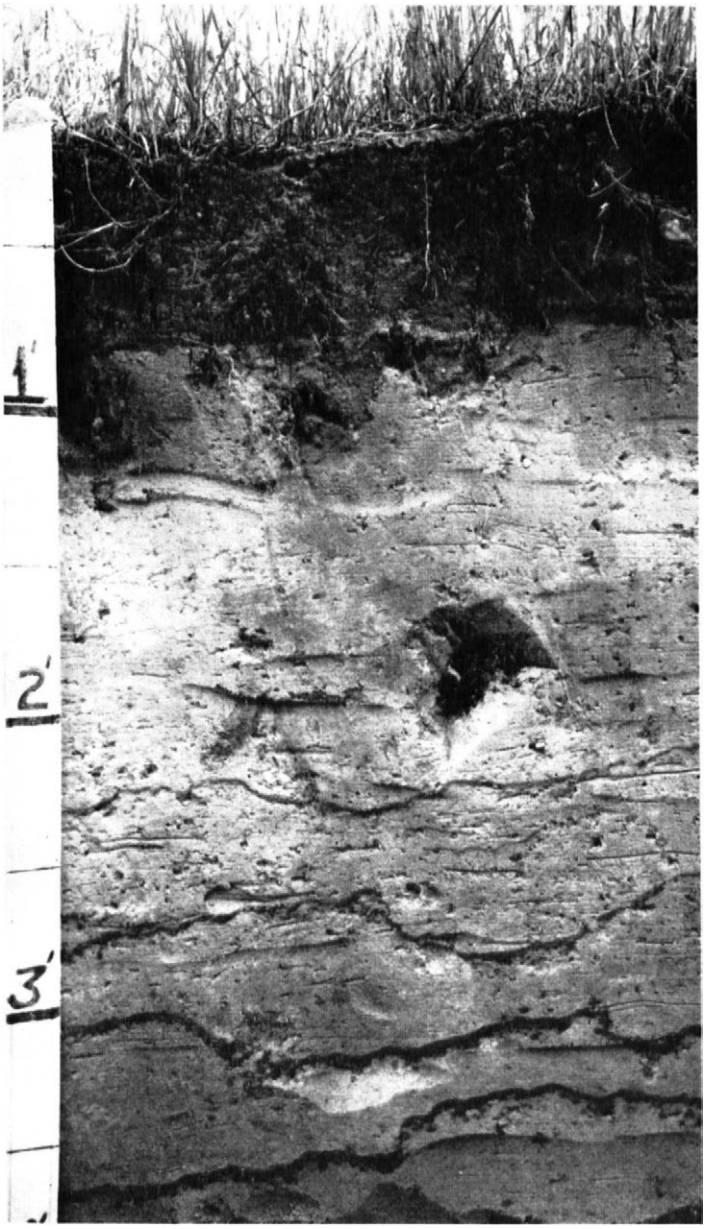

Figure 6.—**Profile of Spinks loamy sand. When dry and not protected by vegetation, this droughty soil is subject to wind erosion.**

than 150 feet in length. A large part of the original surface layer has been removed by erosion. The present surface layer consists of a mixture of the remaining dark grayish-brown surface soil and material from the brown subsurface layer. In some places there are shallow gullies in which the brown subsurface layer is exposed. Included in the areas mapped are a few uneroded areas in which the surface layer is darker colored than that of this soil.

This soil is used mainly for corn, small grain, and meadow crops. Some areas are used for pasture. A considerable acreage has been abandoned and is in various stages of reforestation. Susceptibility to erosion, moderately low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 4aC (IIIe); woodland suitability group E; wildlife suitability group 5)

Spinks loamy sand, 6 to 12 percent slopes, severely eroded (SpC3).—This soil is on the sloping parts of moraines. All of the original surface layer and a considerable part of the subsurface layer have been lost through erosion. The present surface layer is brown loamy sand that contains little organic matter. In many areas there are deep gullies in which the dark-brown subsoil commonly is exposed.

Although most of this soil is no longer cultivated, much of the acreage is pastured. Abandoned areas are gradually reforesting. Pine has been planted in a few areas. The severe erosion, moderately low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 4aC3 (IVe); woodland suitability group E; wildlife suitability group 5)

Spinks loamy sand, 12 to 18 percent slopes, moderately eroded (SpD2).—This soil is on strongly sloping uplands. Erosion has removed a large part of the surface layer. The present surface layer is a brown loamy sand that consists of a mixture of the remaining dark grayish-brown surface layer and material from the brown subsurface layer. Included in a few of the areas mapped are small uneroded wooded areas.

Much of this soil is pastured. A few areas are used for small grain. Some areas have been abandoned and are gradually reforesting. Susceptibility to erosion, moderately low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 4aD (IVe); woodland suitability group E; wildlife suitability group 5)

Spinks loamy sand, 12 to 18 percent slopes, severely eroded (SpD3).—This soil is on strongly sloping uplands. All of the original surface layer and a considerable part of the subsurface layer have been lost through erosion. The present surface layer is brown loamy sand and contains little organic matter. Numerous gullies have formed in some areas, and in many places the dark-brown subsoil is exposed.

This soil is no longer cultivated. Although some areas are used for limited pasture, many areas have been abandoned. Pine has been planted in some places. The severe erosion, moderately low available moisture capacity, and low natural fertility are the major limitations. (Soil management unit 4aD3 (VIe); woodland suitability group E; wildlife suitability group 5)

Tawas Series

In the Tawas series are very poorly drained soils that formed in mixed organic deposits consisting largely of woody materials, reeds, sedges, and grasses. These deposits are from 12 to 42 inches thick over sand, loamy sand, and fine gravel. The Tawas soils occur mainly in level areas and in slight depressions on lake plains, outwash plains, till plains, and moraines. Although they are widely distributed throughout the county, the major part of the total acreage is in the southern part. The native vegetation consisted principally of soft maple, elm, ash, and an understory of reeds, grasses, and sedges.

Typical profile of Tawas muck:

1—0 to 12 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; contains numerous fragments of partially decomposed woody materials; slightly acid; gradual, wavy boundary.
2—12 to 20 inches, very dark grayish-brown (10YR 3/2) muck; weak, coarse, granular structure; friable; numerous fragments of various sized pieces of partially decomposed wood and remains of a few recognizable fibrous plants; slightly acid; gradual, wavy boundary.
3—20 to 32 inches, dark yellowish-brown (10YR 4/4) peat; weak, thick, platy structure; friable; primarily fibrous organic material and some woody material; slightly acid; abrupt, wavy boundary.
IIC—32 inches +, very pale-brown (10YR 7/3) sand; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; mildly alkaline.

In places the color of horizon No. 1 is very dark brown (10YR 2/2). In some areas both the No. 2 and No. 3 horizons are peat, and in others both are muck. The texture of the IIC horizon ranges from sand to loamy sand, loamy fine sand, or fine gravel. The reaction of the organic material ranges from medium acid to neutral.

Surface runoff is very slow or ponded, permeability is moderately rapid, and the available moisture capacity is high. Natural fertility is only moderately high because of the unbalanced proportion of essential plant nutrients. Wind erosion is a hazard if these soils are cleared.

The Tawas soils are underlain by sand, loamy sand, or fine gravel, whereas the Linwood and Willette soils are underlain by loam and clay loam respectively. In the Tawas soils, the depth to the mineral substratum is 12 to 42 inches, and in the Carlisle soils, it is more than 42 inches.

Tawas muck (0 to 1 percent slopes) (To).—This soil is in potholes or swales on the uplands and on swampy flats on the lowlands. A few very small areas are gently sloping. Where the depth to the underlying sand, loamy sand, and fine gravel varies, small areas of the Carlisle soils were included in mapping. Small areas of Edwards muck were also included in some of the areas mapped.

Most of this soil is cleared. If adequately drained, it is used for corn, soybeans, mint, and truck crops, principally onions and Irish potatoes. Excess wetness, susceptibility to wind erosion, and unbalanced fertility are the major limitations. (Soil management unit M/4cA (IVw); woodland suitability group J; wildlife suitability group 8)

Tuscola Series

The Tuscola series consists of moderately well drained soils that formed in stratified calcareous silt, very fine sand, and fine sand. These soils are on level to sloping lake plains, deltas, and outwash plains. They are widely distributed throughout the southern two-thirds of the county. The native vegetation was hardwood forest consisting largely of maple, oak, beech, elm, and basswood.

Typical profile of Tuscola loamy fine sand:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loamy fine sand; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.
A2—7 to 11 inches, brown (10YR 5/3) fine sandy loam; weak, fine, granular structure; friable; slightly acid; clear, wavy boundary.
IIB21—11 to 24 inches, pale-brown (10YR 6/3) silt loam; moderate, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.
IIB22—24 to 36 inches, brown (10YR 5/3) heavy silt loam; common, fine, distinct, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.
IIC—36 inches +, pale-brown (10YR 6/3) silt; massive; friable; calcareous.

The color of the Ap horizon ranges to very dark grayish brown (10YR 3/2). In some areas the A2 horizon has weak, thin, platy structure. The texture of the B horizon ranges from silt loam to sandy loam, heavy sandy loam, heavy fine sandy loam, light clay loam, or light silty clay loam. The texture of this horizon depends on the thickness and sequence of the underlying layers of silt, fine sand, and very fine sand. The texture of the C horizon ranges from stratified silt, fine sand, and very fine sand to dominantly silt or dominantly very fine sand or fine sand. The depth to the C horizon ranges from 24 to 42 inches.

Surface runoff is slow on the nearly level soils and medium on the more strongly sloping soils. Permeability and the available moisture capacity are moderate, and natural fertility is moderately high.

The Tuscola soils are in the drainage sequence that includes the somewhat poorly drained Kibbie soils and the poorly drained and very poorly drained Colwood soils. They have a coarser textured B horizon than the Celina soils, and their B horizon varies more in texture than that of the Dryden soils, which developed in sandy loam till.

Tuscola soils, 0 to 2 percent slopes (TsA).—These soils are on low swells or hills on broad level or nearly level valley plains. The surface layer ranges from fine sandy loam to silt loam, loam, or sandy loam. It is dark grayish brown and is high in organic-matter content. Small depressions in which the Kibbie soils occur were included in some of the areas mapped.

Most of the acreage is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few scattered areas are in farm woodlots. Except for a slight drainage problem, the limitations are minor. (Soil management unit 2.5aA (I); woodland suitability group U; wildlife suitability group 1)

Tuscola soils, 2 to 6 percent slopes (TsB).—These soils are on undulating swells and rises on valley plains and uplands. The surface layer ranges from fine sandy loam to silt loam, loam, or sandy loam. It is dark grayish brown and is medium in organic-matter content. In some areas there are thin layers of sand in the bottom layer.

Most of the acreage is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A small acreage is in farm woodlots. Susceptibility to erosion is the major limitation. (Soil management unit 2.5aB (IIe); woodland suitability group U; wildlife suitability group 1)

Tuscola soils, 2 to 6 percent slopes, moderately eroded (TsB2).—These soils are on undulating to gently sloping swells and rises on valley plains and uplands.

Part of the original surface layer has been removed by erosion, and the present surface layer ranges from fine sandy loam to silt loam, loam, or sandy loam. It is pale brown or light brown in color and contains only a moderate amount of organic matter. In places some sand occurs in the bottom layer. In a few areas shallow gullies have formed, and the third layer is exposed.

These soils are used mostly for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few areas are idle. Susceptibility to erosion is the major limitation. (Soil management unit 2.5aB (IIe); woodland suitability group U; wildlife suitability group 1)

Tuscola soils, 6 to 12 percent slopes, moderately eroded ((TsC2).—These soils are on the short slopes of low hills and swells on valley plains and uplands. Most of the original surface layer has been removed by erosion, and the present surface layer ranges from fine sandy loam to silt loam, loam, or sandy loam. It is light brown or pale brown in color and contains little organic matter. In places the bottom layer contains some sand. Shallow gullies have formed in a few small areas, and the third layer is exposed over much of these areas.

Most of the acreage is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Some areas are idle. Susceptibility to erosion is the major limitation. (Soil management unit 2.5aC (IIIe); woodland suitability group U; wildlife suitability group 1)

Tuscola loamy fine sand, 2 to 6 percent slopes (TuB).—This soil is on undulating and gently sloping swells and rises on valley plains and uplands. The surface layer is dark grayish-brown to dark-brown loamy fine sand and contains only a moderate amount of organic matter. The fourth layer is sandy loam or heavy sandy loam.

Most of this soil is used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. A few areas are in farm woodlots. Susceptibility to erosion is the major limitation. (Soil management unit 2.5aB (IIe); woodland suitability group U; wildlife suitability group 1)

Ubly Series

In the Ubly series are well drained and moderately well drained soils that formed in loamy fine sand to fine sandy loam. These soils are underlain at a depth of 18 to 42 inches by calcareous loam, silty clay loam, or clay loam till. They occur on the level to moderately steep parts of till plains and low moraines throughout the northern part of the county. The native vegetation consisted of mixed stands of hardwoods, mainly sugar maple, ash, beech, and some white pine.

Typical profile of Ubly sandy loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; medium organic-matter content; slightly acid; abrupt, smooth boundary.

Bir—7 to 11 inches, dark-brown (10YR 4/3) sandy loam; weak, medium, granular structure; friable; slightly acid; clear, wavy boundary.

A'2—11 to 14 inches, brown (10YR 5/3) sandy loam; weak, thin, platy structure; friable; slightly acid; clear, wavy boundary.

B'21t—14 to 22 inches, yellowish-brown (10YR 5/4) sandy loam; weak, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B'22t—22 to 38 inches, dark-brown (7.5YR 4/4) sandy clay loam; few, fine, dark yellowish-brown (10YR 4/4) mottles, and common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

IIC—38 inches +, brown (10YR 5/3) clay loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; massive; firm; calcareous.

In undisturbed areas there generally is a very dark brown (10YR 2/2) or very dark gray (10YR 3/1) A1 horizon, 1 to 3 inches thick, and a light brownish-gray (10YR 6/2) A2 horizon, 1 to 4 inches thick, above the Bir horizon. The thickness of the Bir horizon ranges from 3 to 7 inches. In some areas the A'2 horizon is weakly cemented. The B'22t horizon ranges from sandy loam to sandy clay loam or clay loam, and in some areas it is not mottled.

Surface runoff ranges from slow on the mild slopes to rapid on the moderately steep slopes. Permeability is moderately rapid in the upper part of the solum and moderate in the lower part. Natural fertility is medium, and the available moisture capacity is moderately low.

The Ubly soils are in the drainage sequence that includes the somewhat poorly drained Belding soils and the poorly drained and very poorly drained Breckenridge soils. They are finer textured throughout the solum than either the Menominee soils or the Mancelona soils, loamy substratum. They are coarser textured throughout than the Nester soils.

Ubly sandy clay loam, 6 to 12 percent slopes, severely eroded (UbC3).—This soil is on the short rounded slopes of potholes or basins and on sloping swells and ridges, on the uplands. Nearly all of the upper four layers have been removed by erosion. The present surface layer of sandy clay loam contains little organic matter. The depth to the limy clay loam bottom layer commonly is about 22 inches. Shallow gullies have formed in many areas.

This soil has been used for general farm crops, but most areas are now used for hay and pasture. Badly gullied areas are idle or in second-growth forest. Severe erosion, medium natural fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 2.5aC3 (IVe); woodland suitability group A; wildlife suitability group 1)

Ubly sandy loam, 0 to 2 percent slopes (UlA).—This soil is on broad smooth ridgetops on the uplands. The surface layer is very dark grayish-brown sandy loam. Some slightly undulating areas in which the Belding soils occur were included in mapping.

Most of this soil is used for corn, wheat, oats, beans, hay, and pasture. Medium natural fertility and the moderately low available moisture capacity are the major limitations. (Soil management unit 3/2aA (I); woodland suitability group A; wildlife suitability group 1)

Ubly sandy loam, 2 to 6 percent slopes (UlB).—This soil is on undulating uplands. The surface layer is very dark grayish-brown sandy loam. Small areas of Belding soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, hay, and pasture. Moderately low available moisture capacity and medium natural fertility are the major

limitations. (Soil management unit 3/2aB (IIe); woodland suitability group A; wildlife suitability group 1)

Ubly sandy loam, 2 to 6 percent slopes, moderately eroded (UlB2).—This soil occurs on undulating uplands. Most of the original surface layer has been removed by erosion, and the present surface layer is light-brown to yellowish-brown sandy loam. It is low in organic-matter content.

Most of this soil is used for corn, wheat, oats, beans, hay, and pasture. Moderately low available moisture capacity and medium natural fertility are the major limitations. (Soil management unit 3/2aB (IIe); woodland suitability group A; wildlife suitability group 1)

Ubly sandy loam, 6 to 12 percent slopes, moderately eroded (UlC2).—This soil is on the short rounded slopes of potholes or basins and on sloping swells and ridges, on the uplands. Erosion has removed the original surface layer, and the present first layer is light-brown or yellowish-brown sandy loam. Small areas of Menominee soils were included in some of the areas mapped.

Most of this soil is used for corn, wheat, oats, beans, hay, and pasture. A few small areas are in farm woodlots. Medium natural fertility, moderately low available moisture capacity, and susceptibility to erosion are the major limitations. (Soil management unit 3/2aC (IIIe); woodland suitability group A; wildlife suitability group 1)

Ubly sandy loam, 12 to 18 percent slopes, moderately eroded (UlD2).—This soil is on short side slopes along valley walls and on strongly sloping ridges. The present surface layer is light-brown or yellowish-brown sandy loam and contains little organic matter. The depth to the limy clay loam bottom layer is about 25 inches. Small areas of the Mancelona soils, loamy substratum, were included in some of the areas mapped.

Most of this soil is idle or in permanent pasture. A few areas are in farm woodlots. Pine trees have been planted in some areas. Slope, susceptibility to erosion, medium natural fertility, and moderately low available moisture capacity are the major limitations. (Soil management unit 3/2aD (IVe); woodland suitability group A; wildlife suitability group 1)

Ubly sandy loam, 18 to 25 percent slopes, moderately eroded (UlE2).—This soil is on short slopes along the valley walls, on the sides of draws and ravines, and on ridges. The surface layer is light-brown or yellowish-brown sandy loam and is low in organic-matter content. The limy clay loam bottom layer is at a depth of about 25 inches.

Most of this soil is idle or in natural second-growth forest. Steep slopes, susceptibility to erosion, moderately low available moisture capacity, and medium natural fertility are the major limitations. (Soil management unit 4/2aDE (VIe); woodland suitability group A; wildlife suitability group 1)

Wallkill Series

Soils of the Wallkill series are poorly drained and very poorly drained. These soils formed in recently deposited loam, silt loam, light clay loam, and light silty clay loam alluvium that is from 10 to 40 inches thick over buried organic soils. They occur in small level areas and in slight depressions on till plains, lake plains, and moraines throughout the county. Most areas are the sites of former small shallow lakes. The native vegetation consisted mainly of elm, ash, swamp white oak, and water maple.

Typical profile of Wallkill loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

C1—8 to 30 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

IIC2—30 inches +, black (10YR 2/1) muck; weak, fine, granular structure; friable; neutral.

The C1 horizon ranges from heavy sandy loam to loam or silt loam in texture and in places is mottled with yellowish brown (10YR 5/6) and gray (10YR 5/1). In some areas the lower part of the IIC2 horizon grades to peat, and in others the entire horizon is peat.

Surface runoff is very slow or ponded, permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Wallkill soils differ from the Washtenaw soils in that they are underlain by organic soil material, whereas the Washtenaw are underlain by mineral soil material.

Wallkill soils (0 to 1 percent slopes) (Wa).—The texture of the surface layer ranges from sandy loam to loam, silt loam, or clay loam. The depth to the organic material ranges from 10 to about 40 inches. Included in some of the areas mapped, commonly near the edges of these areas, are small areas of the Washtenaw soils.

Most of this acreage is used for corn, soybeans, and truck crops. Areas where drainage is not feasible are in farm woodlots or permanent pasture. Excess wetness is the major limitation. (Soil management unit L–2cA (IIIw); woodland suitability group J; wildlife suitability group 2)

Wasepi Series

The Wasepi series consists of somewhat poorly drained soils that formed in sandy loam and loamy sand outwash that is from 24 to 42 inches thick over stratified calcareous sand and gravel. These soils are on the level to gently sloping parts of outwash plains, valley trains, lake plains, and deltas. They are widely distributed throughout the southern two-thirds of the county. The native vegetation was deciduous forest consisting mainly of elm, ash, swamp white oak, and hickory.

Typical profile of Wasepi sandy loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; friable; moderately high organic-matter content; neutral; abrupt, smooth boundary.

A2—7 to 10 inches, light brownish-gray (10YR 6/2) sandy loam; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B21g—10 to 16 inches, grayish-brown (10YR 5/2) heavy sandy loam; many, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B22g—16 to 30 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIC—30 inches +, grayish-brown (10YR 5/2) sand and gravel; single grain; loose; calcareous.

The color of the Ap horizon ranges from very dark grayish brown (10YR 3/2) to very dark gray (10YR 3/1). In some places there are common mottles in the A2 horizon, and in other places there are many. The texture of the B22g horizon ranges from sandy loam to sandy clay loam, gravelly clay loam, or clay loam. Where the texture is sandy clay loam, gravelly clay loam, or clay loam, the B22g horizon does not exceed 10 inches in thickness. The texture of the IIC horizon ranges from stratified sand and gravel to dominantly sand or gravel.

Surface runoff is slow or very slow. Permeability is moderately rapid in the solum and rapid in the substratum. The available moisture capacity and natural fertility are moderately low.

The Wasepi soils commonly are less acid throughout the solum than the Brady soils, and they are shallower to sand and gravel. They have a coarser textured, thinner B horizon than the Matherton soils. The Wasepi soils are in the drainage sequence that includes the well drained Boyer soils, the moderately well drained Perrin soils, and the poorly drained and very poorly drained Gilford soils.

Wasepi sandy loam, 0 to 2 percent slopes (WeA).—This soil is on broad flats or in shallow swales and depressions on the valley plains and on high terraces on the uplands, commonly adjacent to the higher lying Boyer and Fox soils. In most places some gravel occurs on the surface, and in a few areas there are stones. Included in the areas mapped are small depressions in which the poorly drained and very poorly drained Gilford soils occur. Where this soil is closely associated with the Matherton soils, small areas of these soils were also included in mapping.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Wasepi sandy loam, 2 to 6 percent slopes (WeB).—This soil is on undulating valley plains and high terraces, generally at slightly lower elevations than the associated Boyer and Fox soils. The surface layer contains only a moderate amount of organic matter. A few areas are stony. Included in the areas mapped are slight rises or swells on which the well drained Boyer soils and the moderately well drained Perrin soils occur, and small depressions in which the Gilford soils occur.

Most of this soil is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Wasepi-Brady loamy sands, 0 to 2 percent slopes (WrA).—These soils are on broad flats and in shallow swales and depressions on the valley plains, and on high terraces on the uplands. They generally are at lower elevations than the associated Fox and Boyer soils. Although most areas include both the Wasepi and Brady soils, there are some small areas in which only one soil occurs. The fourth layer of these soils commonly is sandy loam. Included in the areas mapped are small slight depressions in which the Gilford soils occur. The Brady soils are described in detail under the heading "Brady Series."

Most of the acreage is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Wasepi-Brady loamy sands, 2 to 6 percent slopes (WrB).—These soils are on undulating valley plains and high terraces, commonly at lower elevations than the associated Boyer and Fox soils. Although most areas include both the Wasepi and the Brady soils, there are some small areas in which only one soil occurs. In most places, the fourth layer is sandy loam. Included in the areas mapped are small areas of the well drained Boyer soils and the moderately well drained Perrin soils, which are on slight rises or swells. Also included are a few small depressions in which the Gilford soils occur. The Brady soils are described in detail under the heading "Brady Series."

Most of the acreage is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Wasepi-Brady sandy loams, 0 to 2 percent slopes (WsA).—These soils are on broad flats or in shallow swales and depressions on the valley plains and on high terraces on the uplands. They commonly are at lower elevations than the associated Fox and Boyer soils. Most of the areas mapped include both the Wasepi and the Boyer soils, but there are some small areas in which only one soil occurs. Included in mapping were some small depressions in which the Gilford soils occur. The Brady soils are described in detail under the heading "Brady Series."

Most of the acreage is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Undrained areas are in farm woodlots or permanent pasture. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Wasepi-Brady sandy loams, 2 to 6 percent slopes (WsB).—These soils are on undulating valley plains and high terraces, generally at slightly lower elevations than the associated Boyer and Fox soils. Most areas include both the Wasepi and the Brady soils, but in some small areas only one soil occurs. Included in mapping were

small areas of the well drained Boyer and the moderately well drained Perrin soils, which generally are on slight rises or swells. Also included were small depressions in which the Gilford soils occur. The Brady soil is described in detail under the heading "Brady Series."

Most of the acreage is cleared. Adequately drained areas are used for corn, wheat, oats, soybeans, and legume-grass hay or pasture. Excess wetness, moderately low available moisture capacity, and moderately low natural fertility are the major limitations. (Soil management unit 4bAB (IIIw); woodland suitability group G; wildlife suitability group 6)

Washtenaw Series

Soils of the Washtenaw series are poorly drained and very poorly drained. These soils formed in recently deposited loam, silt loam, light clay loam, and light silty clay loam alluvium that is from 10 to 40 inches thick over buried mineral soils. They occur in depressions on moraines, till plains, and outwash plains throughout the county. The native vegetation consisted mainly of maple, ash, elm, and swamp white oak.

Typical profile of Washtenaw loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; medium organic-matter content; neutral; abrupt, smooth boundary.

Cg—8 to 35 inches, dark grayish-brown (10YR 4/2) loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

Ab—35 to 42 inches, very dark gray (10YR 3/1) loam; few, fine, distinct, olive-brown (2.5Y 4/4) mottles; moderate, fine, granular structure; friable; moderately high organic-matter content; neutral; abrupt, smooth boundary.

Bbg—42 to 62 inches, grayish-brown (2.5Y 5/2) clay loam; common, medium, distinct, olive-yellow (2.5Y 6/8) mottles; moderate, medium, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

Cg—62 inches +, grayish-brown (2.5Y 5/2) loam; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; weak, coarse, angular blocky structure; firm; calcareous.

The texture of the surface layer ranges from loam to sandy loam, silt loam, or light clay loam. The depth to free carbonates ranges from 45 to 66 inches.

Surface runoff is very slow or ponded, permeability is moderate, and the available moisture capacity and natural fertility are moderately high.

The Washtenaw soils differ from the Wallkill in that they are underlain by mineral soil material, whereas the Wallkill soils are underlain by organic soil material.

Washtenaw soils (0 to 1 percent slopes) (Wt).—These soils are in swales and depressions on rolling uplands and on undulating lowlands. The surface layer ranges from loam to sandy loam, silt loam, or light silty clay loam. In some areas it is brown. Included in mapping were small areas of the Wallkill soils that are in deep depressions, and narrow areas of the Brookston, Berville, and Sebewa soils that are on the outer edges of the areas mapped.

Most of the acreage is cleared. Adequately drained areas are used principally for corn, wheat, oats, hay, and pasture. Excess wetness is the major limitation. (Soil management unit L-2cA (IIIw); woodland suitability group P; wildlife suitability group 2)

Willette Series

The Willette series consists of very poorly drained soils that formed in mixed woody and fibrous organic material. These soils range from 12 to 42 inches in thickness over heavy clay loam, heavy silty clay loam, clay, or silty clay. They occur mainly in level areas and slight depressions on lake plains, outwash plains, till plains, and moraines throughout the county. The native vegetation consisted principally of elm, ash, soft maple, white cedar, and an understory of reeds, grasses, sedges, and willows.

Typical profile of Willette muck:

1—0 to 11 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; few to many wood fragments; slightly acid; gradual, smooth boundary.

2—11 to 20 inches, very dark grayish-brown (10YR 3/2) muck; weak, coarse, granular structure; friable; some partly decomposed woody and fibrous materials; slightly acid; clear, wavy boundary.

3—20 to 31 inches, dark-brown (10YR 4/3) fibrous peat; weak, thick, platy structure; friable; neutral; clear, wavy boundary.

IIC—31 inches +, olive-brown (2.5Y 4/4) heavy silty clay loam; massive; very firm; calcareous.

In some areas the muck extends to the IIC horizon. In others the muck is only about 12 inches thick and is underlain by peat. The texture of the IIC horizon ranges to clay, silty clay, or heavy clay loam.

Surface runoff is very slow or ponded. Permeability is rapid in the organic material and slow in the underlying clayey material. The available moisture capacity is high. Natural fertility is only moderately high because of the unbalanced proportions of essential plant nutrients. Wind erosion is a hazard if these soils are cleared.

The Willette soils formed in mixed organic material that is from 12 to 42 inches thick, whereas the Carlisle soils formed in similar material that is more than 42 inches thick over the mineral substratum. The Willette soils are underlain by heavy clay loam, heavy silty clay loam, clay, or silty clay, whereas the Tawas and Linwood soils are underlain by sand and loam, respectively.

Willette-Linwood mucks (0 to 1 percent slopes) (Wu).—This complex occurs mainly on swampy flats on the lowlands. In some small areas, all of the organic material above the mineral bottom layer is peat. Although both soils occur in most areas, there are some small areas in which only one soil occurs. Included in mapping were a few small areas of the Carlisle soils, in which the organic material extends to a depth of more than 42 inches. The Linwood soils are described in detail under the heading "Linwood Series."

Most of the acreage is cleared. Adequately drained areas are used principally for corn, soybeans, mint, and truck crops, including onions and potatoes. Excess wetness, susceptibility to wind erosion, and unbalanced natural fertility are the major limitations. (Soil management unit M/4cA (IVw); woodland suitability group J; wildlife suitability group 8)

Wind Eroded Land, Sloping

Wind eroded land, sloping (Wv).—This miscellaneous land type is on undulating to sloping parts of uplands and terraces. It consists of areas of sandy soils from which erosion, mainly wind, has removed the soil material to a

depth of as much as 3 feet or more. The texture of the present surface layer ranges from sand to loamy sand. In most areas there are numerous blowouts, where the wind has scooped out the soil material.

Except for a few scattered shrubs or trees and some weeds, the greater part of the acreage is idle. Attempts have been made to reforest a few areas with conifers. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Wind Eroded Land, Steep

Wind eroded land, steep (Ww).—This miscellaneous land type is on the strongly sloping to steep parts of uplands and terraces. It consists of areas of sandy soils from which erosion, mainly wind, has removed the soil material to a depth of as much as 3 feet or more. The texture of the present surface layer ranges from sand to loamy sand. In many areas there are numerous blowouts, where the wind has removed the soil material and left round or oblong depressions.

Except for a few scattered shrubs or trees and numerous weeds, practically all of the acreage is idle. Conifers have been planted in a few small areas. (Soil management unit 5.7aA–F (VIIs); woodland suitability group N; wildlife suitability group 7)

Use and Management of the Soils

This section gives an explanation of the nationwide capability classification system used by the Soil Conservation Service and an explanation of the system used by Michigan to classify the soils into soil management groups and units. Only the soil management units used in Michigan are described. In order to show the relationship between the two systems, symbols for the capability class and subclass are shown in parentheses following each symbol for a soil management unit. The description of each unit in this section includes suggestions for the use and management of the soils for crops and pasture.

This section also includes a table showing the predicted yields of the principal crops under two levels of management and discusses the management of the soils for woodland, engineering purposes, and wildlife habitats.

Capability Groups of Soils

The capability classification shows, in a general way, how suitable soils are for most kinds of farming. It is based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops or to rice and other crops that have special requirements.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes, there can be up to four subclasses. The subclass is indicated 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* means that water in or on the soil will interfere 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 country, indicates 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 or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c* because the soils are subject to little or no erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, which are referred to in this report as soil management units. A capability unit is made up of soils 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, or soil management unit, is a convenient grouping for making many statements about the management of soils. Soil management units are identified by symbols assigned locally, for example 3aC (see p. 92) or 4aD (see p. 96), combined with the symbol for the capability class and subclass, such as IIIe or IVe.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible major reclamation projects.

The eight classes in the capability system, and the subclasses and soil management units in this county, are described in the list that follows.

Class I. Soils that have a few limitations that restrict their use.
- Unit 1.5aA (I). Level, well drained or moderately well drained, moderately fine textured soils.
- Unit 1.5cA (I). Level, very poorly drained, moderately fine textured soils.
- Unit 2.5aA (I). Level, well drained or moderately well drained, medium-textured soils.
- Unit 2.5cA (I). Level, very poorly drained, medium-textured soils.
- Unit 3/2aA (I). Level, moderately well drained, moderately coarse textured soils.

Class II. Soils that have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Subclass IIe. Soils subject to moderate erosion if they are not protected.
- Unit 1.5aB (IIe). Gently sloping, well drained or moderately well drained, moderately fine textured soils.

Unit 2.5aB (IIe). Undulating or gently sloping, well drained or moderately well drained, medium-textured soils.
Unit 3aB (IIe). Undulating or gently sloping, well drained or moderately well drained, medium-textured or moderately coarse textured soils.
Unit 3/2aB (IIe). Gently sloping, well drained or moderately well drained, moderately coarse textured soils.

Subclass IIw. Soils that have moderate limitations because of excess water.
Unit 1.5bAB (IIw). Level to gently sloping, somewhat poorly drained, moderately fine textured soils.
Unit 2.5bAB (IIw). Level to gently sloping, somewhat poorly drained, medium-textured soils.
Unit 3bAB (IIw). Level to gently sloping, somewhat poorly drained, medium-textured or moderately coarse textured soils.
Unit 3cA (IIw). Level, poorly drained, medium-textured or moderately coarse textured soils.
Unit 3/2bAB (IIw). Level to gently sloping, somewhat poorly drained, moderately coarse textured soils.
Unit 3/2cA (IIw). Level, poorly drained, moderately coarse textured soils.
Unit L–2aA (IIw). Level, well drained or moderately well drained, medium-textured soils on flood plains.

Subclass IIs. Soils that have moderate limitations because of moisture capacity, rooting zone, or other soil features.
Unit 3aA (IIs). Level, well drained and moderately well drained soils that have a medium-textured or moderately coarse textured subsoil.

Class III. Soils that have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.
Unit 1aBC (IIIe). Undulating or sloping, well drained or moderately well drained, fine-textured soils.
Unit 1.5aB (IIIe). Undulating or gently sloping, well drained or moderately well drained, moderately fine textured soils.
Unit 1.5aC (IIIe). Sloping, well drained or moderately well drained, moderately fine textured soils.
Unit 2.5aC (IIIe). Sloping or rolling, well drained or moderately well drained, medium-textured soils.
Unit 3aB3 (IIIe). Undulating or gently sloping, well-drained, severely eroded, moderately coarse textured soils.
Unit 3aC (IIIe). Sloping or rolling, well-drained, moderately coarse textured soils.
Unit 3/2aC (IIIe). Sloping or rolling, well-drained, moderately coarse textured soils, underlain by loam or clay loam at a depth of 18 to 42 inches.
Unit 4aC (IIIe). Sloping, well-drained, moderately coarse textured or coarse textured soils.
Unit 4/2aC (IIIe). Sloping or rolling, well-drained, coarse-textured soils, underlain by loam at a depth of 18 to 42 inches.

Subclass IIIw. Soils that have severe limitations because of excess water.
Unit 1bAB (IIIw). Level to gently sloping, somewhat poorly drained, fine-textured soils.
Unit 4bAB (IIIw). Level to gently sloping, somewhat poorly drained, coarse-textured soils.
Unit 4cA (IIIw). Level, very poorly drained, coarse-textured soils.
Unit 4/2bAB (IIIw). Level to undulating, somewhat poorly drained, coarse-textured soils, underlain by loam at a depth of 18 to 42 inches.
Unit 4/2cA (IIIw). Level, very poorly drained, coarse-textured soils, underlain by loam at a depth of 18 to 42 inches.
Unit 5cA (IIIw). Level, very poorly drained, coarse-textured soils.
Unit L–2cA (IIIw). Level, somewhat poorly drained to very poorly drained, moderately fine textured or medium-textured soils on flood plains.
Unit L–4aA (IIIw). Level, well drained or moderately well drained, coarse-textured soils on flood plains.
Unit L–4cA (IIIw). Level, somewhat poorly drained or poorly drained, moderately coarse textured soils on flood plains.
Unit McA (IIIw). Deep organic soils.

Subclass IIIs. Soils that have severe limitations because of moisture capacity or rooting zone.
Unit 4aA (IIIs). Level, well-drained, coarse-textured soils.
Unit 4aB (IIIs). Gently sloping, well-drained, coarse-textured soils.
Unit 4/2aAB (IIIs). Level to gently sloping or undulating, well-drained, coarse-textured soils, underlain by loam.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.
Unit 1.5aC3 (IVe). Sloping, well drained or moderately well drained, severely eroded, moderately fine textured or fine textured soils.
Unit 1.5aD (IVe). Moderately steep, well drained or moderately well drained, moderately fine textured or fine textured soils.
Unit 2.5aC3 (IVe). Sloping or rolling, well drained or moderately well drained, severely eroded, moderately coarse textured or medium-textured soils.
Unit 2.5aD (IVe). Hilly or moderately steep, well drained or moderately well drained, medium-textured soils.
Unit 3aC3 (IVe). Sloping or rolling, well-drained, severely eroded, moderately coarse textured soils.

Unit 3aD (IVe). Moderately steep or hilly, well-drained, moderately coarse textured soils.
Unit 3/2aD (IVe). Moderately steep or hilly, well-drained, moderately coarse textured soils, underlain by loam or clay loam at a depth of 18 to 42 inches.
Unit 4aC3 (IVe). Sloping or rolling, well-drained, severely eroded, coarse-textured soils.
Unit 4aD (IVe). Moderately steep or hilly, well-drained, coarse-textured soils.
Unit 4/2aC3 (IVe). Sloping or rolling, well-drained, severely eroded, coarse-textured soils.

Subclass IVw. Soils that have very severe limitations for cultivation because of excess water.
Unit 1cA (IVw). Level, very poorly drained, fine-textured soils.
Unit 5bA (IVw). Level, somewhat poorly drained, coarse-textured soils.
Unit M/4cA (IVw). Level, shallow organic soils, underlain by mineral soil at a depth of 12 to 42 inches.
Unit M/mcAB (IVw). Level to gently sloping, shallow organic soils, underlain by marl at a depth of less than 42 inches.

Subclass IVs. Soils that have very severe limitations because of moisture capacity or rooting zone.
Unit 4/RaB (IVs). Undulating or gently sloping, well-drained, shallow soils, underlain by sandstone bedrock.
Unit 5aAB (IVs). Level to undulating, well drained or moderately well drained, coarse-textured soils.

Class V. Soils not likely to erode but that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture, woodland, range, or wildlife food and cover.

Subclass Vs. Soils too stony or rocky for cultivation; removal of stones not feasible.
Unit 4aABC (Vs). Level to sloping, well-drained, moderately coarse textured, stony soils.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, woodland, range, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.
Unit 1.5aDE3 (VIe). Moderately steep or steep; well drained or moderately well drained, moderately fine textured or fine textured soils.
Unit 2.5aD3 (VIe). Hilly or moderately steep, well-drained, severely eroded, moderately coarse textured or medium-textured soils.
Unit 2.5aE (VIe). Steep, well-drained, medium-textured soils.
Unit 3aD3 (VIe). Moderately steep, well-drained, severely eroded, moderately coarse textured soils.
Unit 3aE (VIe). Steep, well-drained, moderately coarse textured soils.
Unit 4aD3 (VIe). Moderately steep or hilly, well-drained, severely eroded, coarse-textured soils.
Unit 4aE (VIe). Steep, well-drained, coarse-textured soils.
Unit 4/2aDE (VIe). Moderately steep or steep, well-drained, coarse-textured soils.

Subclass VIw. Soils generally unsuitable for cultivation and limited for other uses because of excess water and other soil features.
Unit M/mcA (VIw). Level, poorly drained soils that formed in alluvium and marl.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses because of low moisture-supplying capacity, stoniness, or other soil features.
Unit 5aC (VIs). Sloping or rolling, well drained or moderately well drained, coarse-textured soils.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited chiefly by risk of erosion, if cover is not maintained.
Unit 2.5aF (VIIe). Very steep, well-drained, medium-textured soils.
Unit 3aEF (VIIe). Steep or very steep, well-drained, moderately coarse textured soils.
Unit 3aEF3 (VIIe). Steep or very steep, well-drained, medium-textured or moderately coarse textured soils.
Unit 4aE3 (VIIe). Steep, well-drained, severely eroded, coarse-textured soils.
Unit 4aF (VIIe). Very steep, well-drained, coarse-textured soils.
Unit 4aF3 (VIIe). Very steep, well-drained, severely eroded; coarse-textured soils.

Subclass VIIs. Soils very severely limited by low moisture-supplying capacity, stoniness, or other soil features.
Unit 5aD (VIIs). Moderately steep, well-drained, coarse-textured soils.
Unit 5aEF (VIIs). Steep or very steep, well-drained, coarse-textured soils.
Unit 5.7aA–F (VIIs). Level to very steep, well-drained, coarse-textured soils.

Class VIII. Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIs. Gravelly or stony materials that have little potential for production of plants.
Unit Sa (VIIIs). Gravel pits, sandstone quarries, and made land.

Soil Management Groups and Units

This subsection explains how the soils are grouped into soil management groups and units. Many useful statements can be made about groups of soils that are similar in texture and other properties and that have similar drainage. These groups, called soil management groups, are useful for making general suggestions about

management. For the purpose of making more specific statements concerning systems and conservation practices, the soil management groups are further subdivided into soil management units according to significant variations in slope and in degree of erosion.

Table 2 shows that each soil management group is designated by a symbol that shows the position of the soil on the landscape, the texture of significant layers in the profile that greatly affect soil management, and the degree of natural internal drainage. In this table the mineral soils are arranged vertically according to texture, which is designated by Arabic numerals 1 through 5. Drainage is indicated by the small letters a, b, or c, arranged horizontally, from the best drained at the left to the most poorly drained at the right. Soils in soil management groups 3a, for example, are upland soils. The "3" in the symbol indicates that the soils formed in sandy loam, and the "a" shows that the soils are well drained or moderately well drained. Somewhat poorly drained sand that contains a hardpan is identified by the symbol 5b-h.

TABLE 2.—*Relationships of soil management groups*

Position of soil and texture of subsoil	Natural drainage		
	Well drained or moderately well drained (a)	Somewhat poorly drained (b)	Poorly drained or very poorly drained (c)
Upland soils:			
1—Silty clay or clay	1a	1b	1c.
1.5—Clay loam and silty clay loam.	1.5a	1.5b	1.5c.
2.5—Loam and silt loam	2.5a	2.5b	2.5c.
3—Sandy loam	3a	3b	3c.
3/2—Sandy loam, underlain by loam, silt loam, clay loam, or silty clay loam at depth of 18 to 42 inches.	3/2a	3/2b	3/2c.
4—Loamy sand	4a	4b	4c.
4/2—Loamy sand and sand, underlain by loam, silt loam, clay loam, or silty clay loam at depth of 18 to 42 inches.	4/2a	4/2b	4/2c.
4/R—Loamy sand and sand, underlain by sandstone bedrock at depth of 18 to 42 inches.	4/R		
5—Sand	5a	5b	5c.
S—Gravel pits, quarries, and made land.	Sa		
Lowland soils:			
L-2—Loam, silt loam, clay loam, or silty clay loam.	L-2a		L-2c.
L-4—Loamy sand and sand	L-4a		L-4c.
Organic soils:			
M—More than 42 inches thick			Mc.
M/4—Organic material, underlain by mineral material at depth of 12 to 42 inches.			M/4c.
M/m—Organic material, underlain by marl at depth of less than 42 inches.			M/mc.

The capital letter L in a symbol indicates soils that are on lowlands and are subject to flooding. The letter M stands for organic soils, either muck or peat. The symbol Mc, for example, stands for poorly drained or very poorly drained, organic material that is more than 42 inches thick.

Where soils are formed from one kind of soil material on top of another kind, a fractional type of symbol is used. The number or letter above the diagonal line refers to the upper part, and the number or letter below the line refers to the lower part. For example, 3/2 stands for sandy loam, less than 42 inches thick over loam to clay loam. M/4c stands for organic material less than 42 inches thick over sand or loamy sand. The letter c indicates the soil is poorly drained or very poorly drained.

Soil management groups are subdivided according to significant ranges of slope and erosion into soil management units. Soil management units within a management group are identified by a slope group symbol A, B, C, D, E, or F suffixed to the appropriate management group symbol, for example, 3aC, 2.5aE, 3/2cA. The slope group symbols and their associated range in slope gradient are—

	Percent slope
A	0 to 2
B	2 to 6
C	6 to 12
D	12 to 18
E	18 to 25
F	25 to 40

Except for small areas that make up less than 10 percent, the slope range of all the soils in a management unit is indicated by the slope group symbol. Dual capital letters are used to indicate a slope range associated with both letters. For example, in the soil management unit 1.5bAB, the slope ranges from 0 to 6 percent.

For a few of the management units, the number 3 is added to denote that nearly all of the soils included are severely eroded. If the 3 is lacking, the soils included in a management unit are not eroded, or are only slightly or moderately eroded.

Management of Soils for Crops and Pasture

Some of the extensive soils in Ionia County need lime and fertilizer, many of the soils need drainage, and a few need protection from erosion.

Some of the most extensive soils, including those of the Blount, Celina, Conover, Miami, and Morley series, are at least slightly acid. Thus, the need for lime is widespread in the county. Phosphorus deficiency also is common. Phosphate is needed wherever crops are grown or livestock is raised. Potash is needed, especially if fruit is grown. It is also important if alfalfa is grown. On this crop, split applications are best; the second application to be made after the first cutting. If enough potash for maximum growth is put on at once, the result is luxury consumption.

A large proportion of the farms have a need for drainage. Because of the youth of the drainage pattern, most fields have some areas that require drainage to make it possible to farm the entire field in the same way. Drainage is mostly by means of tile. As elsewhere in

the midwest, the casual traveler underestimates the amount of land that has functioning tile drains.

Locally, some of the very sandy soils and some of the cultivated organic soils need windbreaks to keep the soil from blowing. Erosion is a hazard, especially on the short steep slopes that are common, but with modern methods, controlling erosion is not difficult.

In the following pages, the soil management units in the county are described and management suitable for all of the soils in a unit is suggested.

The soils in each unit have about the same limitations and similar risks of damage. All of the soils in one unit, therefore, need about the same kind of management, though they may have formed from different kinds of parent material and in different ways. The soils in each management unit can be identified by referring to the "Guide to Mapping Units."

Management of the soils for woodcrops is discussed in the section "Use of Soils for Woodland."

Soil management unit 1aBC (IIIe)

This unit consists of undulating and gently sloping or sloping, well drained and moderately well drained soils that have a fine-textured subsoil.

These soils are naturally fertile. They are medium acid in the upper part of the profile and are alkaline in the lower part. The rate of air and water movement through the soils is slow, and the available moisture capacity is high. Crops are seldom damaged by lack of moisture. However, the planting of crops may have to be delayed because the soils are slow to warm up in spring, and there are some wet spots.

The principal management needs are to control water erosion, improve permeability, preserve soil structure, and increase or maintain the organic-matter content.

Large amounts of organic matter can be supplied by growing meadow crops, cover crops, or green-manure crops or by returning other crop residues to the soil. Crops that keep the surface layer and subsoil open are also needed. Erosion control measures are helpful. If the tight subsoil is exposed by erosion, tillage is difficult and productivity is lowered. Consequently, if terraces are constructed, care should be taken to expose as little of the subsoil as possible. Terraces need to be constructed on a slight grade so that water will not pond.

The soils of this unit are well suited to most of the common crops grown in the county, but not to potatoes. If proper supporting practices are used, they can be cropped as intensively as level soils, but yields will be lower than those obtained on darker colored, medium-textured soils. If tillage is kept to a minimum, all residues are returned to the soil, and the soils are terraced, stripcropped, or tilled on the contour, the cropping sequence can be as intensive as the following: A row crop, then small grain seeded to green-manure crop. If none of these practices are used, a suitable cropping sequence is the following: A row crop, spring grain, and 3 years of a meadow crop. The moderately eroded areas need more organic material than the less eroded areas and are less productive.

Forage crops grow well on these soils. Grazing needs to be restricted during wet periods, to prevent puddling.

Soil management unit 1bAB (IIIw)

This unit consists of level to gently sloping, somewhat poorly drained soils that have a fine-textured subsoil. These soils are naturally fertile. They are only slightly acid and are moderate in organic-matter content. The rate of air and water movement is slow, and the available moisture capacity is high. The water table fluctuates and may be at or near the surface during part of the year.

The principal management needs are to reduce excess wetness, to increase or maintain the organic-matter content, and to preserve soil structure. Flooding is a hazard in depressions.

Drained areas, except those in frost pockets, are well suited to the crops commonly grown. Tile functions satisfactorily in these soils. Surface drainage may be necessary in some areas because of the uneven surface. If tillage is kept to a minimum and all crop residues are returned to the soil, a suitable cropping sequence for drained areas consists of a row crop followed by a small grain seeded to a green-manure crop. The planting of crops may have to be done later on these soils than on most of the other soils in the county.

These soils are well suited to forage crops. Only water-tolerant grasses are suitable for undrained areas. Delay of grazing through wet periods is necessary because these soils are likely to puddle if grazed when wet. The delay will be longer than on most of the other soils in the county.

Soil management unit 1cA (IVw)

The soils of this unit are level, are very poorly drained, and have a fine-textured subsoil. They are in depressions and are subject to flooding. Although in undrained areas the water table is high, it varies in drained areas according to the amount of artificial drainage. These soils are fertile, are well supplied with organic matter, and are slightly acid to alkaline in reaction. Air and water move slowly through the fine-textured subsoil, and the available moisture capacity is adequate for all crops.

The principal management needs are to reduce excess wetness, to preserve soil structure, and to maintain the organic-matter content. Planting may be delayed in spring because of excess wetness.

If drained, these soils are well suited to most of the crops commonly grown in the county, but not to potatoes. However, artificial drainage is needed to obtain optimum yields of most crops. Tile functions well but a backfilling of straw, grass, or topsoil is necessary because of the plastic subsoil. These soils receive runoff from higher areas and consequently need surface drainage in some areas. If all residues are returned to the soils and tillage is kept to a minimum, a satisfactory cropping sequence is a row crop, then a small grain seeded to a green-manure crop.

The soils of this unit are well suited to water-tolerant forage crops, but grazing may be delayed in spring because of wetness or may be restricted or shortened during prolonged wet periods.

Soil management unit 1.5aA (I)

This unit consists of level, well drained and moderately well drained soils that have a moderately fine textured

subsoil. Permeability is moderately slow, and the available moisture capacity is moderately high. Consequently, crops are seldom damaged by lack of moisture, except during extended dry periods. The organic-matter content is medium or low, and runoff is slow. Wet spots that occur locally are slow to dry out in spring and after rains.

The soils of this unit have few limitations that restrict their use for crops. Erosion generally is not a hazard, but the wet spots may delay planting in spring.

These soils are well suited to forage crops.

Soil management unit 1.5aB (IIe)

This unit consists of gently sloping, well drained and moderately well drained soils that have a moderately fine textured subsoil. These soils are naturally fertile, but they are susceptible to water erosion because of the slope and the tightness of the subsoil. Water and air move moderately slowly through these soils. The available moisture capacity is moderately high, and crops seldom lack sufficient moisture for good growth.

The major management needs are to control water erosion, to maintain good tilth, and to increase or maintain the organic-matter content.

Most of the crops commonly grown in the county are suitable. Optimum yields can be expected if good tilth is maintained and all crop residues are returned to the soils. Large amounts of crop residues are needed to maintain good tilth. A good cropping sequence and other erosion control practices are needed to help keep soil losses to a minimum. If the tight subsoil is exposed by erosion, tillage is difficult and productivity is lowered. If tilled when wet, these soils lose their good tilth and become hard and cloddy in drying. They are slow to warm up in spring. Therefore, the planting of spring crops generally is delayed. Tile or surface drainage is needed in some wet spots.

The soils of this unit are well suited to forage crops and are productive if suitable grasses and legumes are grown. They should not be grazed when wet.

Soil management unit 1.5aB (IIIe)

This unit consists of undulating and gently sloping, well drained and moderately well drained soils that have a moderately fine textured subsoil. These soils are moderately eroded and, because of the slope, are susceptible to further erosion. The rate of air and water movement through the soils is moderately slow, and the available moisture capacity is moderately high. Thus, crops are seldom damaged by lack of moisture, except during long dry periods. However, these soils are low in organic-matter content, have poor structure, and are likely to become cloddy when dry. The thin surface layer and tight subsoil make tillage difficult.

The major limitations are hazard of erosion, low organic-matter content, poor soil structure, and moderately slow rate of water movement.

Most of the crops commonly grown are suitable, but the cropping sequence should include crops that help to control erosion and that produce a large amount of residue that can be returned to the soils to improve soil structure. It can be as intensive as a row crop, a cover crop, and then a row crop if fields are terraced, all residues are returned to the soils, and tillage is kept to a minimum. If terraces are not used, but tillage is kept to a minimum, and all residues are returned to the soils, a satisfactory rotation is a row crop, another row crop, a small grain, and 3 years of meadow.

The soils of this unit are well suited to the common forage crops and are productive if the fertilization program is adequate.

Soil management unit 1.5aC (IIIe)

This unit consists of sloping, well-drained soils that have a moderately fine textured subsoil. The rate of air and water movement through these soils is moderately slow, and the available moisture capacity is moderately high. Thus, crops are seldom damaged by lack of moisture. The soils of this unit are naturally fertile but are susceptible to erosion because of the slope. The organic-matter content is low in the moderately eroded soils and moderately low in the uneroded soils.

The principal management needs are to control water erosion, to reduce runoff, to maintain good tilth, and to increase or maintain the organic-matter content.

These soils are suited to most of the crops commonly grown if good tilth is maintained, erosion is controlled, and all crop residues are returned to the soils. A good cropping sequence and other erosion control practices are needed to keep soil losses to a minimum. If the tight subsoil is exposed by erosion, tillage is difficult and productivity is lowered. The cropping sequence, particularly on the moderately eroded soils, should include crops that produce a large amount of residue that can be returned to the soils to improve soil structure. The moderately eroded soils are slow to warm up in spring and are low in fertility. Consequently, the planting of spring crops commonly is delayed, the germination of seeds is uneven, and stands of plants are poor. Tile or surface drainage is needed in some wet spots.

These soils are well suited to forage crops. Favorable yields of suitable grasses and legumes can be expected.

Soil management unit 1.5aC3 (IVe)

This unit consists of sloping, well drained and moderately well drained, severely eroded soils that have a moderately fine textured or fine textured subsoil. The rate of water movement through the soils is moderately slow, and the available moisture capacity is moderately high. However, crops lack sufficient moisture for good growth because much of the water runs off. These severely eroded soils have poor tilth, are low in organic-matter content, have rapid runoff, and crust when dry. If cultivated, they are subject to further erosion.

The soils of this unit are suited to most crops commonly grown in the county if soil tilth is improved, erosion is controlled, and crop residues are returned to the soils. A good cropping sequence and other erosion control practices are needed to keep soil losses to a minimum. The cropping system should include crops that produce a large amount of residue that can be returned to the soils to improve soil structure. There are a few wet spots that may require tile or surface drainage.

These soils are suited to forage crops. The legumes and grasses generally grown in the county are suitable.

Soil management unit 1.5aD (IVe)

This unit consists of hilly, well drained and moderately well drained soils that have a moderately fine textured subsoil. The rate of water movement is moderately slow, and the available moisture capacity is moderately high. Because much of the water runs off, crops are likely to be damaged by lack of moisture during dry periods.

In cultivated fields, runoff is rapid and erosion is a serious hazard. Consequently, the soils of this unit have severe limitations if used for row crops, but they are suited to forage crops and small grain. If the soils are cultivated, the cropping system should include crops that help to control erosion and that produce a large amount of residue that can be returned to the soils to improve soil structure.

Soil management unit 1.5aDE3 (VIe)

This unit consists of moderately steep or steep, well drained and moderately well drained, severely eroded soils that have a moderately fine textured subsoil. The rate of air and water movement through the soils is moderately slow, and the available moisture capacity is moderately high. Runoff is rapid in cultivated fields. Because erosion has been severe, the organic-matter content has been reduced, fertility has been lowered, and the soils have been left with poor tilth. The surface layer crusts when dry, which makes tillage difficult and slows the germination of seed.

If cultivated, these soils are susceptible to further erosion. They can be used for forage crops if properly fertilized and otherwise well managed.

Soil management unit 1.5bAB (IIw)

This unit consists of level to gently sloping, somewhat poorly drained soils that have a moderately fine textured subsoil. These soils formed under a fluctuating water table, which, except in drained areas, is at or near the surface during part of the year. They dry out slowly in spring and after rains. Because water ponds in depressions, planting and cultivation are delayed during wet periods. The gently sloping soils have better surface drainage than the more nearly level soils. The rate of air and water movement is moderately slow.

The principal management needs are to reduce excess wetness, to preserve good soil tilth, to maintain or increase the organic-matter content, and to control water erosion on the gently sloping soils.

The soils of this unit are naturally fertile and are well suited to all of the crops grown in the county. If adequately drained, they are productive. A combination of tile drains and open ditches is needed. Tile drainage alone will not insure the conditions needed for optimum yields. Because of the uneven relief, however, a complete drainage system is difficult to install in some gently sloping areas. In these areas, random tile and surface drains can be used. The soil material is stable, and both tile drains and open ditches are easily maintained. To preserve good soil tilth, additions of large amounts of organic residues are needed, and tillage should be kept to a minimum. During wet periods, it will be necessary to delay tillage to prevent ponding of the soils.

These soils are well suited to forage crops. The selection of grasses and legumes depends on the degree of wetness of the area. In undrained areas, delay of grazing is necessary through wet periods to prevent puddling.

Soil management unit 1.5cA (I)

This unit consists of level, dark-colored, poorly drained and very poorly drained soils that have a moderately fine textured subsoil. The water table is high and, except in drained areas, is at or near the surface during a large part of the year. These soils dry out slowly in spring and after rains. Consequently, they can be tilled only within a narrow range of moisture content. The planting of crops commonly is delayed during wet periods. Farm machinery easily bogs down if the soils are wet. Frost damage is a hazard in these low-lying areas.

The principal management needs are to reduce excess wetness, to preserve good soil tilth, and to maintain or increase the organic-matter content.

The soils of this unit are naturally fertile, respond well to management, and if drained are well suited to all of the crops commonly grown in the county. Both tile drains and open ditches are necessary because tile drainage alone will not insure the conditions needed for optimum yields. The soil material is stable, and tile drains and surface ditches are easily maintained. However, natural drainage outlets are few, and in places it is necessary to dig ditches to provide outlets. Drainage is not practical in some areas, because outlets are either not available or not adequate. To preserve and improve soil tilth, additions of large amounts of organic residues are needed. Tillage should be kept to a minimum. During wet periods, it will be necessary to delay tillage to prevent puddling.

These soils are well suited to forage crops. The selection of forage crops depends on the degree of wetness of the area. In undrained areas, delay of grazing is necessary through wet periods.

Soil management unit 2.5aA (I)

This unit consists of level, well drained and moderately well drained soils that have a medium-textured subsoil. These soils are moderately high in natural fertility. They are medium acid in the upper part of the profile and alkaline in the lower part. The rate of air and water movement through the soils is moderate or moderately slow, and the available moisture capacity is medium or high. Crops are seldom damaged by lack of moisture. Wet spots occur in some areas.

The principal management needs are to preserve soil structure and to maintain or increase the organic-matter content.

The soils of this unit are well suited to all of the crops commonly grown in the county. If they are intensively cropped, relatively large amounts of crop residues should be returned to the soils. Tillage needs to be kept to a minimum to preserve soil structure. A suitable cropping sequence consists of a row crop followed by a small grain seeded to a green-manure crop. Because these soils are

slow to warm up in spring, the planting of crops generally is delayed.

These soils are well suited to forage crops and are productive of suitable grasses and legumes. Grazing should be restricted or shortened during wet periods.

Soil management unit 2.5aB (IIe)

This unit consists of undulating and gently sloping, well drained and moderately well drained soils that have a medium-textured subsoil. These soils are naturally fertile. They are medium acid in the upper part of the profile and alkaline in the lower part. The rate of air and water movement through the soils is moderate. The available moisture capacity is medium or moderately high, and crops are seldom damaged by lack of moisture. Because of the slope, water erosion is a hazard. Wet spots occur in some areas.

The principal management needs are to control water erosion, to preserve soil structure, and to maintain or increase the organic-matter content.

The soils of this unit are slow to warm up in spring. Thus the planting of spring crops will be later than on the coarser textured soils in the county. All of the crops commonly grown in the county are suitable, but a cropping sequence and other erosion control measures are needed to keep soil losses to a minimum. Where the tight subsoil is exposed by erosion, tillage is difficult and productivity is lowered. To increase the organic-matter content, the cropping sequence should include a crop that produces a large amount of residue. If contour tillage is used, a suitable cropping sequence consists of a row crop, followed by a small grain seeded to a green-manure crop. If fields are terraced, a more intensive crop rotation can be used. Terraces ought to be constructed on a slight grade so that water will not pond, and care taken to expose as little of the subsoil as possible.

These soils are well suited to forage crops and are productive of legumes and grasses. During wet periods, it will be necessary to restrict grazing.

Soil management unit 2.5aC (IIIe)

This unit consists of sloping and rolling, well drained and moderately well drained soils that have a medium-textured subsoil. These soils are naturally fertile and are medium acid in the upper part of the profile and alkaline in the lower part. The rate of air and water movement through the soils is moderate. The available moisture capacity is medium or moderately high, and crops are seldom damaged by lack of moisture. Because of the slope, runoff is rapid and water erosion is a serious hazard. Wet spots occur in some areas.

The principal management needs are to control water erosion, to preserve soil structure, and to maintain or increase the organic-matter content.

These soils are slow to warm up in spring. Thus the planting of spring crops generally is delayed. All of the crops commonly grown in the county are suitable, but a good cropping sequence and other erosion control measures are needed to keep soil losses to a minimum. Where the tight subsoil is exposed by erosion, tillage is difficult and productivity is lowered. If fields are terraced and all crop residues are returned to the soils, the cropping sequence can be as intensive as a row crop, a row crop, a small grain, a small grain, and then a meadow crop. Terraces ought to be constructed on a grade so that water will not pond, and care taken to expose as little of the subsoil as possible in the channel.

These soils are well suited to forage crops and are productive of grasses and legumes.

Soil management unit 2.5aC3 (IVe)

This unit consists of sloping and rolling, well drained and moderately well drained soils that have a moderately coarse textured or medium-textured subsoil. These soils are severely eroded and consequently are low in organic-matter content and have poor structure. They are alkaline in the lower part of the profile. The rate of air and water movement through the soils is moderate or moderately slow, and the available moisture capacity is moderately high. Although crops are seldom damaged by lack of moisture, yields generally are low because the soils are severely eroded. Runoff is very rapid, and further erosion is a serious hazard.

The principal management needs are to control runoff and water erosion, to maintain or increase the organic-matter content, and to improve soil structure.

The soils of this unit are slow to warm up in spring. If crops are grown, measures are needed to improve soil structure. Further soil losses can be kept to a minimum if terraces are constructed and the cropping system is no more intensive than a row crop, a row crop, a small grain, then a meadow crop.

These soils are well suited to forage crops.

Soil management unit 2.5aD (IVe)

This unit consists of hilly or moderately steep, well drained and moderately well drained soils that have a medium-textured subsoil. These soils are naturally fertile. They are medium acid in the upper part of the profile and alkaline in the lower part. The rate of water and air movement through the soils is moderate, and the available moisture capacity is moderately high. Thus crops are seldom damaged by lack of moisture. Because of the slope, however, runoff is very rapid, and the hazard of erosion is serious.

The major limitations are very rapid runoff, susceptibility to water erosion, difficulty in preserving soil structure and in maintaining the organic-matter content, and restrictions on the use of equipment because of the slope.

These soils are slow to warm up in spring. They are poorly suited to row crops because of the serious erosion hazard, but they can be used for small grain and meadow crops.

The soils of this unit are well suited to most of the forage crops commonly grown in the county.

Soil management unit 2.5aD3 (VIe)

This unit consists of hilly or moderately steep, well-drained, severely eroded soils that have a moderately coarse textured or medium-textured subsoil. These soils have very rapid runoff and are subject to further erosion. They are low in organic-matter content and are alkaline in the lower part of the profile. The rate of air and water movement through the soils is moderate. The available moisture capacity is moderately high, and crops are seldom damaged by lack of moisture. Yields are low, however, because of past erosion.

The principal management needs are to control water erosion and to increase the organic-matter content.

These soils are not suited to row crops, but they can be used for small grain or meadow crops. A permanent cover of vegetation, such as legumes and grasses, is desirable.

Soil management unit 2.5aE (VIe)

This unit consists of steep, well-drained soils that have a medium-textured subsoil. The rate of water and air movement through the soils is moderate. The available moisture capacity is moderately high, and crops are seldom damaged by lack of moisture. These soils are medium acid in the upper part of the profile and alkaline in the lower part. They are naturally fertile but are susceptible to erosion. Runoff is difficult to control because of the steep slopes.

The major limitations are susceptibility to water erosion, the moderate rate of water movement through the soils, difficulty of preserving soil structure, and the restricted use of equipment because of the steep slopes.

The soils of this unit are too steep to be used for cultivated crops, but they can be used for the forage crops commonly grown in the county. A permanent cover of vegetation is needed to protect these soils from erosion.

Soil management unit 2.5aF (VIIe)

This unit consists of very steep, well-drained soils that have a medium-textured subsoil. The rate of air and water movement through the soils is moderate. The available moisture capacity is moderately high, and plants are seldom damaged by lack of moisture. These soils are medium acid in the upper part of the profile and alkaline in the lower part. They are naturally fertile but have very rapid runoff and are highly susceptible to erosion. The soils that are severely eroded have poor structure and are low in organic-matter content.

The major limitations are susceptibility to water erosion, the moderate rate of water movement through the soils, rapid runoff, and the restricted use of equipment because of the steep slopes.

A permanent cover of vegetation is needed on these soils to help control erosion.

Soil management unit 2.5bAB (IIw)

This unit consists of level to gently sloping, somewhat poorly drained soils that have a medium-textured subsoil. These soils are naturally fertile. They formed under a fluctuating water table, which, except in drained areas, is at or near the surface during part of the year. They are slightly acid in the upper part of the profile and neutral in the subsoil. The rate of air and water movement through the soils is moderate. The available moisture capacity is medium or moderately high, and crops are seldom damaged by lack of moisture.

The principal management needs are to reduce excess wetness, to increase or maintain the organic-matter content, and to preserve soil structure. At times the planting of crops will be delayed in spring because of wetness.

These soils are stable and can be drained either by tile or by open ditches. Adequately drained areas are productive, provided a suitable cropping system is used. If all residues are returned to the soils, and tillage is kept to a minimum, the cropping sequence can be as intensive as a row crop each year, and a cover crop at least in alternate years.

The soils of this unit are well suited to forage crops. The selection of grasses and legumes depends on the degree of wetness of the area.

Soil management unit 2.5cA (I)

This unit consists of level, very poorly drained soils that have a medium-textured subsoil. The rate of air and water movement through the soils is moderate or moderately slow. The available moisture capacity is medium to high. These soils formed under a high water table, which, except in drained areas, may be at the surface during a large part of the year. They are high in organic-matter content and are naturally fertile.

The principal management needs are to reduce excess wetness and to preserve soil structure.

These soils are stable and are easily drained by tile or by open ditches. The cropping sequence can be as intensive as a row crop followed by a row crop, if cover crops are seeded, tillage is kept to a minimum, and all residues are returned to the soils.

The soils of this unit are well suited to forage crops. The selection of crops depends on the degree of wetness of the area.

Soil management unit 3aA (IIs)

This unit consists of level, well drained and moderately well drained soils that have a medium-textured or moderately coarse textured subsoil.

These soils are moderately fertile and contain a moderate amount of organic matter. They are medium or slightly acid. The McBride soils are acid to a depth of more than 42 inches, whereas the other soils are acid to lesser depths. The rate of air and water movement through the soils is moderate. The available moisture capacity is moderately low or moderate, and crops may be damaged by lack of moisture during a dry period.

Maintenance of the organic-matter content is the major management problem. Droughtiness is a slight limitation. These soils are seldom affected by wind erosion.

All of the crops commonly grown in the county are suitable. The cropping system should include a crop that produces a large amount of residue that can be returned to the soils. A satisfactory rotation is a row crop followed by a small grain seeded to a green-manure crop. Legumes that are suited to well-drained soils can be grown successfully.

Soil management unit 3aB (IIe)

This unit consists of undulating and gently sloping, well drained and moderately well drained soils that have a medium-textured or moderately coarse textured subsoil. The rate of air and water movement through the soils is moderate. The available moisture capacity is moderately low or moderate, and crops lack water during dry periods. Natural fertility is medium, and the reaction is medium acid or slightly acid. The McBride soils are acid to a depth of more than 42 inches, whereas the other soils in this unit are calcareous at a depth of less than 42 inches. Water erosion is a moderate hazard. A few areas are stony and are not suited to cultivation un-

less the stones are removed. These areas are indicated on the soil map by stone symbols.

These soils, for the most part, are well suited to crops if measures are taken to control erosion. Terracing is an effective conservation practice. A cropping system that includes crops that provide large amounts of residue that can be returned to the soils is desirable. In addition, other organic material can be added. If terraces are constructed, all residues are returned, and tillage is kept to a minimum, a satisfactory sequence of crops consists of a row crop, then a small grain seeded to a green-manure crop.

The soils of this unit are well suited to forage crops. Legumes and grasses suited to well-drained soils can be grown successfully. Because of their acid reaction, these soils need to be tested to determine their need for lime.

Soil management unit 3aB3 (IIIe)

This unit consists of undulating and gently sloping, well-drained, severely eroded soils that have a moderately coarse textured subsoil. These soils are low in organic-matter content. The surface layer has poor structure and is likely to become cloddy. The rate of air and water movement through the soils is moderate, and the available moisture capacity is moderately low. Crops lack moisture during extended dry periods. Runoff is rapid.

The major limitations are hazard of erosion, low organic-matter content, poor soil structure, and droughtiness.

The soils of this unit are suited to crops, but they are much less productive than the uneroded soils of the same series. To offset the effect of poor soil structure, the cropping system should include crops that produce large amounts of residue. In addition, a fertilization program that results in the production of large amounts of organic material that can be returned to the soils is desirable. If the organic-matter content of these soils is increased and terraces are constructed, the cropping sequence can be as intensive as a row crop, then a small grain seeded to a green-manure crop. If this rotation is used, it is important to return all crop residues to the soils and to keep tillage to a minimum.

These soils are well suited to the forage crops commonly grown in the county and are productive if a satisfactory stand can be established.

Soil management unit 3aC (IIIe)

This unit consists of sloping and rolling, well-drained soils that have a moderately coarse textured subsoil. The rate of air and water movement through the soils is moderate or moderately rapid. The available moisture capacity is moderate or moderately low, and crops lack water during dry periods. These soils are medium in natural fertility and are medium acid or slightly acid. The McBride soils are acid to a depth of more than 42 inches, whereas the other soils are calcareous at a depth of less than 42 inches. The McBride soils have a weak fragipan. The soils of this unit are subject to water erosion. A few areas are stony and are not suited to cultivated crops unless the stones are removed. These areas are indicated on the soil map by stone symbols. Areas that are not stony are suited to crops if erosion is controlled.

The major limitations are hazard of water erosion, slight droughtiness, and low organic-matter content.

These soils are suited to all of the cultivated crops commonly grown in the county if measures are taken to control erosion. They are well suited to terracing. The cropping system should include crops that produce relatively large amounts of residue that can be returned to the soils. If terraces are constructed, all residues are returned to the soils, and tillage is kept to a minimum, the cropping sequence can be as intensive as a row crop, a row crop, a small grain, then a meadow crop.

The soils of this unit are well suited to the forage crops commonly grown in the county.

Soil management unit 3aC3 (IVe)

This unit consists of sloping and rolling, well-drained, severely eroded soils that have a moderately coarse textured subsoil. The rate of air and water movement is moderate and generally is adequate for all plants. The available moisture capacity is moderate or moderately low, and crops lack water during dry periods. These soils are moderately fertile and are acid in the upper part of the profile. The Fox, Lapeer, and Newaygo soils are calcareous at a depth of less than 42 inches. Water erosion is a serious hazard.

The major limitations are slight droughtiness, moderate fertility, susceptibility to water erosion, and low organic-matter content.

These soils are poorly suited to cultivated crops. Before they can be used successfully for crops, measures are needed to correct the effect of past erosion.

Legumes and grasses are suitable if lime and fertilizers are applied in amounts indicated by soil tests.

Soil management unit 3aD (IVe)

This unit consists of moderately steep and hilly, well-drained soils that have a moderately coarse textured subsoil. The rate of air and water movement through the soils is moderate or moderately rapid but generally is adequate for all plants. The available moisture capacity is moderate or moderately low, and crops lack water during the driest part of the growing season. These soils are moderately fertile and are medium acid. They are susceptible to erosion because of the slope. The McBride soils are acid to a depth of more than 42 inches, whereas the other soils in this unit are calcareous at a depth of less than 42 inches. The McBride soils have a weak fragipan.

The major limitations are hazard of erosion, restrictions on the use of equipment because of the moderately steep slopes, and low organic-matter content.

These soils are not suited to cultivated crops. However, legumes and grasses that are suited to well-drained soils can be grown successfully. These soils are highly erodible if left barren. Consequently, it is desirable to keep them in forage crops as long as possible.

Soil management unit 3aD3 (VIe)

This unit consists of moderately steep, well-drained, severely eroded soils that have a moderately coarse textured subsoil. The available moisture capacity is moderate or moderately low, and crops lack water during ex-

tended dry periods. Because of past erosion, runoff is more rapid on these soils than on less eroded steeper soils.

The soils of this unit are not suited to crops because of the risk of erosion and the limitation on the use of equipment. They are well suited to such permanent vegetation as legumes, grasses, or woody plants. The cover of vegetation should be broken only occasionally.

Soil management unit 3aE (VIe)

This unit consists of steep, well-drained soils that have a moderately coarse textured subsoil. These soils are moderately fertile and are acid in reaction. The McBride soils are acid to a depth of more than 42 inches, whereas the other soils are acid to a depth of less than 42 inches. The rate of air and water movement through the soils is moderate. The available moisture capacity is moderate or moderately low, and in most years crops lack moisture during dry periods. Because of the steep slopes, these soils are highly susceptible to erosion, and the use of equipment is limited. Stones occur on the surface in a few areas. These areas are indicated on the soil map by stone symbols.

These soils are not suitable for cultivated crops, but they are well suited to forage crops. They are productive of legumes and grasses that can be grown successfully on well-drained soils.

Soil management unit 3aEF (VIIe)

This unit consists of very steep, well-drained soils that have a moderately coarse textured subsoil. These soils are somewhat droughty. Runoff is rapid, and the hazard of erosion is severe. The use of equipment is severely limited because of the steep slopes.

The soils of this unit are moderately productive of forage crops. All legumes and grasses that are suited to well-drained soils grow well. A cover of vegetation is needed most of the time to help control erosion.

Soil management unit 3aEF3 (VIIe)

This unit consists of steep and very steep, well-drained, severely eroded soils that have a moderately coarse textured subsoil. These soils are moderately permeable and are medium in available moisture capacity. Because of the steep and very steep slopes, runoff is rapid if the soils are cultivated. The steep slopes limit the use of farm machinery. Severe erosion has reduced the organic-matter content and left these soils with poor tilth. The surface layer crusts readily when dry. In many areas there are cobblestones and gravel on the surface.

The soils of this unit are poorly suited to most cultivated crops but can be used for pasture or forage crops. Most grasses and legumes grow well.

Soil management unit 3bAB (IIw)

This unit consists of level and gently sloping, somewhat poorly drained soils that have a medium-textured or moderately coarse textured subsoil. These soils are fertile and contain a moderate amount of organic matter. The water table fluctuates and may be at or near the surface during part of the year. If the water table is lowered, the movement of air and water through the soils is moderate. The available moisture capacity is adequate for all crops.

The principal management needs are to reduce excess wetness, to preserve soil structure, and to maintain or increase the organic-matter content. Flooding is a hazard in depressions.

Drained areas, except those in frost pockets, are well suited to the crops commonly grown in the county. Tile functions satisfactorily except where sand pockets occur. In these unstable areas, a backfilling of straw, grass, or topsoil is needed. If tillage is kept to a minimum and all residues are returned to the soils, a suitable cropping sequence consists of a row crop, followed in alternate years by a row crop seeded to a cover crop. The planting of crops may have to be done later on these soils than on the well-drained soils in the county.

These soils are well suited to forage crops. Only water-tolerant grasses are suitable for undrained areas. Delay of grazing through wet periods is necessary because these soils are likely to puddle if grazed when wet.

Soil management unit 3cA (IIw)

This unit consists of level, poorly drained soils that have a medium-textured or moderately coarse textured subsoil. These soils are fertile and are well supplied with organic matter. In undrained areas, the water table is high during most of the year. Water moves freely through these soils if the water table is lowered. The available moisture capacity is adequate for plants.

The principal management needs are to reduce excess wetness and to preserve soil structure. Flooding is a hazard in depressions.

Drained areas, except those in frost pockets, are well suited to the crops grown in the county. Tile functions successfully except where sand pockets occur. In these pockets, there is risk of the sand filling the tile. For this reason, a backfilling of straw or topsoil is needed. Surface drainage may be necessary if the surface is uneven. The cropping sequence can be as intensive as a row crop each year if a cover crop is seeded in alternate years. The planting of crops may be delayed because of wetness.

These soils are well suited to forage crops. Only water-tolerant grasses are suitable for undrained areas. Delay of grazing is necessary through wet periods. The delay will be longer on these soils than on soils on uplands.

Soil management unit 3/2aA (I)

This unit consists of level, moderately well drained soils that have a moderately coarse textured subsoil and are underlain by loam, silty clay loam, or clay loam at a depth of 18 to 42 inches. The rate of air and water movement through these soils is moderate, and the available moisture capacity is moderately high to moderately low. Crops are seldom damaged by lack of moisture during a normal growing season. Although the surface layer normally contains a moderate amount of organic matter, this content is difficult to maintain because of the moderately coarse texture of the soil material in the upper 18 to 42 inches.

The principal management needs are to maintain the organic-matter content and to preserve soil structure.

These soils are well suited to all of the crops commonly grown in the county. If all residues are returned to the

soils and tillage is kept to a minimum, the rotation can be as intensive as a row crop, a cover crop, and then a row crop.

The soils of this unit are productive of forage crops if a good fertilization program is followed.

Soil management unit 3/2aB (IIe)

This unit consists of gently sloping, well drained and moderately well drained soils that have a moderately coarse textured subsoil and are underlain by loam or clay loam at a depth of 18 to 42 inches. Air and water move moderately rapidly through the upper layers and moderately slowly through the substratum. The available moisture capacity is moderately low to moderately high. Crops are seldom damaged by lack of moisture, except during extremely dry periods. These soils are moderate in organic-matter content and are acid in the upper part of the profile. Because of the slope, they are susceptible to erosion.

The principal management needs are to control erosion and to maintain the organic-matter content and fertility.

If erosion is controlled, these soils are suited to all of the crops grown in the county. Such erosion control practices as terracing, stripcropping, and contour tillage are well suited. In terraced fields, if tillage is kept to a minimum and all residues are returned to the soils, the cropping sequence can consist of a row crop, followed by a row crop seeded to a cover crop. If erosion control practices are not used, the cropping sequence should be no more intensive than a small grain and 2 years of meadow.

The soils of this unit are well suited to forage crops. They are productive of legumes and grasses that can be grown successfully on well-drained soils.

Soil management unit 3/2aC (IIIe)

This unit consists of sloping and rolling, well-drained soils that have a moderately coarse textured subsoil and are underlain by loam or clay loam at a depth of 18 to 42 inches. Air and water move moderately rapidly through the upper layers of these soils and moderately slowly through the substratum. The available moisture capacity is moderately low. Nevertheless, crops are seldom damaged by lack of moisture, except during extremely dry periods. These soils are moderately fertile and are moderate in organic-matter content. They are acid in the upper part of the profile. Because of the slope, they are highly susceptible to erosion.

The major limitations are hazard of erosion and the difficulty of maintaining fertility and organic-matter content.

All of the crops commonly grown in the county are suitable if measures are taken to control erosion. Such erosion control practices as terracing, contour tillage, and stripcropping are well suited. In terraced fields, if tillage is kept to a minimum and all residues are returned to the soils, the cropping sequence can consist of a row crop, a small grain, and then a meadow crop. If erosion control practices are not used, the cropping sequence should be no more intensive than a small grain and 2 years of meadow.

These soils are well suited to all of the forage crops that can be grown successfully on well-drained soils.

Soil management unit 3/2aD (IVe)

This unit consists of moderately steep and hilly, well-drained soils that have a moderately coarse textured subsoil and are underlain by loam or clay loam at a depth of 18 to 42 inches. Water moves readily through the upper part of the profile and moderately slowly through the substratum. The available moisture capacity is moderately low, and crops occasionally lack water during dry periods. These soils are moderately fertile and are acid in the upper part of the profile. They are moderately well supplied with organic matter. Because of the moderately steep slopes, runoff is rapid and erosion is a hazard.

The major limitations are hazard of erosion, restrictions on the use of equipment, and difficulty of maintaining fertility and organic-matter content.

These soils are poorly suited to cultivated crops but are well suited to forage crops. Legumes and grasses that are suited to well-drained soils can be grown successfully.

Soil management unit 3/2bAB (IIw)

This unit consists of level to gently sloping, somewhat poorly drained soils that have a moderately coarse textured subsoil and are underlain by loam or clay loam at a depth of 18 to 42 inches. The water table fluctuates and in undrained areas is at or near the surface during wet periods. Water moves readily through the upper layers and moderately slowly through the substratum. These soils are fertile and are moderate in organic-matter content. The available moisture capacity is adequate for all crops.

The major limitations are excess wetness and the difficulty of maintaining the organic-matter content and fertility. Flooding is a hazard in depressions.

Drained areas, except those in frost pockets, are well suited to the crops commonly grown in the county. Tile functions satisfactorily in these soils. However, the spacing of tile lines depends on the depth to the substratum. The spacing must be less if the lines are laid in the finer textured substratum than if they are laid in the moderately coarse textured subsoil. Unstable sand spots occur in some places. Surface drainage generally is needed in depressions and in areas where the surface is uneven. If all residues are returned to the soils and tillage is kept to a minimum, the cropping sequence can consist of a row crop, then in alternate years a row crop seeded to a cover crop.

The soils of this unit are well suited to forage crops. The selection of forage crops depends on the degree of wetness of the area. Grazing needs to be restricted through wet periods to prevent damage to the soils.

Soil management unit 3/2cA (IIw)

This unit consists of level, poorly drained soils that have a moderately coarse textured subsoil and are underlain by loam or clay loam at a depth of 18 to 42 inches. In undrained areas the water table is at the surface during wet periods. These soils are well supplied with organic matter and are fertile. Water moves readily through the upper layers and moderately slowly through the sub-

stratum. Runoff from higher soils collects in some low areas.

The major limitations are excess wetness and the difficulty of maintaining the organic-matter content and fertility. The flooding of low areas is a hazard.

Drained areas are well suited to cultivated crops. Tile can be used to drain these soils. The depth and the spacing of tile lines depend on the depth to the substratum. The spacing must be less if the lines are laid in the finer textured substratum than if they are laid in the moderately coarse textured subsoil. Some unstable sandy spots occur in places. Surface drainage generally is needed to remove runoff from depressions. If all residues are returned to the soils and tillage is kept to a minimum, the cropping sequence can consist of a row crop, then in alternate years a row crop seeded to a cover crop.

The soils of this unit are well suited to forage crops. The selection of forage crops depends on the degree of wetness of the area. Grazing needs to be restricted during wet periods to prevent damage to the soils.

Soil management unit 4aA (IIIs)

This unit consists of level, well-drained, coarse-textured soils that have a moderately coarse textured or meduim-textured subsoil that varies in thickness but generally is less than 10 inches. Air and water move readily through the soil material. These soils are moderately low in fertility and in organic-matter content, and they are medium acid to a depth of at least 36 inches. The available moisture capacity is moderately low, and most crops lack moisture during dry periods (fig. 7). A few areas are stony and are not suited to crops unless the stones are removed. These areas are indicated on the soil map by stone symbols.

The major limitations are droughtiness, moderately low fertility, and moderately low organic-matter content.

Although these soils are poorly suited to cultivated crops, they warm up early in spring and can be used for early season crops. Deep-rooted crops grow fairly well. The rotation should include crops that produce large amounts of organic material. If all crop residues are returned to the soils and tillage is kept to a minimum, a satisfactory cropping sequence consists of 2 years of a row crop, 2 years of a small grain, and 1 year of meadow.

These soils are moderately well suited to forage crops. Yields are fairly good early in the season but are low during the dry summer months.

Soil management unit 4aB (IIIs)

This unit consists of gently sloping, well-drained, coarse-textured soils that have a moderately coarse textured or medium-textured subsoil that varies in thickness but generally is less than 10 inches. Air and water move readily through the soil material. The available moisture capacity is moderately low or low, and crops lack moisture during dry periods. These soils are low or moderately low both in fertility and in organic-matter content, and they are medium acid to a depth of at least 36 inches. They are susceptible to both water and wind erosion. A few areas are stony and are not suitable for crops unless the stones are removed. These areas are indicated on the soil map by stone symbols.

Figure 7.—**Sprinkler irrigation on sandy soils of soil management unit 4aA (IIIs).**

The major limitations are hazard of erosion, difficulty of maintaining both fertility and organic-matter content, and droughtiness.

Although these soils are poorly suited to cultivated crops, they warm up early in spring and can be used for early season crops. The rotation should include crops that produce large amounts of organic material that can be returned to the soils. Such erosion control practices as terracing, stripcropping, or contour tillage are needed to help control erosion. In terraced fields, if tillage is kept to a minimum and all residues are returned to the soils, the cropping sequence can consist of 2 years of a row crop, 2 years of a small grain, and 1 year of meadow. If erosion control practices are not used, the cropping sequence should be no more intensive than a row crop, a small grain, and 4 years of meadow.

These soils are moderately well suited to forage crops. Yields are fairly good early in the season but are moderately low during the dry summer months.

Soil management unit 4aC (IIIe)

This unit consists of sloping, well-drained, coarse-textured soils that have a moderately coarse textured or medium-textured subsoil that is less than 10 inches thick. The rate of air and water movement through these soils is moderately rapid. The organic-matter content is low, and natural fertility is medium or low. These soils are droughty during dry periods and are susceptible to both wind and water erosion. The loamy sands, particularly Spinks loamy sand, are more droughty than the sandy loams and are more susceptible to wind erosion.

The major limitations are the difficulty of maintaining and increasing the organic-matter content and fertility, lack of moisture for crops during dry periods, and hazard of wind and water erosion.

The soils of this unit can be cultivated only occasionally because of the hazard of erosion. Large amounts of crop residues, manure, and green-manure are needed to maintain or increase the organic-matter content and fertility. Both winter cover crops and trees, planted as

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windbreaks, help to control wind erosion. In many areas, farming on the contour is difficult because slopes are short and irregular.

These soils are suited to all of the crops grown in the county but are used mainly for corn, small grain, alfalfa, and some soybeans. They warm up and dry out earlier in spring than the loamy and clayey soils in the county. Therefore, they are well suited to early crops, such as small grain, which matures before there is a shortage of soil moisture. Nitrogen and possibly phosphorus are needed to obtain optimum yields. However, large amounts of fertilizer may not be profitable in dry years.

Deep-rooted forage crops that are drought resistant are most suitable. Lime generally is needed if legumes are grown. Yields of forage crops are reduced during the dry summer months.

Soil management unit 4aC3 (IVe)

This unit consists of sloping and rolling, well-drained, severely eroded soils that have a coarse-textured subsoil. The rate of air and water movement through the soils is moderately rapid, and the available moisture capacity is moderately low. Crops commonly lack moisture even in normal years. The organic-matter content normally is very low in these soils and has been lowered as a result of past erosion. Because of their coarse texture, these soils are readily depleted of organic matter. Runoff is moderate.

The major limitations are past erosion, susceptibility to further erosion, low organic-matter content, and droughtiness.

These soils are not suited to cultivated crops, because of the extreme hazard of further erosion. They are moderately well suited to the forage crops commonly grown in the county, but yields will be moderate or moderately low, even if an adequate amount of fertilizer is used.

Soil management unit 4aD (IVe)

This unit consists of moderately steep or hilly, well-drained, coarse-textured soils that have a moderately coarse textured or medium-textured subsoil that varies in thickness but generally is less than 10 inches. The rate of air and water movement through these soils is moderately rapid. The available moisture capacity is moderately low, and crops lack moisture during dry periods. These soils are low in organic-matter content and fertility. They are medium acid to a depth of 36 inches. Because of the moderately steep slopes, they are highly susceptible to erosion. Stones occur on the surface in a few areas. These areas are indicated on the soil map by stone symbols.

The major limitations are hazard of erosion, low fertility, difficulty of maintaining the organic-matter content, droughtiness, and restrictions on the use of equipment because of the slope.

These soils are poorly suited to cultivated crops because of the moderately steep slopes and the hazard of erosion. They should be maintained in meadow as much of the time as possible. Forage crops that grow well early in spring are most suitable because growth will be restricted during the dry summer months.

Soil management unit 4aABC (Vs)

This unit consists of level to hilly, very stony soils that have a coarse-textured subsoil. These soils are very stony and droughty. The stones are numerous enough to prevent the use of common tillage equipment. The available moisture capacity is low or moderate. In most years plants are affected by lack of moisture during dry periods. The Boyer soils and the Plainfield soils, slightly acid variant, are more droughty than the other soils in this unit.

The major limitations are stoniness, low organic-matter content, and droughtiness.

Because of the stones, these soils are not suited to cultivated crops. They can be used for pasture or woods. Most of the forage crops commonly grown are suitable.

Soil management unit 4aD3 (VIe)

This unit consists of moderately steep or hilly, well-drained, severely eroded soils that have a coarse-textured subsoil, which is exposed in places. These soils are low in organic-matter content and are moderately low both in available moisture capacity and in fertility. They are coarse textured and acid to a depth of at least 24 inches.

The major limitations are past erosion, moderately low fertility, droughtiness, low organic-matter content, and restrictions on the use of equipment because of the slope.

The soils of this unit are not suitable for crops. To help control erosion, they need to be kept in a permanent cover of vegetation, such as legumes, grasses, or woody plants. Legumes and grasses grow well, especially during the moist months in spring.

Soil management unit 4aE (VIe)

This unit consists of steep, well-drained, coarse-textured soils that have a moderately coarse textured or medium-textured subsoil that varies in thickness but generally is less than 10 inches. The available moisture capacity is moderately low or low, and crops commonly lack moisture during dry periods. These soils are moderately low or low in fertility and are acid to a depth of 36 inches. They are highly susceptible to erosion because the slopes are steep.

The major limitations are hazard of erosion, droughtiness, low natural fertility, and restrictions on the use of equipment.

These soils are not suited to cultivated crops. To help control erosion, they need to be kept in a permanent cover of vegetation at all times. Yields of forage crops are low during the dry summer months but are higher during the moist months in spring.

Soil management unit 4aE3 (VIIe)

This unit consists of steep, well-drained, coarse-textured, severely eroded soils that have a moderately coarse-textured or medium-textured subsoil, generally less than 10 inches thick. In places the subsoil is exposed. The rate of water movement through the soils is moderately rapid, and the available moisture capacity is moderately low. These soils are moderately low in natural fertility. They are acid to a depth of 24 inches and are calcareous below this depth. Further erosion is a serious hazard because slopes are steep.

The major limitations are past erosion, susceptibility to further erosion, droughtiness, moderately low fertility, low organic-matter content, and restrictions on the use of equipment.

The soils of this unit are not suited to cultivated crops. Because of the hazard of erosion and the difficulty of using equipment, it is desirable to keep them in permanent vegetation, such as legumes and grasses or woody plants. Yields of forage crops are moderate or moderately low.

Soil management unit 4aF (VIIe)

This unit consists of very steep, well-drained soils that have a coarse-textured subsoil. Water moves moderately rapidly through the soil material. These soils are droughty and are low both in organic-matter content and fertility. They are acid to a depth of 36 inches. Runoff is rapid, and erosion is a serious hazard.

The major limitations are hazard of erosion, droughtiness, low organic-matter content, low fertility, and restrictions on the use of equipment because of the steep slopes.

The soils of this unit are poorly suited to cultivated crops. Because of the steep slopes and difficulty of reseeding, they are not well suited to forage crops. However, yields of forage crops are moderate, particularly early in spring.

Soil management unit 4aF3 (VIIe)

This unit consists of very steep, well-drained, severely eroded soils that have a coarse-textured subsoil. The rate of air and water movement through the soils is moderately rapid. The available moisture capacity is moderately low, and crops lack moisture during dry periods. These soils are low in organic-matter content, moderately low in fertility, and acid in reaction. Because of the steep slopes, they are susceptible to further erosion.

The major limitations are the steep slopes, extreme droughtiness, moderately low fertility, and poor soil structure. The Boyer soils are likely to be limy near the surface.

These soils are poorly suited to cultivated crops because of the hazard of erosion and the difficulty of using equipment. Legumes that are suited to well-drained soils can be grown, but yields of forage crops are moderate or moderately low.

Soil management unit 4bAB (IIIw)

This unit consists of level to gently sloping, somewhat poorly drained, coarse textured or moderately coarse textured soils that have a thin, medium-textured or moderately coarse textured subsoil. The rate of air and water movement through the soils is moderately rapid. The water table fluctuates and in undrained areas is at or near the surface during wet periods. The available moisture capacity is adequate for crops. These soils are moderate in organic-matter content and are low or moderately low in fertility.

The major limitations are poor drainage and difficulty of maintaining the organic-matter content.

Drained areas, except those in frost pockets, are well suited to all of the crops commonly grown in the county. If tillage is kept to a minimum and all residues are returned to the soils, a satisfactory crop sequence for drained areas consists of a row crop followed by a small grain seeded to a cover crop. Tile functions satisfactorily in these soils, but the many sand pockets make the installation of tile lines difficult. The banks of open ditches are likely to be unstable because the soils are sandy.

The soils of this unit are well suited to forage crops. The selection of forage crops depends on the degree of wetness of the area. Grazing may be delayed in spring because of wetness.

Soil management unit 4cA (IIIw)

This unit consists of level, very poorly drained soils that have a coarse-textured subsoil. In undrained areas, the water table is at the surface during part of the year. The available moisture capacity is adequate for crops. These soils are high in organic-matter content and medium or low in fertility. They generally are slightly acid or neutral in reaction. A few areas are stony and are not suited to crops. These areas are indicated on the soil map by stone symbols.

The major limitations are excess wetness and the difficulty of maintaining the organic-matter content.

Drained areas, except those in frost pockets, are well suited to crops. If tillage is kept to a minimum and all residues are returned to the soils, a suitable cropping sequence consists of a row crop, then a small grain seeded to a cover crop. Both tile and open ditches can be used to drain these soils. The best time to install tile is during the driest part of the year. Because of the many sand spots, however, the installation of tile lines may be difficult. The banks of open ditches are unstable.

The soils of this unit are well suited to forage crops and are productive during summer. The selection of forage crops depends on the degree of wetness of the area. Grazing needs to be restricted in spring when the soils are wet, and after heavy rains.

Soil management unit 4/2aAB (IIIs)

This unit consists of level to gently sloping or undulating, well-drained soils that have a coarse-textured subsoil and are underlain by loam at a depth of 18 to 42 inches. Water moves rapidly through the upper part of the profile and slowly through the lower part. The available moisture capacity is low. Crops commonly are damaged by lack of moisture during dry periods in summer. If rains are well distributed, however, crops do well. These soils are medium acid in the upper layers and calcareous in the substratum. The organic-matter content is low and is readily depleted if the soils are cultivated. Fertility is also low.

The major limitations are droughtiness, low fertility, and low organic-matter content. Wind erosion is a hazard if fields are not protected by vegetation.

Although all of the crops common to the county can be grown, the most suitable crops are those that produce their maximum growth in the cool moist months, or crops that can withstand long periods of low moisture. If all residues are returned to the soils and tillage is kept to a minimum, a suitable cropping sequence consists of a row crop, followed by a small grain seeded to a green-

manure crop. Regardless of the cropping system used, frequent additions of organic materials are needed.

These soils are not well suited to forage crops. Nevertheless, because they warm up early in spring, they provide grazing early in the growing season. Yields are lower during the dry summer months. Legumes and grasses that can withstand droughty periods are most suitable.

Soil management unit 4/2aC (IIIe)

This unit consists of sloping and rolling, well-drained soils that have a coarse-textured subsoil and are underlain by loam at a depth of 18 to 42 inches. Water moves rapidly through the upper part of the profile and slowly through the fine-textured substratum. The substratum supplies a moderate amount of moisture that plants can use. Crops lack moisture during dry summer months but do well if rains are well distributed. These soils are medium acid in the upper part of the profile and calcareous in the substratum. The content of organic matter is low and is reduced if the soils are cultivated. Fertility is low. The soils of this unit are susceptible to both wind and water erosion.

The major limitations are hazard of erosion, droughtiness, low fertility, and low organic-matter content.

These soils can be used safely for crops if suitable conservation measures are taken. Because the soils are droughty, the most suitable crops are those that produce their maximum growth during the cool moist months, or crops that can withstand extended dry periods. If terraces are constructed, all residues returned to the soils, and tillage kept to a minimum, the cropping sequence can be as intensive as 2 years of a row crop, 1 year of a small grain, and 1 year of a meadow crop. If no supporting practices are used, a suitable rotation consists of a row crop, a small grain, then a meadow crop. Regardless of the cropping sequence, frequent additions of organic materials are needed.

These soils are not well suited to forage crops. Nevertheless, they warm up early in spring and provide grazing early in the growing season. Yields are lower during the dry summer months. Legumes and grasses that can withstand droughty periods are most suitable.

Soil management unit 4/2aC3 (IVe)

This unit consists of sloping and rolling, well-drained, severely eroded soils that have a coarse-textured subsoil and are underlain by a medium-textured or moderately fine textured soil at a depth of 18 to 42 inches. Air and water move rapidly through the upper layers and slowly through the finer textured substratum. The available moisture capacity is low. Shallow-rooted crops lack moisture during dry periods of a normal growing season. These soils are low in organic-matter content. They have moderate runoff and are susceptible to further erosion.

The major limitations are past erosion, hazard of further erosion, low organic-matter content, and droughtiness.

Because of their low organic-matter content and susceptibility to erosion, the soils of this unit are not suited to cultivated crops. They are moderately well suited to forage crops, but yields are moderate or moderately low, even if an adequate amount of fertilizer is applied. Nevertheless, good forage is available early in the growing season and in fall. Yields of forage are reduced during dry periods in summer.

Soil management unit 4/2aDE (VIe)

This unit consists of moderately steep and steep, well-drained soils that have a coarse-textured subsoil and are underlain by loam at a depth of 18 to 42 inches. Water moves rapidly through the upper layers and slowly through the substratum. The available moisture capacity is low. Crops lack moisture during dry periods. These soils are medium acid in the upper part of the profile and calcareous in the substratum. They are low in both organic-matter content and fertility. Runoff is rapid, and the hazard of erosion is serious.

The major limitations are hazard of erosion, droughtiness, low fertility, low organic-matter content, and restrictions in the use of equipment. The severely eroded soils have a lower content of organic matter and are less suitable for crops than the less eroded soils.

These soils are poorly suited to cultivated crops because of the steep slopes and hazard of erosion. Yields of forage crops are low during the summer months but are excellent early in the growing season.

Soil management unit 4/2bAB (IIIw)

This unit consists of level to undulating, somewhat poorly drained soils that have a coarse-textured subsoil and are underlain by loam at a depth of 18 to 42 inches. The water table fluctuates and may be at or near the surface during wet periods. Water moves rapidly through the upper layers and moderately slowly through the substatum. The available moisture capacity is adequate for plants. These soils are slightly acid in the upper part of the profile and are calcareous in the finer textured substratum. They are moderately high in organic-matter content and low in fertility.

The major limitations are excess wetness and the difficulty of maintaining the organic-matter content.

Drained areas, except those in frost pockets, are well suited to the crops commonly grown in the county. Tile functions well in these soils, but the spacing of tile depends on the depth to the substratum. Where the soils are shallow, the spacing between tile lines must be less than in areas where the sandy soil material is thick. Furthermore, unstable sand spots occur in places. If tillage is kept to a minimum and all residues are returned to the soils, a suitable cropping sequence consists of a row crop, then a small grain seeded to a green-manure crop.

The soils of this unit are well suited to forage crops, particularly to legumes and grasses that can withstand some wet periods. In undrained areas, delay of grazing is necessary early in spring.

Soil management unit 4/2cA (IIIw)

This unit consists of level, very poorly drained soils that have a coarse-textured subsoil and are underlain by loam at a depth of 18 to 42 inches. In undrained areas, the water table is at the surface during wet periods. Water moves rapidly through the upper layers and slowly through the substratum. The available moisture ca-

pacity is adequate throughout the year. The organic-matter content is high. These soils are slightly acid or neutral in reaction. Because of the position of these soils on the landscape, crops are likely to be damaged by frost.

The major limitations are excess wetness, difficulty in maintaining the organic-matter content, and hazard of frost damage.

Adequately drained areas, except those in frost pockets, are well suited to cultivated crops. Tile can be used to drain these soils, but the spacing of tile depends on the depth to the finer textured substratum. In the laying of tile, there is some chance that sand spots will be encountered. These spots will not provide stable support for tile lines. In drained areas, if tillage is kept to a minimum and all residues are returned to the soils, a suitable cropping sequence consists of a row crop, then a small grain seeded to a green-manure crop.

The soils of this unit are well suited to forage crops. However, the selection of forage crops depends on the degree of wetness of the area. Grazing needs to be restricted on these soils during wet periods.

Soil management unit 4/RaB (IVs)

This unit consists of undulating to gently sloping, well-drained, shallow soils that are underlain by sandstone at a depth of less than 42 inches. The rate of air and water movement through the soils is rapid in the upper part of the profile but very slow in the lower part. The available moisture capacity is low, and crops commonly lack moisture. The organic-matter content is low. Runoff is moderately rapid. The major limitations are droughtiness and the shallow depth to bedrock.

These soils are not suited to cultivated crops and are only moderately well suited to forage crops.

Soil management unit 5aAB (IVs)

This unit consists of level to undulating, well drained and moderately well drained soils that have a coarse-textured subsoil. Water moves rapidly through these soils, and the available moisture capacity is low. Crops commonly lack moisture. These soils are medium acid to a depth of more than 40 inches. They are low in organic-matter content and are readily depleted of organic matter if cultivated. Fertility is low. Wind erosion is a serious hazard if fields are left barren.

The major limitations are droughtiness, low fertility, difficulty of maintaining the organic-matter content, and hazard of wind erosion.

The soils of this unit are poorly suited to cultivated crops. If crops are grown, measures should be taken to control erosion and to increase the organic-matter content. Early maturing crops and crops that can withstand long dry periods are most suitable. If tillage is kept to a minimum, all crop residues are returned to the soils, and large amounts of organic materials are added, the cropping sequence can be as intensive as a row crop, a small grain, and then a meadow crop. Windbreaks and wind stripcropping help to reduce loss of both soil and moisture.

Although these soils are poorly suited to forage crops, they warm up early in spring and can be used for the production of forage early in the season. Forage crops are affected by a lack of moisture during the summer months.

Soil management unit 5aC (VIs)

This unit consists of sloping and rolling, well drained and moderately well drained soils that have a coarse-textured subsoil. Water moves rapidly through these soils, and the available moisture capacity is low. Plants commonly are damaged by lack of moisture. Fertility is low, and the organic-matter content is also low. These soils are readily depleted of organic material if cultivated. They are highly susceptible to wind erosion and, because of the slope, are also subject to water erosion. They are medium acid to a depth of more than 40 inches.

The major limitations are hazard of erosion, droughtiness, and difficulty of maintaining the organic-matter content and fertility.

The soils of this unit are poorly suited to cultivated crops. The available moisture capacity is not sufficient for most of the crops commonly grown in the county. Early maturing crops can be grown if a large amount of organic material is added to the soils. A cropping sequence that consists of a row crop, a small grain, and 2 years of meadow is suitable if all residues are returned to the soils, tillage is kept to a minimum, and level terraces are constructed. Even then, yields will be low. If crops are grown, windbreaks and wind strips help to reduce the loss of both soil and moisture.

Yields of forage crops are fair in spring and low during the dry summer months.

Soil management unit 5aD (VIIs)

This unit consists of moderately steep, well-drained soils that have a coarse-textured subsoil. Water moves rapidly through these soils, and the available moisture capacity is low. Most crops lack moisture during dry periods. These soils are low in organic-matter content and low in fertility. They are readily depleted of organic-matter if cultivated. They are susceptible to both wind and water erosion.

The major limitations are hazard of erosion, droughtiness, difficulty of maintaining both the organic-matter content and fertility, and restrictions in the use of equipment.

These soils are not suitable for cultivated crops and have low value for forage crops. They warm up early in spring, however, and for this reason can be used for forage crops that mature early in the season.

Soil management unit 5aEF (VIIs)

This unit consists of steep and very steep, well-drained soils that have a coarse-textured subsoil. Water moves rapidly through these soils, and the available moisture capacity is low. The organic-matter content and fertility are also low. These soils are highly susceptible to erosion. The use of equipment is restricted because slopes are steep.

These soils are not suited to either cultivated crops or forage crops. They are suited to trees, but potential productivity is low for hardwoods and medium or high for pine.

Soil management unit 5bA (IVw)

This unit consists of level, somewhat poorly drained soils that have a coarse-textured subsoil. The water table fluctuates and in undrained areas is at or near the surface during part of the year. If the water table is lowered, the rate of air and water movement through the soils is rapid. These soils are low in available moisture capacity, moderate in organic-matter content, and low in fertility. They are medium acid.

The major limitations are excess wetness and the difficulty of maintaining fertility and the organic-matter content.

Artificial drainage is needed if the soils of this unit are used for cultivated crops. Tile lines are difficult to install in the sandy soil material, and tiling must be done during the driest part of the year. There is some risk of sand entering the tile lines. Open ditches can also be used to drain these soils, but their banks will be unstable. If tillage is kept to a minimum, and all residues are returned to the soils, a suitable cropping sequence consists of a row crop, a row crop, a small grain, and then a meadow crop. Yields will be moderately low, and in places crops may be damaged by frost.

These soils are well suited to forage crops. The selection of forage crops depends on the degree of wetness of the area. Grazing needs to be restricted during wet periods.

Soil management unit 5cA (IIIw)

This unit consists of level, very poorly drained soils that have a coarse-textured subsoil. In undrained areas, the water table is at or near the surface during wet periods. Water moves rapidly through the soils if the water table is lowered. These soils are high in organic-matter content, moderately low in available moisture capacity, and moderately low in fertility. They occur mainly in depressions and are susceptible to frost damage.

The major limitations are excess wetness, difficulty in maintaining fertility, and hazard of damage by frost.

The soils of this unit are poorly suited to crops and are seldom cultivated. Occasionally, they are used for special crops. Yields are low.

Forage crops grow well on these soils. The selection of forage crops depends on the degree of wetness of the area.

Soil management unit 5.7aA–F (VIIs)

In this unit are level to steep, well-drained soils that have a coarse-textured subsoil. These soils consist mainly of medium-textured and coarse-textured sand. The rate of air and water movement through the soils is very rapid. The available moisture capacity is low, fertility is low, and the reaction is strongly acid.

These soils are not suited to crops or to the production of forage. They can be used for trees, but yields of woodcrops are poor.

Soil management unit Sa (VIIIs)

This unit consists of miscellaneous land types, such as Gravel pits and Made land. These miscellaneous land types generally are not suitable for agricultural use. Gravel pits represent land from which the soil layers have been removed, and the sand and gravel excavated for commercial use. Some of the pits contain water and may be suitable for recreational uses or as a limited source of water. Made land represents areas that have been covered by fill material or that have been scraped off to such a depth that the natural soil characteristics have been destroyed. Most of these areas are in commercial or residential uses.

Soil management unit L–2aA (IIw)

This unit consists of level to undulating, well drained and moderately well drained soils that have a medium-textured subsoil. These soils are on the flood plains of streams throughout the county. They are subject to flooding and are susceptible to some frost damage if air drainage is restricted. The rate of air and water movement through the soils is moderate to moderately rapid, and the available moisture capacity is moderately low or medium.

The major limitation is the hazard of flooding.

The soils of this unit are well suited to cultivated crops if fields are protected from flooding. If all residues are returned to the soils, and tillage is kept to a minimum, a suitable cropping sequence consists of a row crop, a cover crop, and a row crop.

These soils are productive of forage crops, provided fertilization is adequate.

Soil management unit L–2cA (IIIw)

This unit consists of level and undulating, somewhat poorly drained and very poorly drained soils that have a moderately fine textured or medium-textured subsoil. These soils are on the flood plains of streams throughout the county. The rate of air and water movement through the soils is moderately rapid to moderately slow, and the available moisture capacity is moderately low to high. The water table is high. Runoff is slow. Crops seldom lack moisture, even during extended dry periods. The soils of this unit are high in organic-matter content and have good soil structure. A few areas are stony and are not suited to crops unless the stones are removed. These stony areas are indicated on the soil map by stone symbols.

The major limitations are the high water table and the hazard of flooding.

If protected from flooding and artificially drained, these soils are well suited to cultivated crops. In places, where air drainage is inadequate, the possibility of frost damage is a hazard. Generally, these soils can be used for row crops if all residues are returned to the soils and tillage is kept to a minimum. Because of the texture of the subsoil, tile lines are easily installed and are easily maintained.

Drained areas are well suited to all of the forage crops commonly grown in the county. Only water-tolerant plants are suitable in undrained areas.

Soil management unit L–4aA (IIIw)

This unit consists of level to undulating, well drained and moderately well drained soils that have a coarse-textured subsoil. These soils are on flood plains along streams throughout the county. The rate of air and water movement through the soils is very rapid. The available moisture capacity is low, and crops lack mois-

ture during extended dry periods. The organic-matter content is moderately low and is readily depleted. Runoff is slow.

The major limitations are the difficulty of maintaining the organic-matter content, droughtiness, and the hazard of flooding.

These soils are suited to crops, but yields may be lower than on other soils along stream bottoms. Any cropping system used should include crops that produce large amounts of organic material that can be returned to the soils. A fertilization program that results in the production of large amounts of organic material is desirable.

The soils of this unit are moderately well suited to the forage crops commonly grown in the county.

Soil management unit L–4cA (IIIw)

This unit consists of level to undulating, somewhat poorly drained and poorly drained soils that have a coarse textured subsoil. These soils are on flood plains along streams throughout the county. In undrained areas, the water table is high. All of the soils of this unit except Kerston muck have moderately low or low available moisture capacity. The Kerston has high capacity. Maintenance of the organic-matter content is somewhat difficult because of the texture of the soil material.

The major limitations are hazard of flooding, the high water table, some droughtiness, and difficulty of maintaining the organic-matter content.

If drained and protected from flooding, these soils are suited to crops. Yields are moderate. Generally, if the cropping sequence consists of a row crop, a cover crop, a row crop, and a small grain, there is enough residue to maintain these soils. Tillage should be kept to a minimum.

Drained areas are well suited to the forage crops commonly grown in the county. Only water-tolerant forage crops are suitable in undrained areas.

Soil management unit McA (IIIw)

This unit consists of very poorly drained organic soils that are more than 42 inches thick. The Rifle soils are strongly acid or medium acid; the Lupton are neutral or alkaline; and the other soils in this unit are medium acid or slightly acid. In undrained areas, the water table is at the surface during much of the year. Fertility is high. These soils are more likely to be affected by frost than the higher lying mineral soils.

The major limitations are the high water table, the hazard of wind erosion, and the need for special fertilization.

Before these soils are used for crops, measures need to be taken to control the water level. Also, practices that help to control wind erosion are needed in cultivated fields. These soils are well suited to corn, sugarbeets, vegetables, and grasses. They can be used for the same crop year after year if diseases are controlled.

The soils in this unit are well suited to the forage grasses commonly grown in the county.

Soil management unit M/4cA (IVw)

This unit consists of shallow organic soils that are underlain by mineral soils at a depth of 12 to 42 inches. The Willette soils are underlain by clay; the Linwood, by loam; and the Tawas, by sand. If the organic layer of the Willette soils is destroyed, the heavy plastic clay will be exposed. All of these soils have high available moisture capacity, but the Tawas soils may become droughty if overdrained. Drained areas are susceptible to wind erosion. The soils of this unit are in low areas. Consequently, the risk of frost damage is high.

The major limitations are excess wetness, hazard of wind erosion, and need for special fertilization.

Drained areas, protected from damage by frost, are well suited to both special crops and to general field crops. Both tile and open ditches provide satisfactory drainage, but in the Tawas soils tile is difficult to install in the underlying sand. If these soils are cultivated, measures need to be taken to control the water level. Practices that help to control wind erosion are also needed in cultivated fields.

The soils of this unit are well suited to forage crops. The selection of forage crops depends on the degree of wetness of the area. Grazing needs to be restricted through wet periods.

Soil management unit M/mcA (VIw)

This unit consists of level, poorly drained soils that formed in alluvium and marl. The marl is at or near the surface, and the movement of water through the marl is slow. The water table is high. These soils generally are alkaline in reaction.

The major limitations are the high water table, the extremely alkaline soil reaction, and the slow movement of water through the marl.

Normally, these soils are not suited to cultivated crops but are moderately productive of forage crops.

Soil management unit M/mcAB (IVw)

This unit consists of shallow organic soils that are underlain by marl at a depth of less than 42 inches. The rate of water movement through these soils varies because of the differences in the marl. The water table normally is at or near the surface during part or all of the year.

These soils are not well suited to crops because of the difficulty of drainage and the likelihood of damage by frost. Also, the soils commonly are alkaline in reaction because of the marl. The desirability of using these soils for crops depends on the difficulty of installing a drainage system, on the soil reaction, and the hazard of frost. If the marl does not interfere with the installation of drains, the soils are productive. When drainage is installed, the selection of crops depends on the reaction of the soil material.

Forage crops are well suited if care is taken in the selection of crops. Only water-tolerant plants are suitable in wet areas. Grazing needs to be restricted through wet periods.

Predicted Yields

The predicted average acre yields of the principal crops grown in Ionia County are given in table 3. The estimates are given for each soil at two levels of management. The data are based on information obtained from farmers, from members of the staff of the Michigan Agri-

TABLE 3.—*Predicted average acre yields of principal crops under two evels of management*

[Yields in columns A are to be expected under common management; yields in columns B are to be expected under improved management. Dashes indicate that the soil is not suited to the crop specified, or that the crop ordinarily is not grown]

Soil	Corn				Oats		Wheat		Soybeans		Alfalfa and bromegrass		Clover and timothy	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Abscota loam	45	75	8	14	45	80	25	45	20	30	2.0	3.7	1.7	2.5
Abscota loamy sand	45	75	8	14	45	80	25	45	20	30	2.0	3.7	1.7	2.5
Abscota sandy loam	45	75	8	14	45	80	25	45	20	30	2.0	3.7	1.7	2.5
Algansee loam	50	80	9	15	45	80	25	45	22	32	2.0	3.7	1.7	2.5
Algansee loamy sand	50	80	9	15	45	80	25	45	22	32	2.0	3.7	1.7	2.5
Algansee sandy loam	50	80	9	15	45	80	25	45	22	32	2.0	3.7	1.7	2.5
Alluvial land, marl substratum	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Au Gres sand	25	48	4	8	30	60	10	20	----	----	1.5	2.0	.9	1.5
Barry loam	50	80	9	15	40	75	27	45	22	32	2.1	3.3	1.7	2.5
Barry sandy loam	50	80	9	15	40	75	27	45	22	32	2.1	3.3	1.7	2.5
Belding sandy loam, 0 to 2 percent slopes	45	70	8	13	40	75	27	45	20	30	2.1	3.8	1.7	2.4
Belding sandy loam, 2 to 6 percent slopes	45	70	8	13	40	75	27	45	20	30	2.1	3.8	1.7	2.4
Bergland silty clay loam	35	70	13	16	45	65	27	40	23	35	2.4	3.5	2.0	2.8
Berville loam	50	80	9	15	42	70	28	45	22	32	2.1	3.3	1.8	2.5
Berville sandy loam	50	80	9	15	42	70	28	45	22	32	2.1	3.3	1.8	2.5
Blount loam, 0 to 2 percent slopes	45	80	8	15	50	72	27	43	22	34	2.3	3.5	1.9	2.6
Blount loam, 2 to 6 percent slopes	45	80	8	15	50	72	27	43	22	34	2.3	3.5	1.9	2.6
Blount loam, 2 to 6 percent slopes, moderately eroded	40	70	7	13	45	62	22	37	17	25	2.0	3.0	1.5	2.2
Boyer loamy sand, 0 to 2 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Boyer loamy sand, 2 to 6 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Boyer loamy sand, 2 to 6 percent slopes, moderately eroded	30	60	5	11	25	45	15	25	10	18	1.5	2.6	1.2	2.0
Boyer loamy sand, 6 to 12 percent slopes, moderately eroded	30	55	5	11	20	40	10	20	10	15	1.5	2.6	1.2	2.0
Boyer loamy sand, 12 to 18 percent slopes, moderately eroded	----	----	----	----	15	35	10	15	----	----	1.2	2.0	.9	1.6
Boyer loamy sand, 18 to 25 percent slopes, moderately eroded	----	----	----	----	15	30	10	15	----	----	1.2	2.0	.9	1.6
Boyer loamy sand, 25 to 40 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Boyer sandy loam, 0 to 2 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Boyer sandy loam, 2 to 6 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Boyer sandy loam, 2 to 6 percent slopes, moderately eroded	30	60	5	11	25	45	15	25	10	18	1.5	2.6	1.2	2.0
Boyer sandy loam, 6 to 12 percent slopes, moderately eroded	30	55	5	11	20	40	10	20	10	15	1.5	2.6	1.2	2.0
Boyer sandy loam, 12 to 18 percent slopes, moderately eroded	----	----	----	----	15	35	10	15	----	----	1.2	2.0	.9	1.6
Boyer very stony loamy sand, 0 to 2 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Boyer very stony loamy sand, 2 to 6 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Boyer very stony loamy sand, 6 to 12 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Boyer and Spinks loamy sands, 0 to 2 percent slopes:														
Boyer	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Spinks	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Boyer and Spinks loamy sands, 2 to 6 percent slopes:														
Boyer	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Spinks	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded:														
Boyer	30	60	5	11	25	45	15	25	10	18	1.5	2.6	1.2	2.0
Spinks	30	55	5	10	25	45	15	25	12	20	1.3	2.4	1.0	2.9
Boyer and Spinks loamy sands 6 to 12 percent slopes, moderately eroded:														
Boyer	30	55	5	11	20	40	10	20	10	15	1.5	2.6	1.2	2.0
Spinks	25	50	4	9	20	40	10	20	8	10	1.3	2.4	1.0	1.9
Boyer and Spinks loamy sands, 12 to 18 percent slopes, moderately eroded:														
Boyer	----	----	----	----	15	35	10	15	----	----	1.2	2.0	.9	1.6
Spinks	----	----	----	----	15	35	10	15	----	----	1.2	2.0	.8	1.7
Boyer and Spinks loamy sands, 18 to 25 percent slopes, moderately eroded	----	----	----	----	15	30	10	15	----	----	1.2	2.0	.9	1.6
Boyer and Spinks loamy sands, 25 to 40 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Breckenridge sandy loam	50	80	9	15	42	70	28	45	22	32	2.1	3.3	1.8	2.5
Brevort loamy sand	38	70	7	13	35	70	22	35	20	30	1.8	3.0	1.5	2.3
Brookston loam	55	90	11	16	50	80	30	48	25	40	2.5	3.8	2.0	2.9
Cadmus loam, 0 to 2 percent slopes	50	85	9	15	40	75	32	45	20	35	2.4	4.0	1.5	2.2
Cadmus loam, 2 to 6 percent slopes	45	80	8	14	35	70	28	40	15	30	2.4	4.0	1.5	2.2
Cadmus sandy loam, 0 to 2 percent slopes	55	90	11	16	50	80	32	45	20	35	2.4	4.0	1.5	2.2
Cadmus sandy loam, 2 to 6 percent slopes	45	80	8	14	40	75	28	40	15	30	2.4	4.0	1.5	2.2
Capac loam, 0 to 2 percent slopes	55	90	11	16	48	75	28	45	23	35	2.3	3.5	1.8	2.6
Capac loam, 2 to 6 percent slopes	55	90	11	16	48	75	28	45	23	35	2.3	3.5	1.8	2.6

TABLE 3.—*Predicted average acre yields of principal crops under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Soybeans		Alfalfa and bromegrass		Clover and timothy	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Capac sandy loam, 0 to 2 percent slopes	55	90	11	16	48	75	28	45	23	35	2.3	3.5	1.8	2.6
Capac sandy loam, 2 to 6 percent slopes	55	90	11	16	48	75	28	45	23	35	2.3	3.5	1.8	2.6
Carlisle muck	60	90	11	16										
Celina loam, 0 to 2 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Celina loam, 2 to 6 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Celina loam, 2 to 6 percent slopes, moderately eroded	45	82	8	15	43	65	27	40	20	30	2.3	4.0	1.8	2.6
Celina loam, 6 to 12 percent slopes, moderately eroded	40	75	7	14	35	60	25	35	15	25	2.3	4.0	1.8	2.6
Ceresco-Shoals loams	40	90	7	16	45	80	22	40	20	40	2.1	3.8	1.8	2.9
Ceresco-Shoals sandy loams	40	90	7	16	45	80	22	40	20	40	2.1	3.8	1.8	2.9
Chelsea loamy sand, 0 to 2 percent slopes	20	40	4	7	18	34	13	22			1.2	2.0	1.0	1.5
Chelsea loamy sand, 2 to 6 percent slopes	20	40	4	7	18	34	13	22			1.2	2.0	1.0	1.5
Chelsea loamy sand, 2 to 6 percent slopes, moderately eroded	20	30	4	5	15	30	10	19			1.2	2.0	1.0	1.5
Chelsea loamy sand, 6 to 12 percent slopes, moderately eroded	20	30	4	5	15	30	10	19			1.2	2.0	1.0	1.5
Chelsea sand, 0 to 2 percent slopes	20	35	4	6	18	34	13	22			1.2	2.0	1.0	1.5
Chelsea sand, 2 to 6 percent slopes	20	35	4	6	18	34	13	22			1.2	2.0	1.0	1.5
Chelsea sand, 2 to 6 percent slopes, moderately eroded	18	30	3	5	15	30	10	19			1.2	2.0	1.0	1.5
Chelsea sand, 6 to 12 percent slopes, moderately eroded	18	30	3	5	15	30	10	19			1.2	2.0	1.0	1.5
Cohoctah-Sloan loams	40	90	7	16	45	80	22	40	20	40	2.1	3.8	1.8	2.9
Cohoctah-Sloan sandy loams	40	90	7	16	45	80	22	40	20	40	2.1	3.8	1.8	2.9
Colwood loam	55	90	10	16	50.	80	30	48	25	40	2.5	3.8	2.0	2.9
Conover loam, 0 to 2 percent slopes	55	90	10	16	48	75	28	45	23	35	2.3	3.5	1.8	2.6
Conover loam, 2 to 6 percent slopes	55	90	10	16	55	75	28	45	23	35	2.3	3.5	1.8	2.6
Conover loam, 2 to 6 percent slopes, moderately eroded	50	85	9	15	50	70	25	40	20	30	2.3	3.5	1.8	2.6
Conover extremely stony loam, 2 to 6 percent slopes														
Coral loam, 0 to 2 percent slopes	50	85	9	15	40	70	27	42	20	35	2.0	3.0	1.6	2.4
Coral loam, 2 to 6 percent slopes	50	85	9	15	40	70	27	42	20	35	2.0	3.0	1.6	2.4
Coral sandy loam, 0 to 2 percent slopes	50	85	9	15	40	70	27	42	20	35	2.0	3.0	1.6	2.4
Coral sandy loam, 2 to 6 percent slopes	50	85	9	15	40	70	27	42	20	35	2.0	3.0	1.6	2.4
Dighton clay loam, 6 to 12 percent slopes, severely eroded											1.0	2.7	.9	2.0
Dighton sandy loam, 0 to 2 percent slopes	40	75	7	14	50	70	25	40	20	30	2.3	3.2	1.8	2.5
Dighton sandy loam, 2 to 6 percent slopes	40	75	7	14	50	70	25	40	20	30	2.3	3.2	1.8	2.5
Dighton sandy loam, 2 to 6 percent slopes, moderately eroded	35	70	6	13	45	65	20	35	15	25	2.3	3.2	1.8	2.5
Dighton sandy loam, 6 to 12 percent slopes, moderately eroded	30	65	5	12	40	60	15	30	10	20	2.3	3.2	1.8	2.5
Dryden sandy loam, 0 to 2 percent slopes	52	85	9	15	35	70	28	45	20	35	2.2	3.8	1.4	2.2
Dryden sandy loam, 2 to 6 percent slopes	45	75	7	14	30	65	25	40	18	30	2.2	3.8	1.4	2.2
Dryden sandy loam, 2 to 6 percent slopes, moderately eroded	40	70	6	13	25	60	20	35	15	25	2.2	3.8	1.4	2.2
Edmore sandy loam	38	70	6	13	35	58	22	35	20	30	1.8	3.0	1.5	2.3
Edwards muck	45	70												
Edwards muck, sloping	45	70												
Ensley loam	50	80	9	15	40	75	27	45	22	32	2.1	3.3	1.7	2.5
Epoufette loamy sand	25	48	4	8	20	45	12	25	10	25	1.2	2.2	1.0	1.8
Epoufette sandy loam	25	48	4	8	20	45	12	25	10	25	1.2	2.2	1.0	1.8
Fox sandy loam, 0 to 2 percent slopes	52	80	9	15	30	65	24	40	15	30	2.2	3.8	1.4	2.2
Fox sandy loam, 2 to 6 percent slopes	50	80	9	15	25	60	20	35	15	30	2.2	3.8	1.4	2.2
Fox sandy loam, 2 to 6 percent slopes, moderately eroded	45	75	7	14	25	60	15	30	10	25	2.2	3.8	1.4	2.2
Fox sandy loam, 6 to 12 percent slopes	45	75	8	14	25	60	15	30	10	25	2.2	3.8	1.4	2.2
Fox sandy loam 6 to 12 percent slopes, moderately eroded	40	70	7	13	25	55	15	30	10	20	2.2	3.8	1.4	2.2
Fox sandy loam, 12 to 18 percent slopes, moderately eroded					25	50	12	27			2.0	3.5	1.3	1.9
Fox sandy loam, 18 to 25 percent slopes, moderately eroded					25	45	10	25			2.0	3.0	1.3	1.9
Fox sandy loam, 25 to 40 percent slopes														
Fox stony sandy loam, 2 to 6 percent slopes														
Fox sandy clay loam, 6 to 12 percent slopes, severely eroded	25	50	4	9	25	40	15	25			1.5	2.5	.9	1.4
Fox sandy clay loam, 12 to 18 percent slopes, severely eroded					20	30	10	20			1.5	2.5	.9	1.4
Fox sandy clay loam, 18 to 25 percent slopes, severely eroded											1.0	2.0	.9	1.4
Fox sandy clay loam, 25 to 40 percent slopes, severely eroded														
Gilford loamy sand	38	70	6	13	35	58	22	35	20	30	1.8	3.0	1.5	2.3
Gilford sandy loam	38	70	6	13	35	58	22	35	20	30	1.8	3.0	1.5	2.3
Gladwin loamy sand, 0 to 2 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Gladwin loamy sand, 2 to 6 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Gladwin sandy loam, 0 to 2 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Gladwin sandy loam, 2 to 6 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Glendora loam	38	70	7	13	35	58	22	35	20	30	1.8	3.0	1.5	2.3
Glendora sandy loam	38	70	7	13	35	58	22	35	20	30	1.8	3.0	1.5	2.3
Granby loamy sand	25	48	5	9	22	45	12	25	10	25	1.2	2.2	1.0	1.8
Gravel pits														
Grayling sand, 0 to 6 percent slopes														
Grayling sand, 2 to 6 percent slopes, moderately eroded														
Grayling sand, 6 to 12 percent slopes														

TABLE 3.—*Predicted average acre yields of principal crops under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Soybeans		Alfalfa and bromegrass		Clover and timothy	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Grayling sand, 6 to 12 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Grayling sand, 12 to 18 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Grayling sand, 12 to 18 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Grayling sand, 18 to 40 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Ionia loam, 0 to 2 percent slopes	52	85	9	15	35	70	28	45	20	35	2. 2	3. 8	1. 4	2. 2
Ionia loam, 2 to 6 percent slopes	48	80	8	14	30	65	24	40	18	30	2. 2	3. 8	1. 4	2. 2
Ionia sandy loam, 0 to 2 percent slopes	52	85	9	15	35	70	28	45	20	35	2. 2	3. 8	1. 4	2. 2
Ionia sandy loam, 2 to 6 percent slopes	48	80	8	14	30	65	24	40	18	30	2. 2	3. 8	1. 4	2. 2
Ionia sandy loam, 2 to 6 percent slopes, moderately eroded	45	75	8	13	25	60	20	35	15	25	2. 2	3. 8	1. 4	2. 2
Iosco loamy sand, 0 to 2 percent slopes	38	70	6	12	35	58	22	33	18	30	1. 8	3. 0	1. 5	2. 3
Iosco loamy sand, 2 to 6 percent slopes	38	70	6	12	35	58	22	33	18	30	1. 8	3. 0	1. 5	2. 3
Kawkawlin loam, 0 to 2 percent slopes	35	65	6	11	48	65	25	38	20	32	2. 2	3. 1	1. 6	2. 3
Kawkawlin loam, 2 to 6 percent slopes	35	65	6	11	48	65	25	38	20	32	2. 2	3. 1	1. 6	2. 3
Kawkawlin sandy loam, 0 to 2 percent slopes	35	65	6	11	48	65	25	38	20	32	2. 2	3. 1	1. 6	2. 3
Kawkawlin sandy loam, 2 to 6 percent slopes	35	65	6	11	48	65	25	38	20	32	2. 2	3. 1	1. 6	2. 3
Kendallville loam, 0 to 2 percent slopes	50	85	9	15	40	75	38	45	20	35	2. 4	4. 0	1. 5	2. 2
Kendallville loam, 2 to 6 percent slopes	45	80	8	14	40	70	27	40	20	30	2. 4	4. 0	1. 5	2. 2
Kendallville loam, 2 to 6 percent slopes, moderately eroded	40	75	7	13	35	65	22	35	15	25	2. 4	4. 0	1. 5	2. 2
Kendallville loam, 6 to 12 percent slopes, moderately eroded	40	75	7	13	35	65	22	35	10	20	2. 4	4. 0	1. 5	2. 2
Kendallville sandy clay loam, 6 to 12 percent slopes, severely eroded	35	65	6	12	25	50	17	25	----	----	2. 0	3. 5	1. 0	1. 7
Kendallville sandy loam, 2 to 6 percent slopes	50	80	8	14	35	65	25	35	15	25	2. 2	3. 8	1. 5	2. 2
Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded	45	75	7	13	30	60	20	30	----	----	2. 2	3. 6	1. 5	2. 2
Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded	40	65	6	11	25	55	20	25	----	----	2. 0	3. 5	1. 0	1. 7
Kendallville sandy loam, 12 to 18 percent slopes, moderately eroded	----	----	----	----	25	50	15	20	----	----	1. 8	3. 2	1. 0	1. 7
Kent soils, 2 to 6 percent slopes	35	65	6	12	45	60	20	30	18	28	2. 1	3. 0	1. 6	2. 3
Kent soils, 6 to 12 percent slopes	30	60	5	11	40	55	20	25	15	25	2. 1	3. 0	1. 6	2. 3
Kent soils, 12 to 18 percent slopes	----	----	----	----	35	50	15	20	----	----	1. 7	2. 5	1. 2	2. 0
Kent silty clay, 6 to 12 percent slopes, severely eroded	----	----	----	----	20	30	10	20	----	----	1. 5	2. 0	. 9	1. 5
Kerston muck	50	90	9	16	----	----	----	----	20	40	----	----	----	----
Kibbie loam, 0 to 2 percent slopes	50	85	9	15	40	70	27	42	20	35	2. 0	3. 0	1. 6	2. 4
Kibbie loam, 2 to 6 percent slopes	50	85	9	15	40	70	27	42	20	35	2. 0	3. 0	1. 6	2. 4
Kokomo clay loam	55	90	10	16	50	80	30	58	25	40	2. 5	3. 8	2. 0	2. 9
Landes-Eel loams	45	90	8	16	35	70	24	45	20	35	1. 8	3. 5	1. 6	2. 5
Landes-Eel sandy loams	45	85	8	15	35	65	24	40	20	30	1. 8	3. 5	1. 6	2. 5
Landes-Genesee loams	45	90	8	16	35	70	24	45	20	35	1. 8	3. 5	1. 6	2. 5
Landes-Genesee sandy loams	45	90	8	16	35	70	24	45	20	35	1. 8	3. 5	1. 6	2. 5
Lapeer loam, 0 to 2 percent slopes	52	85	9	15	35	70	28	45	20	35	2. 2	3. 8	1. 4	2. 2
Lapeer loam, 2 to 6 percent slopes	47	80	8	14	30	65	24	40	15	25	2. 2	3. 8	1. 4	2. 2
Lapeer loam, 2 to 6 percent slopes, moderately eroded	40	70	7	13	25	55	20	35	10	20	2. 2	3. 8	1. 4	2. 2
Lapeer loam, 6 to 12 percent slopes, moderately eroded	35	65	6	12	20	50	15	30	10	15	2. 2	3. 8	1. 4	2. 2
Lapeer sandy clay loam, 6 to 12 percent slopes, severely eroded	25	50	4	9	15	40	10	22	----	----	2. 0	3. 5	1. 2	1. 7
Lapeer sandy clay loam, 12 to 18 percent slopes, severely eroded	----	----	----	----	20	35	15	25	----	----	2. 2	3. 8	1. 4	2. 2
Lapeer sandy clay loam, 18 to 40 percent slopes, severely eroded	----	----	----	----	20	35	15	25	----	----	2. 0	3. 5	1. 2	1. 7
Lapeer sandy loam, 0 to 2 percent slopes	50	80	8	14	30	65	28	40	20	30	2. 2	3. 8	1. 4	2. 2
Lapeer sandy loam, 2 to 6 percent slopes	50	75	8	13	25	60	24	40	15	25	2. 2	3. 8	1. 4	2. 2
Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	45	65	8	12	25	55	20	35	15	20	2. 2	3. 8	1. 4	2. 2
Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	30	60	5	11	20	50	15	30	----	----	2. 2	3. 8	1. 4	2. 2
Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	----	----	----	----	20	35	15	25	----	----	2. 0	3. 5	1. 4	2. 2
Lapeer sandy loam, 18 to 40 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	1. 6	3. 0	. 9	1. 5
Linwood muck	60	90	11	16	40	60	----	----	28	40	2. 3	3. 5	2. 0	2. 9
Locke sandy loam, 0 to 2 percent slopes	45	80	8	14	40	65	25	37	15	30	2. 0	3. 0	1. 6	2. 4
Locke sandy loam, 2 to 6 percent slopes	45	80	8	14	40	65	25	37	15	30	2. 0	3. 0	1. 6	2. 4
Lupton muck	60	90	11	16	----	----	----	----	----	----	----	----	----	----
Macomb loam, 0 to 2 percent slopes	45	70	8	13	40	75	28	45	20	30	2. 1	3. 8	1. 7	2. 4
Macomb loam, 2 to 6 percent slopes	45	70	8	13	40	75	28	45	20	30	2. 1	3. 8	1. 7	2. 4
Made land	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mancelona loamy sand, loamy substratum, 2 to 6 percent slopes	35	65	6	12	30	50	20	30	16	24	1. 5	2. 6	1. 2	2. 0
Mancelona loamy sand, loamy substratum, 6 to 12 percent slopes, moderately eroded	25	55	4	11	20	40	10	20	10	15	1. 5	2. 6	1. 2	2. 0

TABLE 3.—*Predicted average acre yields of principal crops under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Soybeans		Alfalfa and bromegrass		Clover and timothy	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Mancelona-Chelsea loamy sands, 0 to 2 percent slopes:														
Mancelona	35	65	5	12	30	50	20	30	----	----	1.5	2.6	1.2	2.0
Chelsea	20	40	4	7	18	34	13	22	----	----	1.2	2.0	1.0	1.5
Mancelona-Chelsea loamy sands, 2 to 6 percent slopes:														
Mancelona	35	65	5	12	30	50	20	30	----	----	1.5	2.6	1.2	2.0
Chelsea	20	40	4	7	18	34	13	22	----	----	1.2	2.0	1.0	1.5
Mancelona-Chelsea loamy sands, 2 to 6 percent slopes, moderately eroded:														
Mancelona	30	60	5	11	25	45	15	25	----	----	1.5	2.6	1.2	2.0
Chelsea	20	30	4	5	15	30	10	19	----	----	1.2	2.0	1.0	1.5
Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, moderately eroded:														
Mancelona	25	50	4	9	25	40	18	25	----	----	1.5	2.6	1.2	2.0
Chelsea	20	30	4	5	15	30	10	19	----	----	1.2	2.0	1.0	1.5
Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, severely eroded	25	45	4	8	25	40	18	25	----	----	1.5	2.6	1.2	2.0
Mancelona-Chelsea loamy sands, 12 to 18 percent slopes	----	----	----	----	22	35	17	22	----	----	1.2	2.2	.9	1.5
Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, moderately eroded	----	----	----	----	20	30	15	20	----	----	1.2	2.2	.9	1.5
Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, moderately eroded	----	----	----	----	20	30	10	15	----	----	.9	1.8	.6	1.3
Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mancelona-Chelsea loamy sands, 25 to 40 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mancelona-Chelsea stony complex, 0 to 2 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Marlette clay loam, 6 to 12 percent slopes, severely eroded	20	45	4	8	15	35	10	20	----	----	1.5	2.7	1.0	1.7
Marlette clay loam, 12 to 18 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	1.0	1.7	1.0	1.7
Marlette clay loam, 18 to 25 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Marlette loam, 0 to 2 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Marlette loam, 2 to 6 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Marlette loam, 2 to 6 percent slopes, moderately eroded	45	83	8	15	43	65	28	40	20	30	2.3	4.0	1.8	2.6
Marlette loam, 6 to 12 percent slopes, moderately eroded	40	80	7	14	40	62	25	37	18	28	2.3	4.0	1.8	2.6
Marlette loam, 12 to 18 percent slopes, moderately eroded	----	----	----	----	30	50	20	30	----	----	1.9	3.5	1.6	2.2
Marlette loam, 18 to 25 percent slopes, moderately eroded	----	----	----	----	25	45	15	25	----	----	1.5	3.0	1.2	1.9
Marlette loam, 25 to 40 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Marlette loamy sand, 2 to 6 percent slopes	45	85	8	16	48	65	32	40	20	30	2.3	4.0	1.8	2.6
Marlette loamy sand, 2 to 6 percent slopes, moderately eroded	40	80	7	15	43	60	28	38	15	25	2.3	4.0	1.8	2.6
Marlette loamy sand, 6 to 12 percent slopes, moderately eroded	40	75	7	14	40	55	23	35	10	20	2.3	4.0	1.8	2.6
Marlette sandy loam, 0 to 2 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Marlette sandy loam, 2 to 6 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Marlette sandy loam, 2 to 6 percent slopes, moderately eroded	45	83	8	15	43	65	28	40	20	30	2.3	4.0	1.8	2.6
Marlette sandy loam, 6 to 12 percent slopes, moderately eroded	40	80	7	14	40	62	25	37	18	28	2.3	4.0	1.6	2.2
Marlette sandy loam, 12 to 18 percent slopes, moderately eroded	----	----	----	----	30	50	20	30	----	----	1.9	3.5	1.6	2.2
Marlette sandy loam, 18 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	1.5	3.0	1.2	1.9
Matherton loam, 0 to 2 percent slopes	50	85	9	15	40	70	27	42	20	32	2.0	3.0	1.6	2.4
Matherton loam, 2 to 6 percent slopes	50	80	9	14	40	70	27	42	20	32	2.0	3.0	1.6	2.4
Matherton sandy loam, 0 to 2 percent slopes	50	85	9	16	40	70	27	42	20	35	2.0	3.0	1.6	2.4
Matherton sandy loam, 2 to 6 percent slopes	50	80	9	15	40	70	27	42	20	32	2.0	3.0	1.6	2.4
McBride loamy sand, 0 to 2 percent slopes	52	85	9	16	35	70	28	45	20	35	2.2	3.8	1.4	2.2
McBride loamy sand, 2 to 6 percent slopes	52	85	9	16	35	70	28	45	20	35	2.2	3.8	1.4	2.2
McBride loamy sand, 2 to 6 percent slopes, moderately eroded	45	77	8	14	30	60	24	40	15	25	1.9	3.4	1.1	1.9
McBride loamy sand, 6 to 12 percent slopes, moderately eroded	40	70	7	13	25	55	21	35	10	20	1.9	3.4	1.1	1.9
McBride sandy clay loam, 2 to 6 percent slopes, severely eroded	----	----	----	----	----	----	15	25	----	----	1.2	2.7	.7	1.2
McBride sandy clay loam, 6 to 12 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	1.2	2.7	.7	1.2

TABLE 3.—*Predicted average acre yields of principal crops under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Soybeans		Alfalfa and bromegrass		Clover and timothy	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
McBride sandy clay loam, 12 to 18 percent slopes, severely eroded											1.0	2.5	0.6	1.0
McBride sandy clay loam, 18 to 25 percent slopes, severely eroded											.9	1.9		
McBride sandy loam, 0 to 2 percent slopes	52	85	9	16	35	70	28	45	20	35	2.2	3.8	1.4	2.2
McBride sandy loam, 2 to 6 percent slopes	52	85	9	16	35	70	28	45	20	32	2.2	3.8	1.4	2.2
McBride sandy loam, 2 to 6 percent slopes, moderately eroded	45	77	8	14	30	60	24	40	15	25	1.9	3.4	1.2	2.0
McBride sandy loam, 6 to 12 percent slopes	45	77	8	14	30	60	24	40	15	25	1.9	3.4	1.2	2.0
McBride sandy loam, 6 to 12 percent slopes, moderately eroded	40	70	7	13	25	55	21	35	10	20	1.9	3.4	1.2	2.0
McBride sandy loam, 12 to 18 percent slopes, moderately eroded					20	45	17	30			1.5	3.0	1.4	1.8
McBride sandy loam, 18 to 25 percent slopes, moderately eroded											1.3	2.7	1.2	1.6
McBride sandy loam, 25 to 40 percent slopes, moderately eroded														
Menominee loamy sand, 0 to 2 percent slopes	30	55	5	10	25	40	17	26			1.3	2.3	1.1	1.7
Menominee loamy sand, 2 to 6 percent slopes	30	55	5	10	25	40	17	26			1.3	2.3	1.1	1.7
Menominee loamy sand, 2 to 6 percent slopes, moderately eroded	25	50	4	9	20	35	12	21			1.3	2.3	1.1	1.7
Menominee loamy sand, 6 to 12 percent slopes, moderately eroded	20	45	4	8	15	30	10	17			1.3	2.3	1.1	1.7
Menominee loamy sand, 6 to 12 percent slopes, severely eroded	15	35	3	6	10	25	9	14			1.1	2.1	1.0	1.5
Menominee loamy sand, 12 to 18 percent slopes, moderately eroded					10	25	9	14			1.1	2.1	1.0	1.5
Menominee loamy sand, 12 to 18 percent slopes, severely eroded											1.0	1.9	.9	1.3
Menominee loamy sand, 18 to 25 percent slopes, moderately eroded					10	20	7	10			1.0	1.9	.9	1.3
Metamora sandy loam, 0 to 2 percent slopes	45	70	8	13	40	75	28	45	20	30	2.1	3.8	1.7	2.4
Metamora sandy loam, 2 to 6 percent slopes	45	70	8	13	40	75	28	45	20	30	2.1	3.8	1.7	2.4
Miami clay loam, 2 to 6 percent slopes, severely eroded	25	50	4	9	25	50	15	25			1.5	2.7	1.0	1.7
Miami clay loam, 6 to 12 percent slopes, severely eroded	20	45	4	8	15	35	10	20			1.5	2.7	1.0	1.7
Miami clay loam, 12 to 18 percent slopes, severely eroded											1.5	2.7	1.0	1.7
Miami clay loam, 18 to 25 percent slopes, severely eroded														
Miami clay loam, 25 to 40 percent slopes, severely eroded														
Miami loam, 0 to 2 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Miami loam, 2 to 6 percent slopes	45	85	8	16	48	70	32	45	22	30	2.3	4.0	1.8	2.6
Miami loam, 2 to 6 percent slopes, moderately eroded	40	80	7	15	42	65	28	40	20	25	2.3	4.0	1.8	2.6
Miami loam, 6 to 12 percent slopes	40	80	7	15	42	65	28	40	20	25	2.3	4.0	1.8	2.6
Miami loam, 6 to 12 percent slopes, moderately eroded	35	75	6	14	37	60	23	35	15	20	2.3	4.0	1.8	2.6
Miami loam, 12 to 18 percent slopes, moderately eroded					30	55	15	30			2.0	3.7	1.5	2.3
Miami loam, 18 to 25 percent slopes, moderately eroded					20	45	15	25			1.8	3.5	1.3	2.1
Miami loam, 25 to 40 percent slopes														
Miami sandy loam, 2 to 6 percent slopes	45	85	8	16	48	70	32	45	22	30	2.3	4.0	1.8	2.6
Miami sandy loam, 2 to 6 percent slopes, moderately eroded	40	80	7	15	42	65	28	40	20	25	2.3	4.0	1.8	2.6
Miami sandy loam, 6 to 12 percent slopes, moderately eroded	35	75	5	14	37	60	23	35	15	20	2.3	4.0	1.8	2.6
Miami sandy loam, 12 to 18 percent slopes, moderately eroded					30	55	15	30			2.0	3.7	1.5	2.3
Miami-Owosso sandy loams, 0 to 2 percent slopes	40	80	7	14	38	60	25	35	20	30	2.0	3.5	1.5	2.0
Miami-Owosso sandy loams, 2 to 6 percent slopes	35	75	6	14	38	60	25	35	20	25	2.0	3.5	1.5	2.0
Miami-Owosso sandy loams, 2 to 6 percent slopes, moderately eroded	30	70	5	13	32	55	21	30	15	20	2.0	3.5	1.5	2.0
Miami-Owosso sandy loams, 6 to 12 percent slopes, moderately eroded	25	65	4	12	30	50	20	30	13	18	2.0	3.5	1.5	2.0
Miami-Owosso sandy loams, 12 to 18 percent slopes, moderately eroded					15	40	10	20			1.5	3.0	1.0	1.8
Montcalm loamy sand, 0 to 2 percent slopes	35	64	6	12	30	50	20	30			1.5	2.6	1.2	2.0
Montcalm loamy sand, 2 to 6 percent slopes	35	64	6	12	30	50	20	30			1.5	2.6	1.2	2.0
Montcalm loamy sand, 2 to 6 percent slopes, moderately eroded	27	55	5	10	22	42	17	25			1.5	2.6	1.2	2.0
Montcalm loamy sand, 6 to 12 percent slopes, moderately eroded	22	45	4	8	19	37	15	20			1.5	2.6	1.2	2.0
Montcalm loamy sand, 6 to 12 percent slopes, severely eroded					14	32	10	15			1.2	2.0	1.0	1.5
Montcalm loamy sand, 12 to 18 percent slopes, moderately eroded					14	32	10	15			1.2	2.2	1.1	1.6

TABLE 3.—*Predicted average acre yields of principal crops under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Soybeans		Alfalfa and bromegrass		Clover and timothy	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Montcalm loamy sand, 12 to 18 percent slopes, severely eroded											1.0	1.7	0.8	1.0
Montcalm loamy sand, 18 to 25 percent slopes, moderately eroded											1.2	2.2	1.1	1.6
Montcalm loamy sand, 18 to 25 percent slopes, severely eroded											.9	1.5	.7	.9
Montcalm loamy sand, 25 to 40 percent slopes, moderately eroded														
Montcalm sandy loam, 0 to 2 percent slopes	35	65	6	12	30	50	20	30			1.5	2.6	1.2	2.0
Montcalm sandy loam, 2 to 6 percent slopes	35	65	6	12	30	50	20	30			1.5	2.6	1.2	2.0
Montcalm sandy loam, 2 to 6 percent slopes, moderately eroded	27	55	5	10	22	42	17	25			1.5	2.6	1.2	2.0
Montcalm sandy loam, 6 to 12 percent slopes, moderately eroded	22	45	4	8	19	37	15	20			1.5	2.6	1.2	2.0
Morley clay loam, 6 to 12 percent slopes, severely eroded					30	50	10	25			1.7	2.5	1.2	1.8
Morley clay loam, 12 to 18 percent slopes, severely eroded					25	45	10	20			1.5	2.3	.9	1.5
Morley loam, 0 to 2 percent slopes	40	75	7	14	50	70	25	40	20	30	2.3	3.2	1.8	2.5
Morley loam, 2 to 6 percent slopes	40	75	7	14	50	70	25	40	20	25	2.3	3.2	1.8	2.5
Morley loam, 2 to 6 percent slopes, moderately eroded	35	67	6	12	45	65	20	35	15	20	2.1	3.0	1.6	2.3
Morley loam, 6 to 12 percent slopes, moderately eroded	30	60	5	11	40	60	15	30	10	15	2.1	3.0	1.6	2.3
Morley loam, 12 to 18 percent slopes, moderately eroded					35	55	15	25			1.9	2.7	1.4	2.0
Morley sandy loam, 2 to 6 percent slopes	40	75	7	14	50	70	25	40	20	30	2.3	3.2	1.8	2.5
Morley sandy loam, 2 to 6 percent slopes, moderately eroded	35	67	6	12	45	65	20	35	20	25	2.3	3.2	1.8	2.5
Morley sandy loam, 6 to 12 percent slopes, moderately eroded	30	60	5	11	40	60	15	30	15	20	2.1	3.0	1.6	2.3
Nester clay loam, 2 to 6 percent slopes, severely eroded					30	50	10	25			1.7	2.5	.9	1.5
Nester clay loam, 6 to 12 percent slopes, severely eroded					30	50	10	25			1.7	2.5	.9	1.5
Nester clay loam, 12 to 18 percent slopes, severely eroded					25	45	10	20			1.5	2.3	.7	1.2
Nester clay loam, 18 to 25 percent slopes, severely eroded														
Nester loam, 2 to 6 percent slopes	40	75	7	14	50	70	25	40	20	25	2.3	3.2	1.8	2.5
Nester loam, 2 to 6 percent slopes, moderately eroded	35	67	6	13	45	65	20	35	15	20	2.1	3.0	1.7	2.4
Nester loam, 6 to 12 percent slopes, moderately eroded	30	60	5	11	40	60	15	30	10	15	2.1	3.0	1.7	2.4
Nester sandy loam, 2 to 6 percent slopes	40	75	7	14	50	70	25	40	20	30	2.3	3.2	1.8	2.5
Nester sandy loam, 2 to 6 percent slopes, moderately eroded	35	67	6	12	45	65	20	35	15	20	2.1	3.0	1.6	2.3
Nester sandy loam, 6 to 12 percent slopes, moderately eroded	30	60	5	11	40	60	15	30	10	15	2.1	3.0	1.6	2.3
Nester sandy loam, 12 to 18 percent slopes					35	55	15	25			2.1	3.0	1.6	2.3
Newaygo sandy clay loam, 6 to 12 percent slopes, severely eroded											1.3	2.0	.5	.8
Newaygo sandy clay loam, 12 to 18 percent slopes, severely eroded											1.0	1.7	.5	.8
Newaygo sandy loam, 0 to 2 percent slopes	52	85	9	16	48	70	28	45	20	35	2.2	3.8	1.4	2.2
Newaygo sandy loam, 2 to 6 percent slopes	47	80	8	15	45	65	25	42	18	30	2.2	3.8	1.4	2.2
Newaygo sandy loam, 2 to 6 percent slopes, moderately eroded	42	75	7	14	40	60	22	39	15	27	2.0	3.5	1.2	2.0
Newaygo sandy loam, 6 to 12 percent slopes, moderately eroded	37	70	7	13	35	55	20	35	10	20	2.0	3.5	1.2	2.0
Newaygo sandy loam, 12 to 18 percent slopes, moderately eroded					30	50	15	30			1.8	3.2	1.0	1.8
Newaygo sandy loam, 18 to 40 percent slopes, moderately eroded					25	40	10	25			1.7	2.9	.8	1.5
Otisco loamy sand, 0 to 2 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Otisco loamy sand, 2 to 6 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Otisco sandy loam, 0 to 2 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Otisco sandy loam, 2 to 6 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Perrin loamy sand, 0 to 2 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Perrin loamy sand, 2 to 6 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Perrin loamy sand, 2 to 6 percent slopes, moderately eroded	28	58	5	10	25	45	18	25	10	15	1.5	2.6	1.2	2.0
Perrin sandy loam, 0 to 2 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Perrin sandy loam, 2 to 6 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Pewamo clay loam	50	85	9	16	50	75	27	47	25	38	2.4	3.7	2.0	2.8
Pewamo loam	50	85	9	16	50	75	27	47	25	38	2.4	3.7	2.0	2.8
Plainfield sand, slightly acid variant, 0 to 6 percent slopes	20	40	4	7	18	34	13	22			1.2	2.0	1.0	1.5
Plainfield sand, slightly acid variant, 6 to 12 percent slopes, moderately eroded	10	25	2	5	15	25	9	15			1.2	2.0	1.0	1.5
Plainfield sand, slightly acid variant, 12 to 18 percent slopes, moderately eroded					10	20	8	12			1.2	2.0	1.0	1.5
Plainfield sand, slightly acid variant, 18 to 25 percent slopes, moderately eroded											1.0	1.7	.8	1.2

TABLE 3.—*Predicted average acre yields of principal crops under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Soybeans		Alfalfa and bromegrass		Clover and timothy	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Rifle muck	60	90	11	16										
Saranac clay loam	50	90	9	16	40	80	25	45	20	40	2.0	3.8	1.5	2.9
Saranac silt loam	50	90	9	16	40	80	25	45	20	40	2.0	3.8	1.5	2.9
Sebewa loam	50	80	9	15	40	75	27	45	22	32	2.1	3.3	1.7	2.5
Selkirk loamy sand, 0 to 2 percent slopes	35	65	6	12	48	65	25	38	20	32	2.2	3.1	1.6	2.3
Selkirk silt loam, 0 to 2 percent slopes	35	65	6	12	48	65	25	38	20	32	2.2	3.1	1.6	2.3
Shallow sandy land														
Shoals clay loam, heavy subsoil variant	40	90	7	16	40	70	20	40	20	40	1.9	3.5	1.8	2.9
Shoals loam, heavy subsoil variant	40	90	7	16	40	70	20	40	20	40	1.9	3.5	1.8	2.9
Shoals sandy loam, heavy subsoil variant	40	90	7	16	40	70	20	40	20	40	1.9	3.5	1.8	2.9
Sims clay loam	50	85	9	16	50	75	27	47	25	38	2.4	3.7	2.0	2.8
Sims loam	50	85	9	16	50	75	27	47	25	38	2.4	3.7	2.0	2.8
Spinks loamy sand, 0 to 2 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Spinks loamy sand, 2 to 6 percent slopes	35	65	6	12	30	50	20	30	16	24	1.5	2.6	1.2	2.0
Spinks loamy sand, 2 to 6 percent slopes, moderately eroded	30	55	5	10	25	45	15	25	12	20	1.3	2.4	1.0	1.9
Spinks loamy sand, 6 to 12 percent slopes, moderately eroded	25	50	4	9	20	40	10	20	8	10	1.3	2.4	1.0	1.9
Spinks loamy sand, 6 to 12 percent slopes, severely eroded											1.0	2.0	.8	1.7
Spinks loamy sand 12 to 18 percent slopes, moderately eroded					15	35	10	15			1.2	2.0	.8	1.7
Spinks loamy sand, 12 to 18 percent slopes, severely eroded														
Tawas muck	50	80	9	15					22	34	1.9	3.4	1.4	2.0
Tuscola soils, 0 to 2 percent slopes	50	90	9	16	48	70	32	45	25	35	2.3	4.0	1.8	2.6
Tuscola soils, 2 to 6 percent slopes	45	85	8	16	48	70	32	45	20	30	2.3	4.0	1.8	2.6
Tuscola soils, 2 to 6 percent slopes, moderately eroded	40	75	7	14	43	65	28	40	15	25	2.1	3.8	1.6	2.4
Tuscola soils, 6 to 12 percent slopes, moderately eroded	40	80	7	15	40	60	28	40	15	25	2.0	3.5	1.4	2.2
Tuscola loamy fine sand, 2 to 6 percent slopes	40	85	7	16	48	70	32	45	20	30	2.3	4.0	1.8	2.6
Ubly sandy clay loam, 6 to 12 percent slopes, severely eroded														
Ubly sandy loam, 0 to 2 percent slopes	50	85	9	16	40	75	32	45	20	35	2.4	4.0	1.5	2.2
Ubly sandy loam, 2 to 6 percent slopes	50	85	9	16	40	75	32	45	20	35	2.4	4.0	1.5	2.2
Ubly sand loam, 2 to 6 percent slopes, moderately eroded	45	80	8	15	35	70	27	40	15	30	2.4	4.0	1.5	2.2
Ubly sandy loam, 6 to 12 percent slopes, moderately eroded	40	75	7	14	30	65	24	35	12	25	2.2	3.8	1.3	2.0
Ubly sandy loam, 12 to 18 percent slopes, moderately eroded					25	55	20	25			2.0	3.5	1.1	1.8
Ubly sandy loam, 18 to 25 percent slopes, moderately eroded					20	50	15	20			1.8	3.2	1.0	1.6
Wallkill soils	50	90	9	16	50	80	25	40	25	40	2.3	3.8	1.8	2.9
Wasepi sandy loam, 0 to 2 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Wasepi sandy loam, 2 to 6 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Wasepi-Brady loamy sands, 0 to 2 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Wasepi-Brady loamy sands, 2 to 6 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Wasepi-Brady sandy loams, 0 to 2 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Wasepi-Brady sandy loams, 2 to 6 percent slopes	35	65	6	12	32	52	22	33	18	26	1.5	2.6	1.3	2.1
Washtenaw soils	55	90	10	16	50	80	30	48	25	40	2.5	3.8	2.0	2.9
Willette-Linwood mucks	60	90	11	16	40	60			28	40	2.3	3.5	2.0	2.9
Wind eroded land, sloping														
Wind eroded land, steep														

cultural Experiment Station, from personnel of the Soil Conservation Service, and from others familiar with the soils and crops of the county.

In columns A are average yields obtained under the management common in the county when the soil survey was made. The amount of lime used generally is small, and the amount of commercial fertilizer applied generally is not enough for good yields. Barnyard manure produced on the farms is returned to the soils. In places artificial drainage has been installed, but in low areas water is still a problem and further drainage is needed. In most places a crop rotation is used that includes some legumes and grasses. On the steep or sandy soils, the rotations include more legumes and grasses than do those on the more nearly level, finer textured soils, where more row crops and small grain are grown.

The yields in columns B are obtained if management is improved. Under improved management, the quantity of lime used is determined by soil tests. The amount of commercial fertilizer applied is based on soil tests and on the kind of crop to be grown. Where needed, an adequate system of artificial drainage is installed. Seeds of high quality and improved varieties of plants are used; the cropping systems are suited to the soils; and seeding, spraying, and cultivating are done at the proper time. Where needed, conservation practices are used to control erosion and to conserve moisture.

Use of Soils for Woodland [1]

Forest originally covered most of Iona County, but clearing the soils for farms and cutting timber for commercial purposes all but eliminated the virgin stands. The woodlands now consist mainly of second-growth and third-growth stands.

The soils of Iona County differ greatly in their suitability for trees. They are an important part of the environment that determines the combination of species, or forest types, that grow on a particular site.

Woodland suitability groups

The soils of Ionia County have been placed in 15 woodland suitability groups to assist farmers and others in planning use of the soils for woodland. Each group consists of soils that are similar in the management they require and in potential productivity. The soils in each group can be identified by referring to the "Guide to Mapping Units" at the back of this survey. Woodland groups are identified by letters assigned on a statewide basis. Since not all of the groups in the State are represented in Ionia County, the lettering is not in consecutive alphabetic order.

Table 4 gives the woodland suitability groups in the county and lists the map symbols for the soils in each group. The table also shows, for each suitability group, the potential productivity for pine, spruce-fir, aspen-birch, oak, and northern hardwoods; gives the species priority to favor in existing stands and in planting; and provides ratings for the major limitations and hazards that affect management. The table provides information that landowners can use in appraising the possible economic returns that can be gained by improved management of woodland.

Following are explanations of the terms used in table 4. Then the woodland suitability groups in the county are described.

Potential productivity.—Potential productivity refers to the growth and yield of specified woodland types on a named soil under a stated system of management. The ratings shown in table 4 are for essentially unmanaged naturally occurring stands. They indicate the average productivity of the different woodland types for all soils in each woodland suitability group. The ratings cover a range of productivity, and each soil therefore should be considered separately in determining its potential productivity for trees. The values of the potential productivity ratings in board feet and cords per acre per year are shown in table 5.

Species suitability.—Table 4 shows the kinds of trees to favor in existing stands and those to favor where planting is necessary. In both columns the trees are listed in order of relative suitability, the most desirable first. Priorities are based on the productivity rating of the soils for the species given and the potential commercial value of the trees.

Plant competition.—When a site has been disturbed by fire, by logging, or by some other means, the invasion of undesirable brush, trees, grasses, or other plants may delay or prevent the establishment of desirable trees.

Competition is *slight* if unwanted plants do not prevent or delay the establishment of a stand by natural means or do not interfere with the growth of planted seedlings. Competition is *moderate* if invading plants delay but do not prevent reestablishment of a normal stand by natural methods or by tree planting. Competition is *severe* if the invaders prevent the establishment of a normal stand unless intensive site preparation and effective control practices are used.

Insect and disease hazard.—The hazard of damage by certain insects and diseases is related to the soils. For example, Dutch elm disease is more of a problem on wet soils.

The hazard is *slight* if no soil-related problems are recognized. It is *moderate* if there is likely to be some loss of woodcrops unless preventative measures are taken. The hazard is *severe* if there will be considerable loss of woodcrops unless special control measures are taken.

Wetness hazard.—The growth of trees is affected by the depth to the water table and the rate of water movement through the soils. Very fine textured soils have slow internal drainage. These soils are wet and cold in spring and during rainy periods in fall.

The wetness hazard is *slight* if the water table is low enough to have little or no unfavorable effect on tree growth, and if internal drainage is adequate. The hazard is *moderate* if there is some limit to the choice of trees, and if growth may be slower than normal and the establishment of seedlings more difficult. It is *severe* if the choice of trees is limited, if seedling mortality is high unless the soils are drained, and if the growth of all trees except swamp or lowland trees is likely to be slow or very slow.

Droughtiness.—Shortage of moisture limits the choice of trees and makes the establishment of trees difficult.

A rating of *slight* indicates that the establishment of seedlings will not be delayed or prevented, and that growth will be adequate. A rating of *moderate* indicates that there will be some losses of seedlings, and that growth will be slower than normal. A rating of *severe* indicates that the choice of plants is limited, that heavy losses of planted seedlings can be expected, and that seedlings ordinarily will not revegetate naturally.

Seedling mortality.—Seedling mortality refers to the loss of planted or naturally occurring seedlings. It depends largely on plant competition, on the hazard of damage by insects and disease, and on the wetness hazard or droughtiness.

The rating of *slight* indicates that a stand of desirable trees can be established either by planting or by natural regeneration without special management. A rating of *moderate* indicates that although a certain percentage of the seedlings will die, an acceptable stand can be expected. A rating of *severe* indicates that ordinarily natural reseeding cannot be depended upon to maintain a stand, and that the expected mortality of planted seedlings will be more than 50 percent.

[1] RONALD M. WILSON, former woodland conservationist, Soil Conservation Service, assisted in the preparation of this section.

TABLE 4.—*Woodland management*

[Dashes indicate trees not suited or data not available. Gravel pits and Made land are not

Woodland suitability groups and map symbols	Potential productivity ratings of woodland types [1]					Species to favor—
	Pine	Spruce-fir	Aspen-birch	Oak	Hardwoods	In managing existing stands
Group A: MnA, MnB, MnB2, MnC2, MoB3, MoC3, MoD3, MoE3, MpA, MpB, MpB2, MpC, MpC2, MpD2, MpE2, MpF2, NwC3, NwD3, NyA, NyB, NyB2, NyC2, NyD2, NyF2, UbC3, UlA, UlB, UlB2, UlC2, UlD2, UlE2.	High to very high.	High	High to very high.	High	High to very high.	Red oak, white ash, basswood, white oak, sugar maple.
Group B: DgC3, DhA, DhB, DhB2, DhC2, KkB, KkC, KkD, KlC3, MzC3, MzD3, MzaA, MzaB, MzaB2, MzaC2, MzaD2, MzbB, MzbB2, MzbC2, NcB3, NcC3, NcD3, NcE3, NeB, NeB2, NeC2, NsB, NsB2, NsC2, NsD.	Low	Medium to very high.	High	High	Very high	Red oak, white oak, sugar maple, basswood.
Group C: MdA, MdB, MdB2, MdC2, MdC3, MdD, MdD2, MdD3, MdE2, MdE3, MdF, MdF2, MdF3, MeA, MrA, MrB, MrB2, MrC2, MrC3, MrD2, MrD3, MrE2, MxA, MxB, MxB2, MxC2, MxC3, MxD2, MxD3, MxE2, MxE3, MxF2, MyA, MyB, MyB2, MyC2, Sg.	High to very high.	----------	Medium	Low to medium.	Medium to high.	Red oak, white oak, white pine, sugar maple, basswood.
Group D: ChA, ChB, ChB2, ChC2, MfC3, MfD3, MfE3, MgA, MgB, MgB2, MgC2, MgD2, MgE2, MgF2, MhB, MhB2, MhC2, MkA, MkB, MkB2, MkC2, MkD2, MkE, MtB3, MtC3, MtD3, MtE3, MtF3, MuA, MuB, MuB2, MuC, MuC2, MuD2, MuE2, MuF, MvB, MvB2, MvC2, MvD2, MwA, MwB, MwB2, MwC2, MwD2.	Low	High to very high.	High to very high.	Very high.	Very high	Red oak, white ash, basswood, white oak, sugar maple.
Group E: CnA, CnB, CnB2, CnC2, CoA, CoB, CoB2, CoC2, PoB, PoC2, PoD2, PoE2, SpA, SpB, SpB2, SpC2, SpC3, SpD2, SpD3.	Medium to high.	Very low to low.	Medium to high.	Very low to low.	Low to medium.	Red oak, white oak, white pine, aspen, beech.
Group F: As, GhA, GhB, GlA, GlB	Low to medium.	Low	Low	----------	Very low	Aspen, red maple
Group G: BeA, BeB, CvA, CvB, CwA, CwB, IsA, IsB, KnA, KnB, LsA, LsB, Lt, MaA, MaB, MlA, MlB, MmA, MmB, MsA, MsB, OcA, OcB, OtA, OtB, WeA, WeB, WrA, WrB, WsA, WsB.	Very low to low.	Medium	Low to medium.	Low	Low to medium.	White ash, basswood, red maple, cottonwood.
Group J: Cg, Ek, Em, Km, Lo, Rm, Ta, Wa, Wu	----------	----------	----------	----------	----------	Elm, red maple, aspen.
Group M: BmA, BmB, BmB2, BmC2, BmD2, BnA, BnB, BnB2, BnC2, BnD2, BoA, BoB, BoC, BpE2, BpF2, BsA, BsB, BsB2, BsC2, BsD2, BsE2, BsF, BsF3, McB, McC2, PdA, PdB, PdB2, PeA, PeB.	Medium to high.	Low to medium.	----------	Low to medium.	Low to medium.	Red oak, white oak, white pine, sugar maple, basswood.
Group N: GrA, GrB2, GrC, GrC2, GrD, GrD2, GrF, Wv, Ww.	Very low to low.	Very low	Very low	Very low	----------	Red pine, oaks, jack pine.

See footnotes at end of table.

by suitability groups

placed in a woodland suitability group, because they generally are not suited to trees]

Species to favor—Continued For plantings	Plant competition	Insect and disease hazard	Wetness hazard	Droughtiness	Seedling mortality	Erosion hazard	Equipment limitation	Windthrow hazard
White pine, red pine, white spruce.	Moderate	Slight	Slight	Slight	Slight or moderate.	Slight or moderate.	Slight	Slight.
White spruce, Norway spruce, white pine.	Moderate or severe.	Slight	Slight	Slight	Slight or severe.	Moderate	Moderate	Slight.
Red pine, white pine, white spruce, jack pine.	Slight	Slight	Slight	Slight	Slight	Slight or moderate.	Slight	Slight.[2]
White spruce, Norway spruce, white pine.	Moderate	Slight	Slight	Slight	Slight or moderate.	Slight or moderate.	Slight or moderate.	Slight.
Red pine, white pine, jack pine.	Slight	Slight	Slight	Slight or moderate.	Slight	Slight or moderate.	Slight	Slight.
White pine, white spruce.	Slight	Moderate	Moderate	Slight	Slight or moderate.	Slight	Moderate	Moderate.
White spruce, white pine, Austrian pine.	Moderate or severe.	Moderate	Moderate	Slight	Moderate or severe.	Slight	Slight or moderate.	Moderate.
Austrian pine, Scotch pine, willow.	Severe	Moderate	Severe	Slight	Severe	Slight	Severe	Severe.
White pine, red pine, white spruce, jack pine.	Slight	Slight	Slight	Slight or moderate.	Slight	Slight or moderate.	Slight	Slight.
Red pine, jack pine	Moderate	Slight	Slight	Severe	Slight or moderate.	Slight or moderate.	Slight	Slight.

See footnote at end of table.

TABLE 4.—*Woodland management*

Woodland suitability groups and map symbols	Potential productivity ratings of woodland types [1]					Species to favor—
	Pine	Spruce-fir	Aspen-birch	Oak	Hardwoods	In managing existing stands
Group O: Ab, Ac, Ad, Ae, Ag, Ah, Am, Cl, Cm, Cp, Cr, Gm, Gn, Go, Le, Lg, Lh, Sa, Sc, Sh, Sk, Sl.	----------	----------	----------	----------	----------	White ash, red maple, cottonwood, sycamore, red oak.
Group P: Bg, Bh, Bk, Bw, Ko, La, Pm, Pn, Sm, Sn, Wt.	----------	Low to medium.	Low to medium.	----------	Low-------	Red maple, white ash, basswood.
Group U: CaA, CaB, CdA, CdB, DrA, DrB, DrB2, FoA, FoB, FoB2, FoC, FoC2, FoD2, FoE2, FoF, FsB, FxC3, FxD3, FxE3, FxF3, IoA, IoB, IrA, IrB, IrB2, KeA, KeB, KeB2, KeC2, KgC3, KhB, KhB2, KhC2, KhD2, LlA, LlB, LlB2, LlC2, LmC3, LmD3, LmF3, LnA, LnB, LnB2, LnC2, LnD2, LnF2, TsA, TsB, TsB2, TsC2, TuB.	High to very high.	High-------	High to very high.	High-------	High to very high.	Red oak, white ash, basswood, white oak, sugar maple.
Group W: Ba, Bd, Bt, Bv, Cs, Ed, En, Eo, Ep, Gf, Gg, Sd.	----------	Low to medium.	Low to medium.	----------	Very low to low.	White ash, red maple, basswood.
Group Z: BlA, BlB, BlB2, CeA, CeB, CfA, CfB, CtA, CtB, CtB2, CuB, KaA, KaB, KdA, KdB, SeA, SfA.	Very low---	Medium----	Low to medium.	Medium----	Low to medium.	Red oak, white oak, white ash, basswood, cottonwood.

[1] For values in board feet and cords, see table 5. [2] Windthrow hazard will be severe where bedrock is near the surface.

TABLE 5.—*Values of potential productivity ratings in board feet and cords per acre per year*

Rating	Board feet	Cords
Very high----------	More than 325	More than 1.5.
High----------	300	1.3.
Medium----------	240	.8.
Low----------	160	.3.
Very low----------	Less than 125	Less than .1.

Erosion hazard.—Woodland can be protected from erosion by choosing the kinds of trees; by adjusting the rotation age and cutting cycles; by using special techniques in management; and by carefully constructing and maintaining roads, trails, and landings.

A rating of *slight* indicates that only small soil losses are to be expected. Generally, the soils are level or nearly level and few erosion control practices are needed. A rating of *moderate* indicates that there will be a moderate soil loss if runoff is not controlled and the cover of vegetation is not adequate for the protection of the soils. The erosion hazard is not severe in any of the woodland in Ionia County.

Equipment limitation.—Drainage, slope, stoniness, soil texture, or other soil characteristics may restrict or prohibit the use of ordinary equipment in pruning, thinning, harvesting, or other woodland management.

The limitation is *slight* if there are no restrictions on the type of equipment or on the time of the year that the equipment can be used. It is *moderate* if there are some restrictions on the type of equipment that can be used or if the use of heavy equipment is restricted by wetness 1 to 3 months each year. The limitation is *severe* if special equipment is needed; if there are seasonal limitations on the use of equipment for more than 3 months each year; or if the use of equipment severely damages the roots of trees or the structure and stability of the soil.

Windthrow hazard.—Soil characteristics affect the development of tree roots and the firmness with which roots anchor the tree in the soil so that it resists the force of the wind. Knowing the degree of this hazard is important when choosing trees to favor or to plant and when planning release cuttings or harvest cuttings.

The windthrow hazard is *slight* if roots hold the tree firmly against a normal wind and individual trees remain standing when protective trees on all sides are removed. The hazard is *moderate* if some trees blow down during extremely wet periods or during periods of high winds. It is *severe* if the rooting is not deep enough to give ade-

by suitability groups—Continued

Species to favor—Continued For plantings	Plant competition	Insect and disease hazard	Wetness hazard	Droughtiness	Seedling mortality	Erosion hazard	Equipment limitation	Windthrow hazard
Cottonwood [3]	Moderate or severe.	Moderate	Slight or severe.	Slight or moderate.	Moderate or severe.	Slight	Moderate	Moderate.
	Moderate or severe.	Moderate	Severe	Slight	Severe	Slight	Severe	Moderate or severe.
White pine, white spruce, Norway spruce, Austrian pine, red pine.	Moderate	Slight	Slight	Slight	Slight or moderate.	Slight or moderate.	Slight	Slight.
	Severe	Moderate	Severe	Slight	Severe	Slight	Severe	Severe.
White spruce, white pine, white-cedar.	Moderate or severe.	Moderate	Moderate	Slight	Moderate or severe.	Slight	Moderate	Moderate.

[3] If overflow not a problem, plant pine on better drained sites and white spruce on somewhat poorly drained and poorly drained sites.

quate stability, and if individual trees are likely to blow over if they are released on all sides. A high water table, a hardpan, or bedrock are restricting soil characteristics.

WOODLAND SUITABILITY GROUP A

This group consists of well drained and moderately well drained soils that have medium or rapid internal drainage. These soils have a moderately coarse textured surface layer and a medium-textured subsoil. The McBride soils of this group commonly have a slightly developed to well-developed fragipan that may restrict the growth of roots. The Ubly soils are underlain by loam, clay loam, or silty clay loam at a depth of 18 to 42 inches.

All woodland types grow well on the soils of this group (see table 4), but market prices and availability of markets vary. For example, the market value of aspen is only a fraction of that of red pine, white pine, or red oak.

WOODLAND SUITABILITY GROUP B

This group consists of well drained and moderately well drained soils that have slow or very slow internal damage. These soils have a medium-textured or moderately fine textured surface layer and a fine textured or moderately fine textured subsoil. Aeration is fair, and the available moisture capacity and natural fertility are medium or high. In all of the soils except the Dighton, the subsoil is calcareous at a depth of 18 to 42 inches. The Dighton soils are underlain by sand, loamy sand, or gravel at a depth of 18 to 42 inches and commonly are slightly acid at a depth of 42 inches.

The soils in this group are well suited to all of the woodland types except pine. White pine can be planted on noncalcareous soils, but the potential productivity is low. Although spruce does not occur naturally, adequate stands of Norway spruce or white spruce can be established by planting.

The relative suitability of trees for woodcrops varies. Oaks and hardwoods should be favored in natural stands. Table 4 indicates the most suitable species to favor in natural stands and those to favor in planting.

WOODLAND SUITABILITY GROUP C

This group consists of well drained and moderately well drained soils that have rapid or very rapid internal drainage. These soils have a coarse textured or moderately coarse textured surface layer and a medium-textured or moderately coarse textured subsoil. Aeration is excellent, and the available moisture capacity and natural fertility are low or moderately low. The Menominee soils are underlain by loam, clay loam, or silty clay loam and are calcareous at a depth of 18 to 42

inches. The Mancelona soils are also calcareous at a depth of 18 to 42 inches, whereas the Montcalm soils are calcareous at a depth of more than 42 inches. Shallow sandy land is underlain by sandstone bedrock at a depth of 7 to 30 inches.

Pine is the most suitable woodland type for the soils in this group. The annual yield of hardwood is about 200 to 300 board feet or less per acre. Hardwoods are the next most suitable type. Oak gives the poorest yields. The spruce-fir type does not grow on these soils.

WOODLAND SUITABILITY GROUP D

This group consists of well drained and moderately well drained soils that have medium or slow internal drainage. These soils have a medium-textured or moderately coarse textured surface layer and a moderately fine textured or fine textured subsoil. Aeration is moderately good, and the available moisture capacity and natural fertility are moderately high. The subsoil is calcareous at a depth of 18 to 42 inches.

The soils in this group are well suited to all of the woodland types except pine. If pine is used for tree planting, white pine should be grown on the most calcareous soils. However, it is doubtful if the management of these soils for pine is economically feasible. Spruce does not grow naturally, but good stands of white spruce or Norway spruce can be established by planting.

WOODLAND SUITABILITY GROUP E

This group consists of well drained or moderately well drained soils that have rapid internal drainage. These soils have a coarse textured surface layer and a coarse textured or moderately coarse textured subsoil. In the Chelsea and Spinks soils the moderately coarse textured subsoil is in the form of thin bands. In the Chelsea soils the bands are below a depth of 36 inches, whereas in the Spinks they are nearer the surface. Because of the bands, these soils have higher available moisture capacity than sandy soils that lack the bands. The soils in this group are well aerated but are low in available moisture capacity and natural fertility. They are acid to a depth of more than 42 inches.

These soils are well suited to pine. Red pine has the highest potential value, and white pine has the next highest.

WOODLAND SUITABILITY GROUP F

This group consists of somewhat poorly drained, coarse-textured soils that have rapid internal drainage. Internal drainage is somewhat impeded in the Au Gres soils because of a hardpan. The soils in this group are low in available moisture capacity and in natural fertility. The Au Gres soils range from strongly acid to slightly acid in reaction, and the Gladwin soils from medium acid to mildly alkaline.

These soils are not well suited to woodcrops. Spruce, pine, and aspen are the most productive, but aspen has low market value. Also, it is subject to hypoxylon canker, which may be a factor in determining the rotation. Oaks are poorly suited. The low economic returns limit the possibility of investment in other woodland types.

WOODLAND SUITABILITY GROUP G

This group consists of somewhat poorly drained soils that have rapid to slow internal drainage. The surface layer is medium textured to coarse textured, and the subsoil is moderately coarse textured to moderately fine textured. The Belding, Iosco, Macomb, and Metamora soils are underlain by loam, clay loam, or silty clay loam at a depth of from 18 to 42 inches. The soils of this group are somewhat poorly aerated because of a seasonal high water table. They are low to moderately high in available moisture capacity and in natural fertility, and they are medium acid to neutral in reaction.

At best, the soils of this group are only moderately well suited to woodcrops. Woodland can be expected to produce from 160 to 240 board feet per acre per year. Several of the species that grow well are of low value. Thus, care needs to be taken in choosing the species to plant or to favor.

WOODLAND SUITABILITY GROUP J

This group consists of very poorly drained organic soils that have a high water table and slow internal drainage. These soils are high in available moisture capacity, and they are medium or moderately high in natural fertility. The reaction ranges from neutral to moderately alkaline in the Lupton and Edwards soils; from strongly alkaline to neutral in the Carlisle, Tawas, Linwood, and Willette soils; and from extremely acid to slightly acid in the Rifle soils. At a depth of 12 to 42 inches, the Tawas soils are underlain by sand; the Linwood soils by loam or sandy loam; the Willette soils by clay; and the Edwards by marl. The Wallkill soils consist of 10 to 40 inches of loamy material over muck or peat.

The potential productivity of these soils varies greatly for each tree species or woodland type. Woodlands commonly can be expected to produce from 125 to 240 board feet per acre per year.

WOODLAND SUITABILITY GROUP M

This group consists of well drained and moderately well drained soils that have rapid internal drainage. These soils have a coarse textured or moderately coarse textured surface layer and a medium-textured or moderately coarse textured subsoil. The Mancelona soils are underlain by loam to clay at a depth of 42 to 66 inches. Aeration is excellent in the soils of this unit, and the available moisture capacity and natural fertility are medium or low. The Mancelona soils, loamy substratum, are acid to a depth of at least 42 inches. The Boyer and Perrin soils are calcareous at a depth of 24 to 42 inches.

The soils in this group generally are not highly productive of woodcrops, although there are some stands of pine that produce as much as 300 board feet per acre per year. However, because of the low potential productivity of the other woodland types and the low market value of some species, the relative value of these soils for woodland is medium at best.

WOODLAND SUITABILITY GROUP N

This group consists of well-drained soils that have very rapid internal drainage. Both the surface layer and subsoil are coarse textured. Soil aeration is excessive, and the available moisture capacity and natural fertility are low. The reaction ranges from medium acid to mildly alkaline.

The soils of this group are poorly suited to woodcrops. Jack pine is the most suitable species for management. It can be expected to produce up to 160 board feet per acre per year.

WOODLAND SUITABILITY GROUP O

This group consists of well-drained to poorly drained, moderately fine textured to coarse-textured soils on stream bottoms. Soil aeration ranges from good to poor. The available moisture capacity and natural fertility range from low in the coarse-textured soils to high in the moderately fine textured soils. The reaction ranges from neutral to calcareous. Most sites are subject to overflow.

The woodland types and potential productivity vary greatly on these soils because of the frequency and severity of overflow. Even in areas where there is little or no overflow, drainage and soil texture affect both the type of woodland cover and the productivity.

WOODLAND SUITABILITY GROUP P

This group consists of poorly drained and very poorly drained soils that have slow or very slow internal drainage. The water table is high. These soils have a medium-textured to moderately fine textured surface layer and a moderately fine textured to fine textured subsoil. Natural fertility and the available moisture capacity are medium to very high. The reaction ranges from slightly acid to calcareous.

Dutch elm disease is a serious hazard on these sites. Large amounts of dead wood make conditions favorable for the carrier elm bark beetle. Other fungus diseases are also likely to develop.

Pine normally does not grow on the soils in this group, and natural stands of spruce, aspen, oak, and lowland hardwoods generally are poor. The potential productivity is too low to make woodland improvement economically feasible. The most practical management is to harvest the trees as they mature and as markets become available.

WOODLAND SUITABILITY GROUP U

This group consists of well drained and moderately well drained soils that have rapid to slow internal drainage. These soils have a moderately coarse textured or medium-textured surface layer and a medium-textured or moderately fine textured subsoil. The Cadmus and Kendallville soils are underlain by loam, clay loam, or silty clay loam at a depth of 18 to 42 inches. Aeration generally is good, and the available moisture capacity and natural fertility are medium or moderately high. The soils are calcareous at a depth of 18 to 42 inches.

Aspen normally does not grow on the soils in this group. However, excellent stands of other woodland types can be established. Spruce does not grow naturally, but Norway spruce or white spruce do well in planted stands.

WOODLAND SUITABILITY GROUP W

This group consists of poorly drained soils that have a high water table and slow internal drainage. These soils have a medium-textured to coarse textured surface layer and a moderately fine textured to moderately coarse textured subsoil. The Breckenridge and Brevort soils are underlain by loam, clay loam, or silty clay loam at a depth of 18 to 42 inches. Natural fertility and the available moisture capacity range from low to high. The soils are slightly acid or neutral in reaction.

Dutch elm disease is a serious hazard on these sites. Large amounts of dead wood make conditions favorable for the carrier elm bark beetle. Other fungus diseases are also likely to develop.

The soils in this group are not suited to pine or oak. Natural stands of spruce, aspen, and lowland hardwoods generally are poor. Consequently, potential productivity is too low to make woodland improvement economically feasible. The most practical management is to harvest the trees as they mature and as markets become available.

WOODLAND SUITABILITY GROUP Z

This group consists of somewhat poorly drained soils that have slow or very slow internal drainage. These soils have a medium-textured or moderately coarse textured surface layer and a fine-textured subsoil. They are somewhat poorly aerated because of a seasonal high water table. The available moisture capacity and natural fertility are high or moderately high, and the reaction is slightly acid or neutral.

The amount of dead elm wood on these sites is enough to make the elm bark beetle a problem. Increases in the beetle population will increase the spread of Dutch elm disease. The wet sites provide optimum conditions for the development of fungus infections.

All woodland types will grow on the soils in this group, but only spruce and hardwoods have enough potential value to make woodland improvement economically feasible.

Engineering Uses of Soils

This section describes the properties of the soils that are important to engineering. Some soil properties are of special interest to the engineer because they affect the construction and maintenance of roads, airports, pipelines, building foundations, structures for water storage, structures for controlling erosion, drainage systems, and sewage disposal systems. The soil properties most important to the engineer are permeability to water, shear strength, compaction characteristics, drainage, shrink-swell characteristics, grain size, plasticity, and pH. Depth to the water table, depth to bedrock, and topography are also important.

The information in this section can be used by engineers to—

1. Make soil and land-use studies that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Make preliminary estimates of soil properties that are important in planning agricultural drainage systems, farm ponds, irrigation systems, terraces and diversions, and other structures for conserving soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, cables, and sewage disposal fields and in planning detailed surveys of the soils at the selected locations.

4. Locate probable sources of sand and gravel for use in construction.
5. Correlate pavement performance with the soil mapping units, and thus develop information that will be useful in designing and maintaining the pavements.
6. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
7. 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. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and 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.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words, for example, soil, clay, sand, and aggregate, have special meanings in soil science. These and other special terms that are used are defined in the Glossary. Information useful to engineers can also be obtained from the detailed soil map and other sections of the survey, particularly the sections "General Soil Map," "Geology," and "Descriptions of the Soils."

Engineering classification systems

The engineering classification systems now most widely used are the American Association of State Highway Officials (AASHO) system [2] and the Unified system.[3] Both classifications are based on the field performance of soil materials.

The AASHO system is used by most engineers. In this system, soil materials are placed in seven principal groups. The groups range from A–1, consisting of gravelly materials of high bearing capacity, to A–7, consisting of clay soils having low strength when wet. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses after the soil group symbol in table 6.

The Unified soil classification system is preferred by some engineers. In this system, soil material is divided into 15 classes. Eight classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, SC); six classes are for fine-grained material (ML, CL, OL, MH, CH, OH); and one class is for highly organic material (Pt).

[2] AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Pt. 1, ed. 8, 1961.

[3] WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS. UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3–357, v. 1, 1953.

Engineering test data

Engineering test data for three of the principal soil series in Ionia County are given in table 6. Soil samples taken from nine locations in the county were tested by standard procedures in the laboratories of the Bureau of Public Roads. The soil samples are from selected layers and do not represent the entire range of soil properties in the county or even within the three series sampled.

The engineering classifications shown in table 6 are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by combined sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used as a basis for naming soil textural classes.

The tests to determine liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a solid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. 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 6 also gives compaction, or moisture-density, data for the samples tested. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, 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 highest dry density obtained in the compaction test is termed maximum dry density. Moisture-density data are important in earthwork, for, as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is about the optimum moisture content.

Soil properties significant in engineering

In table 7 the soil series in the county and the map symbols for each are listed and estimates of some of the physical and chemical properties of the soils are given. The estimates are based on the actual test data in table 6, on other available test data, and on field experience.

Generally, the information in table 7 applies to the soil material to a depth of 5 feet or less. Depth from the surface normally is shown only for the major horizons, but other horizons are indicated if they have engineering properties significantly different from adjacent horizons. The depths shown are considered to be typical for the series, but in most areas there are variations of a foot or less both in the depth to and in the thickness of the various layers. All of the organic soils are classified on the basis of the upper 42 inches. Below this depth there is considerable variation in texture and thickness.

Also given in table 7 are the textural classification of the U.S. Department of Agriculture, estimates of the Unified classification, and estimates of the classification used by the American Association of State Highway Officials. The figures giving the percentages of material passing through sieves No. 4, No. 10, and No. 200 are rounded off to the nearest 5 percent. The percentage of material passing the No. 200 sieve approximates the combined amount of silt and clay in a soil.

The column showing permeability, or the rate at which water moves downward through undisturbed soil material, is estimated. The estimates are based mainly on texture, structure, and consistence of the soils.

Available water capacity, expressed in inches per inch of soil depth, refers to the approximate amount of capillary water in the soil when wet to field capacity. This amount of water will wet air-dry soil to a depth of 1 inch without deeper penetration. Available water capacity is influenced primarily by soil texture and organic-matter content.

Reaction as shown in table 7 is the estimated range in pH values for each major horizon of the soils as determined in the field. It indicates the acidity or alkalinity of the soils. A pH of 7, for example, indicates a neutral soil, a lower pH value indicates acidity, and a higher value indicates alkalinity.

Shrink-swell potential refers to the change in volume of the soil that results from a change in moisture content. The estimates in table 7 are based mainly on the amount and kind of clay in a soil.

In estimating the depth to the water table, it has been assumed that no artificial drainage practices are in operation. During prolonged wet or extremely dry periods, the depth commonly is outside the range shown in table 7.

Engineering interpretations

Table 8 gives estimates of the suitability of the soils of the county for specified engineering uses and lists the soil properties that present hazards or difficulties in specified engineering uses. Made land is not included in this table. The data in this table apply to the representative profile of the soil series, which is described in the section "Descriptions of the Soils."

The suitability of the soils as a source of topsoil refers specifically to the use of soil material, preferably rich in organic matter, as a topdressing for back slopes, embankments, lawns, gardens, and so on. The ratings are based mainly on the texture of the soil and on its content of organic matter. Unless otherwise indicated, only the surface layer of a mineral soil is rated as a source of topsoil.

The suitability of the soils as a source of sand and gravel refers to sources of such material that are within a depth of 5 feet from the surface (fig. 8). In some soils, however, the depth to sand and gravel is less than or greater than 5 feet, and in adjacent areas of the same soil unsuitable material can be just below 5 feet. Although some soils are rated as unsuitable for sand and gravel, these soils in places contain such material at a depth of more than 5 feet. Individual test pits are needed in such areas to determine the availability of sand and gravel.

Figure 8.—**The material underlying the Fox, Mancelona, and Newaygo soils is a source of sand and gravel.**

The suitability of the soils as a source of subgrade material for pavements depends partly on the texture of the soil material. If the subsoil and substratum have contrasting characteristics, both are rated. Sand generally is the most desirable material for subgrade, and clay is the least desirable.

The entire soil profile was considered to determine the suitability of the soils as locations for highways. The features shown in table 8 are for undisturbed soils without artificial drainage. Additional information can be obtained from data compiled by the State Highway Department of Michigan, which has rated the major soil series in the State as to their suitability for highway construction. This information is contained in the Field Manual of Soil Engineering.

Features that affect the suitability of undisturbed soils for foundations for buildings of no more than three stories are also shown in table 8. The suitability of the soils as a base for low buildings depends mainly on characteristics of the substratum, which generally provides the base for foundations. Therefore the features shown are those of the substratum. Among the main factors considered in determining the suitability of the soils as foundations for low buildings is the shrink-swell potential. It can be determined for a specific horizon by referring to the column "Shrink-swell potential" in table 7.

In determining the suitability of the soils for domestic sewage disposal systems, the factors considered were depth to the water table or bedrock, permeability or percolation rate, hazard of flooding, and topography.

Features that affect the suitability of the soils for agricultural drainage include soil texture, rate of water movement into and through the soil, depth to a restricting layer or to bedrock, depth to the water table, and position of the soil on the landscape.

In determining the suitability of the soils for farm ponds, the entire soil profile is considered for both the reservoir area and for embankment material unless otherwise specified. The features shown for reservoir areas are those of undisturbed soils. Those shown for em-

TABLE 6.—*Engineering test data for soil samples*

[Tests performed by the Bureau of Public Roads (BPR) in accordance with

Soil name and location	Parent material	BPR report No.	Depth	Horizon	Moisture-density data [1]	
					Maximum dry density	Optimum moisture
			Inches		*Lb. per cu. ft.*	*Percent*
Conover loam:						
SW¼SW¼NW¼ sec. 14, T. 6 N., R. 6 W. (Modal.)	Calcareous glacial till.	S 33532	0–8	Ap	114	14
		S 33533	20–29	B22	118	15
		S 33534	36–48	C	123	12
SE¼SE¼SW¼ sec. 15, T. 6 N., R. 7 W. (Coarser textured than modal.)	Glacial till.	S 33535	0–9	Ap	110	16
		S 33536	22–32	B22	119	14
		S 33537	44–54	C	128	10
SW¼SW¼SE¼ sec. 11, T. 7 N., R. 5 W. (Finer textured than modal.)	Calcareous glacial till.	S 33538	0–5	A1	99	20
		S 33539	21–30	B22	113	17
		S 33540	30–42	C	12	11
Montcalm loamy sand:						
SW¼SW¼SW¼ sec. 8, T. 8 N., R. 7 W. (Modal.)	Glacial till.	S 33550	0–9	Ap	115	11
		S 33551	9–20	Bir	111	11
		S 33552	20–34	A21	105	13
		S 33553	38–42	B2	126	10
		S 33554	42–72	A2 and B2	106	13
		S 33555	72–114	A2 and B2t	102	14
NW¼NE¼ sec. 3, T. 8 N., R. 8 W. (Coarser textured than modal.)	Glacial till.	S 33556	0–7	Ap	112	11
		S 33557	7–22	Biy	112	12
		S 33558	22–36	A2	105	17
		S 33559	36–46	A2 and B2	102	18
		S 33560	56–66	A2 and B2	102	15
NE¼NW¼NW¼ sec. 3, T. 8 N., R. 8 W. (Finer textured than modal.)	Glacial till.	S 33561	0–8	Ap	119	10
		S 33562	8–16	Bir	121	9
		S 33563	16–24	A2	119	9
		S 33564	24–31	B2	104	15
		S 33565	31–56	A2 and B2	105	15
		S 33566	72–84	C	126	10
Morley loam:						
NE¼NW¼NE¼ sec. 8, T. 7 N., R. 5 W. (Modal.)	Calcareous glacial till.	S 33541	0–8	Ap	124	11
		S 33542	17–26	Bp2	111	18
		S 33543	29–42	C	117	14
NW¼NE¼NE¼ sec. 32, T. 8 N., R. 5 W. (Coarser textured than modal.)	Calcareous glacial till.	S 33544	3–6	A2	120	12
		S 33545	16–26	B2	111	18
		S 33546	33–42	C	118	15
NE¼NE¼NW¼ sec. 27, T. 7 N., R. 5 W. (Finer textured than modal.)	Calcareous glacial till.	S 33547	0–7	Ap	113	15
		S 33548	11–20	Bp2	110	18
		S 33549	25–36	C	118	15

[1] Based on AASHO Designation: T 99–57, "The Moisture-Density Relations of Soils Using a 5.5-lb. Rammer and a 12-in. Drop," (Method A) in "Standard Specifications for Highway Materials and Methods of Sampling and Testing," pt. 2, Ed. 8 (1961), published by AASHO.

[2] According to Designation: T 88–57, "Mechanical Analysis of Soils," in "Standard Specifications for Highway Materials and Methods of Sampling and Testing," pt. 2, Ed. 8 (1961), published by AASHO. Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 milli-

taken from 9 soil profiles, Ionia County, Mich.

standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [2]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—					Percentage smaller than—						AASHO	Unified [3]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
98	97	93	86	68	64	48	28	18	26	7	A-4(7)	ML-CL.
99	96	92	86	68	65	53	38	28	30	12	A-6(7)	CL.
98	96	91	86	68	65	51	36	24	24	9	A-4(7)	CL.
98	97	92	83	63	58	40	19	12	27	5	A-4(6)	ML-CL.
96	94	87	77	52	47	37	27	23	27	11	A-6(4)	CL.
95	93	86	75	48	44	32	20	15	19	6	A-4(3)	SM-SC.
----------	100	98	95	85	80	54	25	16	37	9	A-4(8)	ML.
99	98	94	87	72	69	60	46	35	36	16	A-6(10)	CL.
97	93	86	78	58	54	43	27	19	20	7	A-4(5)	ML-CL.
----------	100	99	87	23	20	13	8	6	[4]	[4]	A-2-4(0)	SM.
98	98	97	84	14	12	9	6	4	[4]	[4]	A-2-4(0)	SM.
----------	----------	100	89	8	7	4	3	2	[4]	[4]	A-3(0)	SP-SM.
----------	----------	100	96	50	44	27	16	14	18	4	A-4(3)	SM-SC.
----------	100	98	75	6	5	4	2	2	[4]	[4]	A-3(0)	SP-SM.
----------	100	99	67	7	6	3	3	2	[4]	[4]	A-3(0)	SP-SM.
----------	100	97	79	11	9	8	6	5	[4]	[4]	A-2-4(0)	SP-SM.
98	97	94	76	12	11	9	6	4	[4]	[4]	A-2-4(0)	SP-SM.
----------	100	99	83	4	4	4	3	2	[4]	[4]	A-3(0)	SP.
----------	----------	100	85	5	4	3	2	1	[4]	[4]	A-3(0)	SP.
----------	100	99	87	2	2	2	2	2	[4]	[4]	A-3(0)	SP.
----------	100	95	70	19	16	12	8	6	[4]	[4]	A-2-4(0)	SM.
96	95	90	68	21	18	12	9	6	[4]	[4]	A-2-4(0)	SM.
98	97	91	69	19	17	13	9	6	[4]	[4]	A-2-4(0)	SM.
----------	100	99	79	3	2	2	2	2	[4]	[4]	A-3(0)	SP.
----------	100	99	71	3	3	3	3	3	[4]	[4]	A-3(0)	SP.
98	97	93	76	27	24	18	15	12	[4]	[4]	A-2-4(0)	SM.
96	93	88	80	58	53	38	23	14	18	4	A-4(5)	ML-CL.
99	97	93	87	73	70	62	50	40	39	18	A-6(11)	CL.
98	96	91	87	77	75	65	47	34	31	13	A-6(9)	CL.
98	96	89	78	53	49	36	23	14	18	3	A-4(4)	ML.
99	98	95	89	74	72	65	51	41	40	18	A-6(11)	CL.
97	94	89	84	72	68	58	41	30	30	11	A-6(8)	CL.
99	98	95	90	74	68	50	31	21	26	8	A-4(8)	CL.
99	98	95	90	75	72	61	49	38	37	17	A-6(11)	CL.
98	96	93	89	78	76	62	44	30	29	11	A-6(8)	CL.

meters 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 analysis data used in this table are not suitable for naming textural classes for soils.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are ML-CL, SM-SC, SP-SM.

[4] Nonplastic.

TABLE 7.—*Estimated*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture [1]	Unified	AASHO
	Inches			
Abscota (Ab, Ac, Ad).	0 to 15	Sandy loam, loam, or loamy sand.	SM or ML	A-4
	15 to 66	Sand or loamy sand	SP or SM	A-3 or A-2
Algansee (Ae, Ag, Ah).	0 to 10	Sandy loam, loam, or loamy sand.	ML, SM	A-4
	10 to 15	Sand	SP, SW	A-3
	15 to 66	Loamy sand	SM	A-2
Alluvial land (Am). No estimates of engineering properties.				
Au Gres (As).	0 to 33	Sand	SP-SM	A-3
	33 to 66	Sand	SP-SM	A-3
Barry (Ba, Bd).	0 to 16	Sandy loam or loam	SM	A-2 or A-4
	16 to 24	Sandy clay loam	SC	A-6
	24 to 38	Sandy loam	SM	A-2 or A-4
	38 to 66	Sandy loam	SM	A-2 or A-4
Belding (BeA, BeB).	0 to 36	Sandy loam	SM	A-2 or A-4
	36 to 66	Loam, clay loam, or silty clay loam.	ML or CL	A-4 or A-6
Bergland (Bg).	0 to 7	Silty clay loam	CL	A-6
	7 to 35	Silty clay	CH	A-7
	35 to 66	Silty clay or clay	CH	A-7
Berville (Bh, Bk).	0 to 10	Loam or sandy loam	ML-CL	A-4
	10 to 20	Sandy loam	SM	A-2 or A-4
	20 to 30	Gravelly clay loam	CL	A-6
	30 to 38	Clay loam	CL	A-6
	38 to 66	Loam	ML	A-4
Blount (BlA, BlB, BlB2).	0 to 10	Loam	ML-CL or ML	A-4
	10 to 28	Silty clay loam	CL	A-6
	28 to 66	Silty clay loam	CL	A-6
Boyer (BmA, BmB, BmB2, BmC2, BmD2, BnA, BnB, BnB2, BnC2, BnD2, BoA, BoB, BoC, BpE2, BpF2, BsA, BsB, BsB2, BsC2, BsD2, BsE2, BsF, BsF3). (For Spinks part of the BsA, BsB, BsB2, BsC2, BsD2, BsE2, BsF, BsF3 units, see Spinks series.)	0 to 18	Loamy sand or sandy loam	SM	A-2
	18 to 27	Sandy loam	SM	A-2
	27 to 34	Sandy clay loam	SC	A-2 or A-6
	34 to 66	Sand and gravel	SW or GW	A-1
Brady.	0 to 13	Sandy loam or loamy sand	SM	A-2
	13 to 19	Sandy clay loam	SC	A-2 or A-6
	19 to 33	Sandy loam	SM	A-2
	33 to 48	Loamy sand	SM	A-2
	48 to 66	Sand and gravel	SW or GW	A-3 or A-1
Breckenridge (Bt).	0 to 8	Sandy loam	SM	A-2
	8 to 36	Fine sandy loam	ML-CL, SM	A-4
	36 to 66	Clay loam	CL	A-6
Brevort (Bv).	0 to 24	Loamy sand	SM	A-2
	24 to 40	Fine sand	SM	A-2
	40 to 66	Clay loam	CL	A-6
Brookston (Bw).	0 to 9	Loam	ML-CL	A-4
	9 to 28	Clay loam	CL	A-6
	28 to 66	Loam	ML	A-4
Cadmus (CaA, CaB, CdA, CdB).	0 to 7	Sandy loam or loam	SM	A-2
	7 to 14	Sandy loam	SM	A-2, A-4
	14 to 34	Sandy clay loam	SC	A-2 or A-6
	34 to 66	Loam	ML-CL	A-4

See footnotes at end of table.

properties of the soils

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Depth to water table
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*		*Feet*
95 to 100	90 to 100	35 to 70	0.80 to 2.5	0.14	7.4 to 7.8	Low.	4 to 20
95 to 100	90 to 95	0 to 25	5.00 to 10.0	.06	7.4 to 8.0	Low.	
95 to 100	90 to 100	35 to 70	2.50 to 5.0	.14	7.4 to 8.0	Low.	0 to 4
100	95 to 100	0 to 5	>10.0	.02	7.4 to 8.0	Low.	
95 to 100	90 to 100	10 to 25	5.00 to 10.0	.07	7.4 to 8.0	Low.	
100	95 to 100	5 to 10	>10.0	.04	5.7 to 6.1	Low.	0 to 4
100	95 to 100	5 to 10	>10.0	.02	5.6 to 6.7	Low.	
95 to 100	90 to 100	25 to 45	0.80 to 2.5	.12	6.6 to 7.3	Low.	0 to 3
95 to 100	95 to 100	35 to 50	0.80 to 2.5	.15	6.6 to 7.3	Low to moderate.	
95 to 100	90 to 100	30 to 45	0.80 to 2.5	.10	7.4 to 7.8	Low.	
95 to 100	95 to 100	20 to 40	2.50 to 5.0	.10	[2] 7.8 to 8.0	Low.	
90 to 100	85 to 95	30 to 50	2.50 to 5.0	.12	5.5 to 6.6	Low.	2 to 10
90 to 100	85 to 95	60 to 90	0.05 to 1.5	.17	[2] 7.0 to 8.0	Moderate.	
100	95 to 100	80 to 95	0.80 to 2.5	.20	6.6 to 7.3	Moderate.	0 to 3
100	95 to 100	80 to 100	0.05 to 0.2	.17	6.6 to 7.3	High.	
100	95 to 100	75 to 95	0 to 0.2	.15	[2] 7.0 to 8.0	High.	
95 to 100	90 to 100	55 to 90	0.80 to 2.5	.17	6.5 to 7.0	Low.	0 to 3
95 to 100	95 to 100	20 to 40	1.50 to 2.5	.10	6.5 to 7.0	Low.	
50 to 80	45 to 80	60 to 85	0.80 to 2.5	.16	7.0 to 7.3	Moderate to low.	
95 to 100	90 to 100	60 to 80	0.20 to 1.5	.17	7.3 to 7.3	Moderate.	
90 to 100	85 to 95	50 to 85	0.05 to 1.5	.17	7.5 to 8.0	Low.	
100	95 to 100	55 to 90	0.80 to 2.5	.20	6.1 to 6.5	Low.	2 to 8
100	95 to 100	80 to 100	0.80 to 2.5	.20	5.5 to 6.6	Moderate.	
95 to 100	90 to 100	80 to 95	0.05 to 1.5	.17	[2] 7.5 to 8.0	Moderate.	
90 to 100	85 to 100	15 to 35	2.50 to 10.0	.10	5.3 to 6.3	Low.	4 to 30+
100	95 to 100	15 to 35	2.50 to 5.0	.12	5.3 to 6.3	Low.	
95 to 100	90 to 100	30 to 50	0.80 to 2.5	.16	5.3 to 6.3	Moderate to low.	
10 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.0 to 8.0	Low.	
85 to 95	80 to 95	15 to 35	2.50 to 5.0	.12	5.7 to 6.3	Low.	2 to 10
95 to 100	90 to 100	25 to 50	0.80 to 2.5	.16	5.1 to 5.5	Moderate.	
95 to 100	90 to 100	20 to 35	2.50 to 5.0	.10	5.1 to 5.5	Low.	
100	95 to 100	10 to 25	5.00 to 10.0	.05	6.1 to 6.5	Low.	
10 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.0 to 8.0	Low.	
95 to 100	90 to 100	20 to 30	0.80 to 2.5	.14	5.6 to 6.0	Low.	0 to 3
95 to 100	80 to 95	35 to 60	0.80 to 2.5	.14	5.8 to 6.4	Low.	
95 to 100	90 to 100	65 to 80	0.05 to 1.5	.17	[2] 7.0 to 8.0	Moderate.	
100	90 to 100	10 to 25	5.00 to 10.0	.08	6.2 to 6.8	Low.	0 to 3
100	90 to 100	2 to 15	5.00 to 10.0	.03	6.5 to 7.4	Low.	
95 to 100	90 to 100	65 to 80	0.05 to 1.5	.17	[2] 7.4 to 8.0	Moderate.	
95 to 100	90 to 100	60 to 75	0.80 to 2.5	.21	6.6 to 7.3	Low.	0 to 3
95 to 100	90 to 100	65 to 80	0.80 to 2.5	.18	7.4 to 7.8	Moderate.	
95 to 100	90 to 100	60 to 75	0.20 to 0.8	.17	[2] 7.4 to 7.8	Low.	
100	95 to 100	15 to 30	2.50 to 5.0	.14	6.1 to 6.4	Low.	3 to 10
95 to 100	90 to 100	20 to 40	0.80 to 5.0	.12	5.6 to 6.0	Low.	
95 to 100	90 to 100	30 to 45	0.20 to 2.5	.16	5.6 to 6.0	Low to moderate.	
95 to 100	90 to 100	55 to 75	0.20 to 1.5	.17	[2] 7.4 to 7.8	Low.	

TABLE 7.—*Estimated properties*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture [1]	Unified	AASHO
	Inches			
Capac (CeA, CeB, CfA, CfB).	0 to 13	Loam or sandy loam	ML–CL	A–4
	13 to 34	Clay loam or silty clay loam	CL	A–6
	34 to 66	Loam	ML–CL or CL	A–4
Carlisle (Cg).[3]	0 to 42	Muck and peat	Pt	
Celina (ChA, ChB, ChB2, ChC2).	0 to 11	Loam	ML–CL	A–4
	11 to 24	Clay loam	CL	A–6
	24 to 66	Loam	CL	A–6
Ceresco (Cl, Cm). (For Shoals part of Cl, Cm, see Shoals series.)	0 to 66	Loam	SM or ML	A–2 or A–4
Chelsea (CnA, CnB, CnB2, CnC2, CoA, CoB, CoB2, CoC2).	0 to 10	Loamy sand or sand	SM	A–2
	10 to 45	Loamy sand or sand	SP–SM or SM	A–2 or A–3
	45 to 60	Sand	SP	A–3
	60 to 66	Sand	SP	A–1
Cohoctah (Cp, Cr). (For Sloan part of Cp, Cr, see Sloan series.)	0 to 8	Sandy loam or loam	SM or ML	A–2 or A–4
	8 to 66	Sandy loam	SM or ML–CL	A–2 or A–4
Colwood (Cs).	0 to 8	Loam	SM or ML	A–2 or A–4
	8 to 12	Fine sandy loam	SM–SC	A–2 or A–4
	12 to 18	Sandy loam	SM	A–2 or A–4
	18 to 28	Light sandy clay loam	SC	A–2 or A–4
	28 to 36	Sandy loam	SM	A–2
	36 to 66	Silt and very fine sand	ML	A–4
Conover (CtA, CtB, CtB2, CuB).	0 to 8	Loam	ML	A–4
	8 to 16	Heavy loam	CL	A–6
	16 to 34	Clay loam	CL	A–6
	34 to 66	Heavy loam	CL	A–6
Coral (CvA, CvB, CwA, CwB).	0 to 17	Sandy loam or loam	SM	A–2 or A,4
	17 to 35	Sandy clay loam	SC	A–4
	35 to 43	Sandy loam	SM	A–2 or A–4
	45 to 66	Sandy loam	SM	A–2 or A–4
Dighton (DgC3, DhA, DhB, DhB2, DhC2).	0 to 11	Sandy loam or clay loam	SM	A–2 or A–4
	11 to 34	Silty clay loam	CL	A–6
	34 to 66	Loamy sand	SM	A–2
Dryden (DrA, DrB, DrB2).	0 to 15	Sandy loam	SM	A–2
	15 to 34	Sandy clay loam	SC	A–6
	34 to 66	Sandy loam	SM	A–2
Edmore (Ed).	0 to 9	Sandy loam	SM	A–2
	9 to 28	Loamy sand	SM	A–2
	28 to 32	Sandy loam	SM	A–2 or A–4
	32 to 66	Loamy sand	SM	A–2
Edwards (Ek, Em).	0 to 32	Muck	Pt	
	32 to 66	Marl		
Eel.	0 to 66	Loam	ML	A–4
Ensley (En).	0 to 7	Loam	ML	A–4
	7 to 12	Sandy loam	SM	A–2 or A–6
	12 to 34	Sandy clay loam	SC	A–6
	34 to 66	Sandy loam	SM	A–2
Epoufette (Eo, Ep).	0 to 8	Sandy loam or loamy sand	SM	A–2
	8 to 21	Loamy sand to coarse sandy loam	SM	A–2
	21 to 66	Sand and fine gravel	SW or GW	A–3 or A–1
Fox (FoA, FoB, FoB2, FoC, FoC2, FoD2, FoE2, FoF, FsB, FxC3, FxD3, FxE3, FxF3).	0 to 14	Sandy loam or sandy clay loam	SM	A–2
	14 to 35	Sandy clay loam	SC	A–6, A–2
	35 to 66	Sand and fine gravel	SW or GW	A–3 or A–1

See footnotes at end of table.

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Depth to water table
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*		*Feet*
95 to 100	90 to 100	60 to 75	0.80 to 2.5	.18	6.2 to 6.8	Low.	2 to 10
100	95 to 100	65 to 90	0.20 to 2.5	.18	6.4 to 7.4	Moderate.	
95 to 100	90 to 100	55 to 80	0.05 to 1.5	.17	[2] 7.4 to 8.0	Low.	
----------	----------	----------	5.00 to 10.0	.50	6.4 to 6.8	Variable.	0 to 2
95 to 100	90 to 100	60 to 75	0.80 to 2.5	.18	5.8 to 6.3	Low.	4 to 20
90 to 100	85 to 95	65 to 80	0.20 to 1.5	.17	6.0 to 7.9	Moderate.	
95 to 100	90 to 100	65 to 80	0.05 to 1.5	.17	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	30 to 80	0.80 to 2.5	.14	[2] 7.4 to 8.0	Low.	2 to 10
90 to 100	85 to 100	10 to 25	5.00 to 10.0	.08	5.8 to 6.3	Low.	4 to 30
85 to 100	80 to 100	5 to 15	5.00 to 10.0	.07	5.8 to 6.3	Low.	
95 to 100	90 to 100	0 to 5	5.00 to 10.0	.05	5.8 to 6.3	Low.	
95 to 100	90 to 100	0 to 5	>10.0	.03	6.4 to 6.8	Low.	
95 to 100	90 to 100	30 to 70	0.80 to 2.5	.14	6.6 to 7.3	Low.	0 to 3
95 to 100	90 to 100	25 to 60	0.80 to 2.5	.14	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	25 to 65	0.80 to 5.0	.14	6.6 to 7.3	Low.	0 to 3
90 to 100	85 to 95	25 to 45	2.50 to 5.0	.12	6.6 to 7.3	Low.	
95 to 100	90 to 100	20 to 40	0.80 to 5.0	.10	6.6 to 7.3	Low.	
95 to 100	90 to 100	30 to 45	0.80 to 2.5	.16	7.4 to 7.6	Low.	
95 to 100	90 to 100	20 to 35	0.80 to 5.0	.10	7.4 to 7.6	Low.	
100	95 to 100	70 to 90	0.20 to 2.5	.20	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	60 to 70	0.80 to 2.5	.18	5.7 to 6.0	Low.	2 to 10
95 to 100	90 to 100	65 to 75	0.80 to 1.5	.17	5.7 to 6.0	Moderate.	
95 to 100	90 to 100	65 to 80	0.20 to 1.5	.17	5.4 to 7.3	Moderate.	
95 to 100	90 to 100	65 to 75	0.20 to 1.5	.17	[2] 7.4 to 8.0	Moderate.	
95 to 100	90 to 100	25 to 45	0.80 to 2.5	.14	5.4 to 6.4	Low.	2 to 10
95 to 100	90 to 100	35 to 50	0.20 to 2.5	.16	5.7 to 6.0	Low to moderate.	
95 to 100	90 to 100	25 to 45	0.80 to 2.5	.16	6.2 to 6.5	Low.	
95 to 100	90 to 100	20 to 40	0.80 to 5.0	.12	[2] 7.4 to 8.0	Low.	
95 to 100	95 to 100	20 to 45	0.80 to 2.5	.12	5.5 to 6.0	Low.	4 to 30
95 to 100	90 to 100	80 to 95	0.20 to 1.5	.17	5.5 to 6.0	Moderate.	
100	90 to 100	10 to 20	5.00 to 10.0	----------	5.5 to 6.0	Low.	
95 to 100	90 to 100	20 to 35	0.80 to 2.5	.12	5.7 to 6.4	Low.	4 to 20
95 to 100	90 to 100	35 to 50	0.80 to 2.5	.16	6.4 to 6.5	Low to moderate.	
95 to 100	90 to 100	20 to 35	0.80 to 5.0	.10	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	20 to 35	2.50 to 5.0	.10	6.2 to 6.5	Low.	0 to 3
95 to 100	90 to 100	10 to 25	5.00 to 10.0	.07	5.8 to 6.6	Low.	
95 to 100	90 to 100	20 to 40	0.08 to 5.0	.12	6.4 to 6.8	Low.	
95 to 100	90 to 100	10 to 25	5.00 to 10.0	.07	7.0 to 7.8	Low.	
----------	----------	----------	2.50 to 5.0	.50	7.6 to 7.8	Variable.	0 to 3
----------	----------	----------	[4] 0.80 to 5.0	(4)	[2] 7.4 to 8.0	Variable.	
95 to 100	90 to 100	55 to 90	0.05 to 1.5	.18	[2] 7.4 to 8.0	Low.	4 to 20
95 to 100	90 to 100	55 to 65	0.80 to 2.5	.15	6.5 to 7.2	Low.	0 to 3
95 to 100	90 to 100	25 to 50	0.80 to 2.5	.15	7.4 to 7.6	Low.	
95 to 100	90 to 100	35 to 50	0.20 to 2.5	.16	7.4 to 7.6	Low.	
95 to 100	90 to 100	20 to 35	2.50 to 5.0	.11	[2] 7.4 to 8.0	Low.	
85 to 95	80 to 95	10 to 35	2.50 to 10.0	.13	6.6 to 7.0	Low.	0 to 3
85 to 95	80 to 90	15 to 25	5.00 to 10.0	.07	6.5 to 7.4	Low.	
20 to 80	10 to 80	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low.	
90 to 100	85 to 95	20 to 35	0.80 to 5.0	.12	5.7 to 6.0	Low.	4 to 30
50 to 80	45 to 80	25 to 45	2.50 to 5.0	.16	5.8 to 6.4	Low to moderate.	
20 to 80	10 to 80	0 to 5	>10.0	.02	7.4 to 8.0	Low.	

TABLE 7.—*Estimated properties*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture [1]	Unified	AASHO
	Inches			
Genesee.	0 to 8	Loam or sandy loam	ML–CL	A–4
	8 to 45	Loam	ML–CL	A–4
	45 to 66	Silt loam	ML	A–4
Gilford (Gf, Gg).	0 to 16	Loamy sand or sandy loam	SM	A–2
	16 to 24	Sandy clay loam	SC	A–4 or A–2
	24 to 44	Loamy sand	SM	A–2
	44 to 66	Sand and fine gravel	SP or GP	A–1
Gladwin (GhA, GhB, GlA, GlB).	0 to 8	Loamy sand or sandy loam	SM	A–2
	8 to 20	Sand to loamy sand	SM or SP–SM	A–2
	20 to 25	Sandy loam	SM	A–2
	25 to 66	Fine gravel and sand	GW or SM	A–1 and A–3
Glendora (Gm, Gn).	0 to 8	Loam or sandy loam	ML–CL	A–4
	8 to 66	Loamy sand	SM	A–2
Granby (Go).	0 to 8	Loamy sand	SM	A–2
	8 to 41	Sand	SW or SW–SM	A–3
Gravel pits (Gp).	66	Gravel and sand	GW or SW	A–1
Grayling (GrA, GrB2, GrC, GrC2, GrD, GrD2, GrF).	0 to 66	Sand	SP	A–1 or A–3
Ionia (IoA, IoB, IrA, IrB, IrB2).	0 to 12	Sandy loam or loam	SM	A–2
	12 to 15	Loam	ML	A–4
	15 to 34	Clay loam	CL	A–6
	34 to 66	Gravel and sand	GW or SP	A–1 or A–3
Iosco (IsA, IsB).	0 to 8	Loamy sand	SM	A–2
	8 to 18	Sand	SP–SM or SP	A–3
	18 to 32	Loamy sand	SM	A–2
	32 to 66	Silty clay loam	CL	A–6
Kawkawlin (KaA, KaB, KdA, KdB).	0 to 10	Loam or sandy loam	ML–CL, SM	A–4
	10 to 14	Clay loam	CL	A–6
	14 to 24	Silty clay loam	CL	A–6
	24 to 66	Clay loam	CL	A–6
Kendallville (KeA, KeB, KeB2, KeC2, KgC3, KhB, KhB2, KhC2, KhD2).	0 to 14	Loam, sandy loam, or sandy clay loam.	ML	A–4
	14 to 24	Sandy loam	SM	A–2
	24 to 38	Sandy clay loam	SC	A–6
	38 to 66	Loam	ML–CL	A–4
Kent (KkB, KkC, KkD, KlC3).	0 to 9	Silt loam or sandy loam	ML	A–4
	9 to 22	Silty clay	CH	A–7
	22 to 66	Silty clay	CH	A–7
Kerston (Km).	0 to 66	Muck or peat	Pt	
Kibbie (KnA, KnB).	0 to 7	Loam	ML–CL	A–4
	7 to 18	Very fine sandy loam	ML–CL, SM	A–4
	18 to 34	Sandy clay loam	SC	A–6
	34 to 66	Silt and very fine sand	ML	A–4
Kokomo (Ko).	0 to 8	Clay loam	CL	A–6
	8 to 48	Clay loam	CL	A–6
	48 to 66	Clay loam	CL	A–6
Landes (La, Le, Lg, Lh). (For Eel part of La, Le units, see Eel series. For the Genesee part of the Lg, Lh units, see the Genesee series.)	0 to 9	Loam or sandy loam	ML	A–4
	9 to 42	Fine sandy loam	SM or ML	A–4
	42 to 66	Sandy loam	SM	A–2, A–4

See footnotes at end of table.

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Depth to water table
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*		*Feet*
95 to 100	90 to 100	55 to 70	0.80 to 2.5	.20	[2] 7.4 to 8.0	Low.	4 to 20
95 to 100	90 to 100	55 to 70	0.80 to 1.5	.17	[2] 7.4 to 8.0	Low.	
100	95 to 100	75 to 90	0.20 to 2.5	.20	[2] 7.4 to 8.0	Low.	
90 to 100	85 to 95	15 to 35	2.50 to 5.0	.13	6.3 to 6.8	Low.	0 to 3
50 to 80	45 to 80	25 to 45	2.50 to 5.0	.16	5.7 to 6.3	Low to moderate.	
100	95 to 100	10 to 30	5.00 to 10.0	.06	7.3 to 8.0	Low.	
10 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.3 to 8.0	Low.	
90 to 100	85 to 100	10 to 35	2.50 to 10.0	.10	6.2 to 6.5	Low.	2 to 10
75 to 95	70 to 90	5 to 25	5.00 to 10.0	.04	5.8 to 6.3	Low.	
75 to 95	70 to 90	15 to 30	2.50 to 5.0	.12	6.5 to 7.0	Low.	
20 to 80	10 to 80	0 to 5	>10.0	.03	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	55 to 70	0.80 to 2.5	.18	7.4 to 8.0	Low.	0 to 3
95 to 100	90 to 100	10 to 25	5.0 to 10.0	.08	[2] 7.4 to 8.5	Low.	
90 to 100	85 to 100	10 to 25	5.00 to 10.0	.08	6.6 to 7.0	Low.	0 to 3
95 to 100	90 to 100	0 to 10	>10.0	.03	6.2 to 7.6	Low.	
10 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low.	2 to 20
100	95 to 100	0 to 5	>10.0	.02	5.7 to 6.7	Low.	4 to 30
95 to 100	90 to 100	20 to 35	0.80 to 2.5	.12	5.5 to 6.0	Low.	4 to 20
95 to 100	95 to 100	55 to 85	0.80 to 2.5	.14	5.5 to 6.0	Low.	
95 to 100	90 to 100	60 to 80	0.20 to 1.5	.16	5.8 to 6.3	Moderate.	
20 to 80	10 to 80	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	10 to 25	2.50 to 5.0	.07	5.6 to 5.8	Low.	2 to 10
95 to 100	90 to 100	0 to 10	5.00 to 10.0	.03	5.8 to 6.2	Low.	
95 to 100	90 to 100	10 to 25	2.50 to 5.0	.05	6.2 to 6.5	Low.	
95 to 100	95 to 100	80 to 100	0.20 to 1.5	.17	[2] 7.4 to 8.0	Moderate.	
95 to 100	90 to 100	35 to 80	0.80 to 2.5	.18	6.4 to 6.8	Low.	2 to 10
95 to 100	90 to 100	55 to 80	0.20 to 0.8	.18	6.2 to 6.5	Moderate.	
95 to 100	90 to 100	80 to 100	0.20 to 0.8	.17	6.6 to 6.8	Moderate.	
95 to 100	90 to 100	55 to 80	0.20 to 0.8	.16	[2] 7.4 to 8.0	Moderate.	
95 to 100	90 to 100	60 to 80	0.80 to 2.5	.19	5.4 to 5.7	Low.	4 to 30
95 to 100	90 to 100	20 to 35	0.80 to 5.0	.12	5.6 to 5.9	Low.	
95 to 100	90 to 100	35 to 50	0.20 to 2.5	.16	6.1 to 6.4	Low to moderate.	
95 to 100	90 to 100	55 to 75	0.20 to 1.5	.17	[2] 7.4 to 8.0	Low.	
100	95 to 100	60 to 90	0.80 to 1.5	.19	6.1 to 6.4	Low.	4 to 20
100	95 to 100	70 to 95	0.05 to 0.2	.17	6.3 to 6.8	High.	
100	95 to 100	70 to 95	0 to 0.2	.16	[2] 7.4 to 8.0	High.	
			5.00 to 10.0	.50	6.4 to 7.4	Variable.	0 to 2
100	100	55 to 70	0.80 to 2.5	.19	6.2 to 6.5	Low.	2 to 10
100	100	45 to 80	0.80 to 2.5	.19	6.2 to 6.5	Low.	
95 to 100	90 to 100	35 to 50	0.20 to 2.5	.16	6.4 to 6.8	Low to moderate.	
100	95 to 100	70 to 100	0.20 to 2.5	.20	[2] 7.4 to 8.0	Moderate.	
100	95 to 100	60 to 80	0.20 to 0.8	.18	6.7 to 7.2	Moderate to low.	0 to 3
95 to 100	90 to 100	60 to 85	0.20 to 0.8	.16	6.9 to 7.5	Moderate.	
95 to 100	90 to 100	60 to 80	0.05 to 1.5	.16	[2] 7.4 to 8.0	Moderate.	
90 to 100	90 to 100	50 to 85	0.80 to 2.5	.20	[2] 7.4 to 8.0	Low.	4 to 20
90 to 100	90 to 100	35 to 60	0.80 to 2.5	.14	[2] 7.4 to 8.0	Low.	
90 to 100	90 to 100	20 to 40	0.80 to 5.0	.12	[2] 7.4 to 8.0	Low.	

TABLE 7.—*Estimated properties*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture [1]	Unified	AASHO
	Inches			
Lapeer (LIA, LIB, LIB2, LIC2, LmC3, LmD3, LmF3, LnA, LnB, LnB2, LnC2, LnD2, LnF2).	0 to 7	Sandy loam, loam, or sandy clay loam.	SM	A-2 or A-4
	7 to 17	Sandy loam	SM	A-2
	17 to 34	Sandy clay loam	SC	A-6
	34 to 66	Sandy loam	SM	A-2
Linwood (Lo).	0 to 20	Muck	Pt	
	20 to 34	Peat	Pt	
	34 to 66	Sandy loam	SM	A-2 to A-4
Locke (LsA, LsB).	0 to 12	Sandy loam	SM	A-2
	12 to 15	Heavy sandy loam	SM	A-2 to A-4
	15 to 32	Sandy clay loam	SC	A-6
	32 to 66	Sandy loam	SM	A-2
Lupton (Lt).	0 to 29	Muck	Pt	
	29 to 66	Peat	Pt	
Macomb (MaA, MaB).	0 to 7	Loam	ML-CL	A-4
	7 to 11	Heavy sandy loam	SM	A-2 or A-4
	11 to 13	Loam	ML-CL	A-4
	13 to 32	Sandy clay loam	SC	A-6
	32 to 66	Loam	ML-CL	A-4
Made land (Mb). No estimates of engineering properties.				
Mancelona (McB, McC2, MdA, MdB, MdB2, MdC2, MdC3, MdD, MdD2, MdD3, MdE2, MdE3, MdF, MdF2, MdF3, MeA). (For Chelsea part of the MdA, MdB, MdB2, MdC2, MdC3, MdD, MdD2, MdD3, MdE2, MdE3, MdF, MdF2, MdF3, MeA units, see Chelsea series.)	0 to 27	Loamy sand	SM	A-2
	27 to 33	Sandy clay loam	SC	A-4
	33 to 66	Sand and fine gravel	SW or GW	A-3 or A-1
Marlette (MgA, MgB, MgB2, MgC2, MgD2, MgE2, MgF2, MfC3, MfD3, MfE3, MhB, MhB2, MhC2, MkA, MkB, MkB2, MkC2, MkD2, MkE).	0 to 7	Loam, sandy loam, clay loam, or loamy sand.	ML-CL, SM	A-4
	7 to 15	Light loam	ML	A-4
	15 to 32	Clay loam	CL	A-6
	32 to 66	Loam	ML-CL	A-4
Matherton (MIA, MIB, MmA, MmB).	0 to 12	Loam or sandy loam	ML-CL	A-4
McBride (MnA, MnB, MnB2, MnC2, MoB3, MoC3, MoD3, MoE3, MpA, MpB, MpB2, MpC, MpC2, MpD2, MpE2, MpF2).	0 to 16	Sandy loam, sandy clay loam, or loamy sand.	SM	A-2
	16 to 38	Sandy clay loam	SC	A-2 or A-6
	38 to 48	Sandy loam	SM	A-2 or A-4
	48 to 66	Sandy loam	SM	A-2 or A-4
Menominee (MrA, MrB, MrB2, MrC2, MrC3, MrD2, MrD3, MrE2).	0 to 14	Loamy sand	SP-SM or SM	A-2
	14 to 30	Sand	SP-SM or SP	A-3
	30 to 34	Silty clay loam	CL	A-6
	34 to 66	Loam	ML	A-4
Metamora (MsA, MsB).	0 to 16	Sandy loam	SM	A-2
	16 to 33	Heavy sandy loam	SM	A-4
	33 to 66	Loam	ML-CL	A-4
Miami (MtB3, MtC3, MtD3, MtE3, MtF3, MuA, MuB, MuB2, MuC, MuC2, MuD2, MuE2, MuF, MvB, MvB2, MvC2, MvD2, MwA, MwB, MwB2, MwC2, MwD2). (For Owosso part of the MwA, MwB, MwB2, MwC2, MwD2 units, see Owosso series.)	0 to 8	Loam, sandy loam, or clay loam	ML-CL	A-4
	8 to 11	Silt loam	ML	A-4
	11 to 34	Clay loam or silty clay loam	CL	A-6
	34 to 66	Loam	ML-CL	A-4

See footnotes at end of table.

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Depth to water table
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*		*Feet*
95 to 100	90 to 100	20 to 45	2.50 to 5.0	.12	6.2 to 6.5	Low.	4 to 30
95 to 100	90 to 100	15 to 30	2.50 to 5.0	.10	6.2 to 6.5	Low.	
95 to 100	90 to 100	35 to 50	0.80 to 2.5	.16	5.5 to 6.0	Low to moderate.	
95 to 100	90 to 100	20 to 35	2.50 to 5.0	.10	[2] 7.4 to 8.0	Low.	
			5.00 to 10.0	.50	6.2 to 6.5	Variable.	0 to 2
			5.00 to 10.0	.50	6.2 to 6.5	Variable.	
95 to 100	90 to 100	25 to 45	0.80 to 2.5	.10	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	20 to 35	2.50 to 5.0	.14	5.8 to 6.3	Low.	2 to 10
95 to 100	90 to 100	25 to 45	0.80 to 2.5	.12	5.6 to 5.9	Low.	
95 to 100	90 to 100	35 to 50	0.80 to 2.5	.15	6.2 to 6.5	Low to moderate.	
95 to 100	90 to 100	20 to 35	2.50 to 5.0	.10	[2] 7.4 to 8.0	Low.	
			2.50 to 5.0	.50	6.6 to 7.3	Variable.	0 to 2
			2.50 to 5.0	.50	7.4 to 7.8	Variable.	
95 to 100	90 to 100	60 to 75	0.80 to 2.5	.18	6.2 to 6.5	Low.	2 to 10
95 to 100	90 to 100	30 to 45	0.80 to 2.5	.14	6.2 to 6.5	Low.	
95 to 100	95 to 100	60 to 80	0.80 to 2.5	.17	6.2 to 6.5	Low.	
95 to 100	95 to 100	35 to 50	0.80 to 2.5	.14	5.7 to 6.0	Low to moderate.	
95 to 100	90 to 100	55 to 75	0.20 to 1.5	.14	[2] 7.4 to 8.0	Low.	
60 to 95	55 to 95	10 to 25	2.50 to 10.0	.08	5.8 to 6.4	Low.	4 to 30
60 to 95	55 to 95	35 to 50	0.80 to 2.5	.14	6.4 to 6.8	Low to moderate.	
20 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	35 to 80	0.80 to 2.5	.21	6.6 to 7.0	Low.	4 to 20
95 to 100	90 to 100	55 to 65	0.80 to 2.5	.14	6.1 to 6.5	Low.	
95 to 100	90 to 100	60 to 85	0.20 to 2.5	.16	6.6 to 7.1	Moderate.	
95 to 100	90 to 100	55 to 80	0.20 to 2.5	.14	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	60 to 75	0.80 to 2.5	.16	6.2 to 6.5	Low.	4 to 30
95 to 100	90 to 100	20 to 35	0.80 to 5.0	.13	5.6 to 6.0	Low.	4 to 30
95 to 100	95 to 100	20 to 45	0.80 to 2.5	.15	4.6 to 5.0	Low to moderate.	
95 to 100	95 to 100	20 to 45	2.50 to 5.0	.12	4.7 to 6.3	Low.	
95 to 100	95 to 100	20 to 40	2.50 to 5.0	.10	[2] 7.4 to 8.0	Low.	
100	95 to 100	10 to 20	5.00 to 10.0	.05	5.7 to 6.7	Low.	4 to 20
100	95 to 100	0 to 10	5.00 to 10.0	.02	6.2 to 6.5	Low.	
95 to 100	90 to 100	80 to 95	0.20 to 2.5	.17	7.4 to 7.7	Moderate.	
95 to 100	90 to 100	55 to 70	0.20 to 2.5	.17	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	20 to 35	0.80 to 2.5	.12	5.7 to 6.7	Low.	2 to 10
95 to 100	90 to 100	35 to 50	0.80 to 2.5	.14	6.1 to 6.4	Low.	
95 to 100	90 to 100	60 to 85	0.20 to 1.5	.17	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	60 to 80	0.80 to 2.5	.20	6.1 to 6.4	Low.	4 to 30
100	95 to 100	80 to 100	0.80 to 2.5	.20	5.6 to 6.0	Low.	
95 to 100	90 to 100	65 to 95	0.20 to 2.5	.18	5.4 to 6.2	Moderate.	
95 to 100	90 to 100	60 to 80	0.20 to 2.5	.17	[2] 7.4 to 8.0	Low.	

TABLE 7.—*Estimated properties*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture [1]	Unified	AASHO
	Inches			
Montcalm (MxA, MxB, MxB2, MxC2, MxC3, MxD2, MxD3, MxE2, MxE3, MxF2, MyA, MyB, MyB2, MyC2).	0 to 24	Loamy sand or sandy loam	SM	A-2
	24 to 31	Sandy loam	SM	A-2 or A-4
	32 to 72	Sand	SP	A-3
	72 to 84	Sand	SP	A-3
Morley (MzC3, MzD3, MzaA, MzaB, MzaB2, MzaC2, MzaD2, MzbB, MzbB2, MzbC2).	0 to 12	Loam, sandy loam, or clay loam	ML, SM, or ML-CL.	A-4
	12 to 16	Clay loam	CL	A-6
	16 to 30	Silty clay laom	CL	A-6
	30 to 66	Silty clay loam	CL	A-6
Nester (NcB3, NcC3, NcD3, NcE3, NeB, NeB2, NeC2, NsB, NsB2, NsC2, NsD).	0 to 6	Sandy loam, loam, or clay loam	SM	A-2 or A-4
	6 to 11	Loam	ML-CL	A-4
	11 to 30	Clay loam and silty clay loam	CL	A-6
	30 to 66	Silty clay loam	CL	A-6
Newaygo (NwC3, NwD3, NyA, NyB, NyB2, NyC2, NyD2, NyF2).	0 to 8	Sandy loam or sandy clay loam.	SM	A-2 or A-4
	8 to 16	Loam	ML	A-4
	16 to 32	Fine sandy loam	SM or ML	A-2 or A-4
	32 to 38	Sandy clay loam	SC	A-6
	38 to 66	Fine gravel and sand	GW or SW	A-1 or A-3
Otisco (OcA, OcB, OtA, OtB).	0 to 31	Loamy sand or sandy loam	SM	A-2
	31 to 40	Sandy loam	SM	A-2
	40 to 66	Loamy sand	SM	A-2
Owosso.	0 to 15	Sandy loam	SM	A-2
	15 to 34	Heavy sandy loam	SM	A-2 or A-4
	34 to 66	Loam	ML-CL	A-4
Perrin (PdA, PdB, PdB2, PeA, PeB).	0 to 11	Loamy sand or sandy loam	SM	A-2
	11 to 26	Sandy loam	SM	A-2
	26 to 33	Sandy clay loam	SC	A-6
	33 to 66	Gravel and sand	GW or SW	A-1 or A-3
Pewamo (Pm, Pn).	0 to 12	Clay loam or loam	CL	A-6
	12 to 40	Silty clay loam	CL	A-6
	40 to 66	Silty clay loam	CL	A-6
Plainfield (PoB, PoC2, PoD2, PoE2).	0 to 48	Sand	SP	A-3
	48 to 66	Sand	SP	A-3
Rifle (Rm).	0 to 6	Peat	Pt	
	6 to 66	Peat	Pt	
Saranac (Sa, Sc).	0 to 10	Clay loam or silt loam	CL or ML	A-6 or A-4
	10 to 66	Silty clay loam	CL	A-6
Sebewa (Sd).	0 to 10	Loam	ML-CL	A-4
	10 to 36	Clay loam	CL	A-6
	36 to 66	Gravel and sand	GW or SW	A-1 or A-3
Selkirk (SeA, SfA).	0 to 11	Silt loam or loamy sand	ML-CL	A-4
	11 to 21	Silty clay loam	CL	A-6
	21 to 66	Silty clay loam	CL	A-6
Shallow sandy land (Sg).	0 to 16	Loamy sand	SM	A-2
	16 to 24	Light sandy loam	SM	A-2
	24 to 66	Sandstone		
Shoals (Sh, Sk, Sl).	0 to 10	Loam, sandy loam, or clay loam	ML or CL	A-4 or A-6
	10 to 24	Silt loam	ML	A-4
	24 to 36	Loam	ML-CL	A-4
	36 to 49	Silt loam	ML	A-4
	49 to 66	Loam	ML-CL	A-4

See footnotes at end of table.

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Depth to water table
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*		*Feet*
85 to 100	85 to 100	15 to 35	0.80 to 5.0	.08	5.4 to 6.2	Low.	4 to 30
95 to 100	90 to 100	25 to 40	0.20 to 2.5	.13	5.4 to 6.2	Low.	
95 to 100	95 to 100	0 to 5	5.00 to 10.0	.04	5.4 to 6.2	Low.	
100	95 to 100	0 to 5	>10.0	.02	6.2 to 6.7	Low.	
100	95 to 100	60 to 85	0.20 to 1.5	.20	5.4 to 6.1	Low.	4 to 20
95 to 100	90 to 100	60 to 80	0.80 to 1.5	.17	5.1 to 5.5	Moderate.	
95 to 100	90 to 100	80 to 100	0.20 to 1.5	.21	5.8 to 6.7	Moderate.	
95 to 100	90 to 100	80 to 95	0.05 to 0.8	.17	[2] 7.4 to 8.0	Moderate.	4 to 30
95 to 100	90 to 100	20 to 45	0.80 to 2.5	.12	6.3 to 6.7	Low.	
95 to 100	90 to 100	60 to 75	0.80 to 2.5	.17	6.3 to 6.7	Low.	
100	95 to 100	65 to 95	0.20 to 2.5	.17	6.6 to 7.3	Moderate.	
100	95 to 100	80 to 95	0.20 to 2.5	.17	[2] 7.4 to 8.0	Moderate.	
90 to 100	85 to 95	25 to 45	2.50 to 4.0	.13	6.2 to 6.4	Low.	4 to 30
95 to 100	90 to 100	55 to 70	0.80 to 2.5	.19	6.2 to 6.4	Low.	
95 to 100	90 to 100	25 to 60	0.80 to 2.5	.15	6.1 to 6.5	Low.	
50 to 80	50 to 80	35 to 45	2.50 to 5.0	.16	6.6 to 7.3	Low to moderate.	
10 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low.	
95 to 100	90 to 100	10 to 35	2.50 to 5.0	.08	5.5 to 6.4	Low.	2 to 10
95 to 100	90 to 100	15 to 35	0.80 to 5.0	.11	6.6 to 7.3	Low.	
95 to 100	90 to 100	10 to 25	2.50 to 5.0	.08	7.0 to 7.5	Low.	
95 to 100	90 to 100	25 to 35	0.80 to 2.5	.12	5.7 to 6.2	Low.	4 to 30
95 to 100	90 to 100	20 to 45	0.80 to 2.5	.10	6.2 to 6.5	Low.	
95 to 100	90 to 100	60 to 85	0.20 to 1.5	.17	[2] 7.4 to 8.0	Low.	
90 to 100	85 to 100	10 to 35	5.00 to 10.0	.08	5.7 to 6.0	Low.	4 to 20
100	95 to 100	15 to 30	2.50 to 5.0	.10	5.7 to 6.0	Low.	
95 to 100	90 to 100	35 to 50	0.20 to 2.5	.16	6.1 to 6.4	Low to moderate.	
10 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low.	
100	95 to 100	60 to 80	0.20 to 2.5	.20	6.6 to 7.1	Moderate.	0 to 3
100	95 to 100	80 to 95	0.05 to 0.2	.17	7.4 to 7.9	Moderate.	
95 to 100	90 to 100	80 to 95	0.05 to 0.2	.17	[2] 7.4 to 8.0	Moderate.	
100	95 to 100	0 to 5	5.00 to 10+	.02	6.1 to 6.5	Low.	4 to 30
100	95 to 100	0 to 5	5.00 to 10+	.02	6.6 to 7.4	Low.	
			5.00 to 10.0	.50	6.1 to 6.4	Variable.	0 to 2
			5.00 to 10.0	.50	5.6 to 6.0	Variable.	
100	95 to 100	60 to 90	0.20 to 2.5	.20	[2] 7.4 to 8.0	Moderate to low.	0 to 3
100	95 to 100	80 to 95	0.05 to 0.8	.17	[2] 7.4 to 8.0	Moderate.	
95 to 100	90 to 100	60 to 80	0.80 to 2.5	.18	6.1 to 6.4	Low.	0 to 3
95 to 100	90 to 100	60 to 85	0.20 to 1.5	.17	6.4 to 6.8	Moderate.	
20 to 80	10 to 80	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low.	
100	95 to 100	60 to 90	0.20 to 1.5	.20	6.2 to 6.5	Low.	2 to 10
100	95 to 100	80 to 95	0.05 to 0.2	.17	6.2 to 6.6	Moderate.	
100	95 to 100	80 to 95	0.20 to 0.05	.16	[2] 7.4 to 8.0	Moderate.	
95 to 100	90 to 100	10 to 25	2.50 to 5.0	.06	5.8 to 6.6	Low.	2 to 10
95 to 100	90 to 100	20 to 35	2.50 to 5.0	.12	5.6 to 6.0	Low.	
95 to 100	90 to 100	60 to 85	0.80 to 2.5	.17	7.4 to 7.6	Low.	2 to 10
100	90 to 100	60 to 90	0.20 to 1.5	.18	7.4 to 7.6	Low.	
95 to 100	90 to 100	55 to 85	0.20 to 2.5	.17	7.4 to 7.6	Low.	
100	90 to 100	60 to 90	0.20 to 1.5	.20	7.4 to 7.6	Low.	
95 to 100	90 to 100	55 to 85	0.05 to 2.5	.16	[2] 7.4 to 8.0	Low.	

TABLE 7.—*Estimated properties*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture [1]	Unified	AASHO
	Inches			
Sims (Sm, Sn).	0 to 8	Clay loam or loam	CL	A-6
	8 to 38	Silty clay loam	CH	A-7
	38 to 66	Silty clay loam	CL	A-6
Sloan.	0 to 36	Loam	ML-CL	A-4
	36 to 54	Silt loam	ML	A-4
	54 to 66	Loam	ML-CL	A-4
Spinks (SpA, SpB, SpB2, SpC2, SpC3, SpD2, SpD3).	0 to 25	Loamy sand	SM	A-2
	25 to 55	Sand	SP or SP-SM	A-3 or A-2
	55 to 66	Loamy sand	SM	A-2
Tawas (Ta).	0 to 27	Muck and peat	Pt	
	27 to 32	Sedimentary peat	Pt	
	32 to 66	Sand	SP-SM or SP	A-3 or A-2
Tuscola (TsA, TsB, TsB2, TsC2, TuB).	0 to 11	Loamy fine sand	SM	A-2 or A-4
	11 to 36	Silt loam	ML-CL	A-4
	36 to 66	Silt and very fine sand	ML	A-4
Ubly (UbC3, UlA, UlB, UlB2, UlC2, UlD2, UlE2).	0 to 22	Sandy loam or sandy clay loam	SM	A-2
	22 to 38	Heavy sandy loam	SM	A-4
	38 to 66	Clay loam	CL	A-6
Wallkill (Wa).	0 to 30	Loam	ML	A-4
	30 to 66	Muck	Pt	
Wasepi (WeA, WeB, WrA, WrB, WsA, WsB). (For Brady part of the WrA, WrB, WsA, WsB units, see Brady series.)	0 to 16	Sandy loam or loamy sand	SM	A-2
	16 to 26	Sandy clay loam	SC	A-6
	26 to 66	Fine gravel and sand	GW or SW	A-1 or A-3
Washtenaw (Wt).	0 to 35	Loam	ML-CL	A-4
	35 to 42	Loam	ML-CL	A-4
	42 to 62	Clay loam	CL	A-6
	62 to 66	Loam	ML-CL	A-4
Willette (Wu). (For Linwood part of Wu, see Linwood series.)	0 to 20	Muck	Pt	
	20 to 28	Fibrous peat	Pt	
	28 to 31	Sedimentary peat	Pt	
	31 to 66	Heavy silty clay loam	CL	A-6
Wind eroded land (Wv, Ww). No estimates of engineering properties.				

[1] Estimates generally are for the dominant type in the series.
[2] Normally calcareous.

bankments are for disturbed soils. Features that affect the suitability of the soils for reservoirs and embankments are content of organic matter, permeability, depth to bedrock, shrink-swell potential, ground water level, and strength and stability.

Also considered in table 8 are features that affect the layout and construction of waterways, the establishment of vegetation in the waterways, the continued growth of the plants, and maintenance of waterways. Permeability, fertility, and the hazard of erosion are some of the main factors affecting the suitability of the soils for this purpose.

The main factors to be considered in determining the suitability of the soils for irrigation are the water-holding capacity and the rate at which water moves into a soil. Also important are depth to the water table, depth to soil material that restricts growth of roots, and topography.

Features that affect the suitability of the soils for terraces and diversions are the texture of the soil, depth to soil material unfavorable to production of crops, and topography.

Wildlife [4]

The soils of Ionia County are used primarily for crops and pasture, but they can also support many kinds of

[4] By GEORGE THRELKELD, Soil Conservation Service, and EDWARD MIKULA, game biologist, Michigan Department of Conservation, Game Division, Lansing, Mich.

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Depth to water table
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*		*Feet*
100	95 to 100	60 to 80	0.80 to 1.5	.20	6.1 to 6.5	Moderate.	0 to 3
100	90 to 100	60 to 85	0.20 to 0.8	.18	6.6 to 7.4	Moderate.	
100	90 to 100	60 to 85	0.05 to 0.2	.17	[2] 7.4 to 8.0	Moderate.	
95 to 100	90 to 100	60 to 75	0.80 to 2.5	.17	7.4 to 7.6	Low.	0 to 3
100	90 to 100	60 to 90	0.20 to 1.5	.20	7.4 to 7.6	Low.	
95 to 100	90 to 100	60 to 75	0.20 to 1.5	.16	7.4 to 7.6	Low.	
85 to 100	85 to 100	10 to 25	2.50 to 5.0	.08	6.1 to 6.5	Low.	4 to 30
95 to 100	95 to 100	0 to 10	5.00 to 10.0	.04	6.1 to 6.8	Low.	
95 to 100	90 to 100	10 to 25	2.50 to 5.0	.05	7.2 to 7.4	Low.	
----------	----------	----------	5.00 to 10.0	.50	6.2 to 6.5	Variable.	0 to 2
----------	----------	----------	5.00 to 10.0	.50	6.2 to 6.5	Variable.	
100	95 to 100	0 to 15	>10	.03	7.4 to 7.6	Low.	
100	95 to 100	20 to 50	0.80 to 2.5	.14	6.1 to 6.4	Low.	4 to 25
100	95 to 100	60 to 90	0.20 to 1.5	.20	6.1 to 6.4	Low.	
100	95 to 100	70 to 100	0.20 to 2.5	.19	[2] 7.4 to 8.0	Low.	
90 to 100	85 to 95	20 to 35	2.50 to 5.0	.12	6.1 to 6.3	Low.	4 to 25
90 to 100	85 to 95	35 to 45	0.80 to 2.5	.14	6.3 to 6.5	Low.	
95 to 100	90 to 100	60 to 80	0.05 to 1.5	.17	[2] 7.4 to 8.0	Moderate.	
90 to 100	90 to 100	60 to 90	0.80 to 2.5	.20	6.6 to 7.3	Low.	0 to 3
----------	----------	----------	2.50 to 5.0	.50	6.6 to 7.3	Variable.	
90 to 100	90 to 100	25 to 35	2.50 to 5.0	.14	6.1 to 6.7	Low.	2 to 10
95 to 100	90 to 100	35 to 50	0.20 to 2.5	.16	6.7 to 7.3	Moderate.	
10 to 60	10 to 60	0 to 5	>10.0	.02	[2] 7.4 to 8.0	Low	
90 to 100	90 to 100	55 to 85	0.80 to 2.5	.20	6.6 to 7.3	Low.	0 to 3
95 to 100	90 to 100	55 to 70	0.80 to 2.5	.18	6.6 to 7.3	Low.	
95 to 100	90 to 100	60 to 80	0.20 to 0.8	.20	7.3 to 8.0	Moderate.	
95 to 100	95 to 100	55 to 70	0.20 to 0.8	.16	[2] 7.4 to 8.0	Low.	
----------	----------	----------	5.00 to 10.0	.50	6.1 to 6.5	Variable.	0 to 2
----------	----------	----------	5.00 to 10.0	.50	6.6 to 6.9	Variable.	
----------	----------	----------	5.00 to 10.0	.50	6.7 to 7.0	Variable.	
100	95 to 100	80 to 95	0.20 to 0.8	.16	[2] 7.4 to 8.0	Moderate.	

[3] In some small areas, mineral soil deposits have formed a 6- to 10-inch surface layer of sandy loam (SM, A-2); loam (ML-CL, A-4); or silt loam (ML, A-4).

[4] Variable.

wildlife if some measures are taken to provide suitable food and cover. On some farms, small areas are set aside specifically for the use of wildlife.

Odd areas, only about one-fourth acre or more in size, can be developed to provide well-rounded habitats for wildlife. These areas include eroded soils in crop fields, bare knobs, depressions, sand blowouts, large gullies, railroad rights-of-way, borrow pits, gravel pits and small isolated spots. The outer perimeter, or about half the total acreage, is planted to grass and legumes for good ground cover; the center is planted to such fruit-producing shrubs as autumn olive, multiflora rose, highbush cranberry, or tartarian honeysuckle; and the very center commonly is planted to suitable pines or spruces.

Marshes that have a dependable water supply and that cannot be economically drained for crops can be managed for either fur-bearing animals or waterfowl.

Ditchbanks provide habitats for small wildlife. Water generally is present in the drainage ditch, and food often is available in nearby fields.

Fence rows and hedgerows of woody plants furnish food, cover, nesting places, escape routes, travel lanes, and shade for wildlife. They commonly are a major source of food in winter.

Ponds, pits, and pond areas provide water and cover for fur-bearing animals, game birds, and songbirds. Ponds can be stocked with fish.

Field and farmstead windbreaks of shrub hardwoods and conifers provide cover and travel lanes for game.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Abscota (Ab, Ac, Ad)	Fair in upper 6 to 10 inches.	Fair; considerable fines; stratified.	Unsuitable	Good	Hazard of flooding.	Fair to good bearing capacity; hazard of flooding.
Algansee (Ae, Ag, Ah)	Fair or poor in upper 6 to 10 inches.	Unsuitable	Unsuitable	Good; wet below depth of 36 to 48 inches.	Seasonal high water table; hazard of flooding.	Seasonal high water table; slight piping hazard.
Alluvial land (Am)	Poor	Unsuitable	Unsuitable	Unsuitable	Seasonal high water table; occasional flooding; marl below depth of 10 to 40 inches; moderate risk of frost heaving.	Seasonal high water table; occasional flooding; marl below depth of 10 to 40 inches; moderate risk of frost heaving.
Au Gres (As)	Poor; sandy; droughty.	Good; mostly medium sand.	Unsuitable	Good; wet below depth of 36 to 48 inches.	Seasonal high water table; loses stability when wet.	Piping hazard; seasonal high water table.
Barry (Ba, Bd)	Good	Unsuitable	Unsuitable	Fair; generally wet; good if not wet.	Seasonal high water table; moderate risk of frost heaving; occasionally ponded.	High water table; moderate risk of frost heaving; moderate bearing strength; moderate piping hazard.
Belding (BeA, BeB)	Good or fair	Unsuitable	Unsuitable	Fair; generally wet below depth of 36 to 48 inches; slightly plastic.	Seasonal high water table; risk of frost heaving in substratum.	Some risk of frost heaving; seasonal high water table; moderate volume change.

See footnotes at end of table.

interpretations of the soils

Soil features affecting engineering practices—Continued

Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Hazard of flooding; needs on-site study.	Not needed; well drained or moderately well drained; hazard of flooding.	Rapid seepage rate; seal blanket required.	Rapid seepage rate; very sandy; piping hazard.	Generally not needed; low available moisture capacity; low fertility.	Rapid rate of water intake; low water-holding capacity; frequent applications of water required.	Not needed; little runoff; mostly level or nearly level areas; short slopes in gently sloping areas.
Seasonal high water table; hazard of flooding.	Seasonal high water table; very rapid permeability; sandy material makes tiling difficult.	Rapid seepage rate; hazard of flooding; seal blanket required.	Rapid seepage rate; piping hazard; low stability.	Generally not needed; low available moisture capacity; low fertility; nearly level bottom lands.	Rapid rate of water intake; low water-holding capacity; frequent applications of water necessary.	Not needed; little runoff; mostly level or nearly level areas; short slopes in the more sloping areas.
Seasonal high water table; permeability moderately rapid in upper 10 to 40 inches, moderate below this depth.	Somewhat poor drainage; permeability moderately rapid in upper part, moderate in lower part; tile blinding necessary in many places.	Generally not suitable.	Poor compaction properties; moderate seepage rate; generally not suitable.	Establishing vegetation difficult; calcareous.	Rapid rate of water intake; high water-holding capacity; seasonal high water table.	Not needed; level or nearly level areas.
Seasonal high water table; possible pollution of water supplies.	Seasonal high water table; sandy material makes tiling difficult; good lateral movement of water.	Rapid seepage rate; seal blanket required.	Rapid seepage rate; very sandy; piping hazard.	Low available water capacity; low fertility; erodible; difficult to establish vegetation.	Very low water-holding capacity; rapid rate of water intake; frequent applications of water required.	Not needed; very sandy soil with little runoff.
Seasonal high water table.	Naturally poor drainage; moderate permeability; tile functions well if adequate outlets are available.	Moderate seepage rate; high but fluctuating water table.	Good compaction properties; little seepage in well compacted fill.	Water-tolerant plants suitable.	Medium water-holding capacity; medium rate of water intake; drainage required.	Not needed; depressions or level areas.
Seasonal high water table; moderate or slow permeability below depth of 18 to 42 inches.	Seasonal high water table; tile functions well.	Moderate seepage rate in upper 18 to 42 inches; slow seepage rate below this depth.	Good compaction properties; mixing of soil material in upper 18 to 42 inches with finer textured material below results in slow seepage rate in fill.	No restrictions, other than seasonal high water table.	Medium rate of water intake; medium water-holding capacity.	Not needed; mostly nearly level areas; short irregular slopes in gently sloping areas.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Bergland (Bg)	Good in upper 10 to 12 inches.	Unsuitable	Unsuitable	Poor; highly plastic; high volume change.	High water table; plastic soil material; frequent ponding.	Low bearing strength; high shrink-swell potential; risk of frost heaving; poor shear strength.
Berville (Bh, Bk)	Good in upper 8 to 12 inches.	Unsuitable	Unsuitable	Fair; generally wet; good compaction properties if not wet.	High water table; risk of frost heaving.	High water table; risk of frost heaving; fair to poor bearing capacity.
Blount (BlA, BlB, BlB2).	Good in upper 8 to 10 inches.	Unsuitable	Unsuitable	Fair in upper 36 to 48 inches.	Seasonal high water table; risk of frost heaving.	Seasonal high water table; moderate risk of frost heaving; moderate shrink-swell potential.
Boyer (BmA, BmB, BmB2, BmC2, BmD2, BnA, BnB, BnB2, BnC2, BnD2, BoA, BoB, BoC, BpE2, BpF2, BsA, BsB, BsB2, BsC2, BsD2, BsE2, BsF, BsF3). (For Spinks part of the BsA, BsB, BsB2, BsC2, BsD2, BsE2, BsF, BsF3 units, see Spinks series.)	Poor	Fair or good; contains considerable amount of gravel.	Good; but contains an appreciable amount of sand.	Good; low volume change; good to fair bearing capacity.	Cuts and fills commonly needed; good bearing capacity.	No restrictions; good bearing capacity; low volume change.
Brady	Fair for sandy loam, poor for loamy sand, in upper 8 to 12 inches; seasonal high water table.	Good; contains some fines and gravel.	Fair; contains considerable amount of sand.	Fair in upper 42 to 66 inches; low volume change; fair or good bearing capacity.	Seasonal high water table; fair to good bearing capacity.	Seasonal high water table; fair to good bearing capacity; low volume change; very low compressibility; fair to good shear strength; flows when wet.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Slow to very slow permeability; clayey material expands.	Slow or very slow permeability; naturally poor drainage.	Little seepage because of slow permeability.	High shrink-swell potential; slow seepage rate; fair stability; fair to poor compaction properties.	Water-tolerant plants suitable.	Medium to slow rate of water intake; high water-holding capacity; slow permeability; drainage required.	Not needed; level areas or depressions.
High water table; permeability moderate in upper 18 to 42 inches, and moderate or moderately slow below this depth.	Poor drainage; permeability moderate in upper 18 to 42 inches, and moderate or moderately slow below this depth; tile functions satisfactorily.	Slow seepage rate; pit-type ponds suitable; high water table.	Slow seepage rate; fair to good compaction properties; low shear strength.	Generally not needed; high water table; nearly level relief.	Medium rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions and level or nearly level areas; high water table.
Moderately slow permeability; seasonal high water table.	Somewhat poor drainage; moderately slow permeability; tile functions satisfactorily.	Slow seepage rate..	Slow seepage rate; low shear strength when wet.	No restrictions other than rapid runoff.	Slow rate of water intake; high water-holding capacity.	Generally not needed; mainly level or nearly level areas; slopes commonly are short and irregular.
Construction difficult; downslope pollution possible on slopes of more than 9 percent.	Not needed.....	Rapid seepage rate; seal blanket required.	Fairly stable; fair to good compaction properties; sand and gravel substratum.	Low available moisture capacity; vegetation difficult to establish.	Rapid rate of water intake; little runoff; medium water-holding capacity.	No restrictions other than short irregular slopes and some steep slopes.
Seasonal high water table; permeability very rapid at depth of 42 to 66 inches; possible pollution of shallow water supplies.	Somewhat poor drainage; seasonal high water table; sand and gravel in substratum makes blinding of tile necessary.	Medium seepage rate in upper 42 inches; seal blanket required if porous sand and gravel are exposed.	Fair stability; medium seepage rate and fair to good compaction properties in upper 42 to 66 inches; fair compaction properties and rapid seepage rate below this depth.	Level relief with little runoff.	Medium or low water-holding capacity; rapid rate of water intake; moderate depth to sand and gravel.	Generally not needed; level or nearly level areas.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Breckenridge (Bt)	Good in upper 8 to 12 inches.	Unsuitable	Unsuitable	Poor; generally wet below depth of 24 inches.	High water table; risk of frost heaving.	High water table; risk of frost heaving.
Brevort (Bv)	Fair or poor in upper 4 to 6 inches.	Fair or poor in upper 18 to 42 inches; some fines.	Unsuitable	Fair; generally wet below depth of 24 inches.	High water table; occasionally ponded.	High water table.
Brookston (Bw)	Good	Unsuitable	Unsuitable	Poor; generally wet; good compaction properties if not wet.	High water table; risk of frost heaving.	High water table; risk of frost heaving.
Cadmus (CaA, CaB, CdA, CdB).	Good or fair	Unsuitable	Unsuitable	Fair; moderate to high volume change; poor bearing capacity.	Fair to poor bearing capacity.	Slight risk of frost heaving; fair to poor bearing capacity.
Capac (CeA, CeB, CfA, CfB).	Good	Unsuitable	Unsuitable	Fair; generally wet below depth of 3 or 4 feet; fair workability.	Seasonal high water table; moderate risk of frost heaving.	Seasonal high water table; moderate risk of frost heaving.
Carlisle (Cg)	Poor; erodible; oxidizes readily.	Unsuitable	Unsuitable	Unsuitable; unstable.	Organic soil; high water table; excavation necessary.	Unsuitable; high water table; unstable organic soil.
Celina (ChA, ChB, ChB2, ChC2).	Good	Unsuitable	Unsuitable	Fair; moderate to high volume change.	Some cuts and fills needed.	Slight risk of frost heaving.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
High water table; permeability moderately slow below depth of 18 to 42 inches.	Naturally poor drainage; permeability moderately rapid in upper part, moderately slow below depth of 18 to 42 inches; tile outlets difficult to locate.	Moderate seepage rate in upper 18 to 42 inches, slow below this depth.	Good compaction properties; mixing of sandy upper layers with finer textured underlying material results in slow seepage rate.	Generally not needed; level or nearly level relief; high water table; use water-tolerant plants.	Medium water-holding capacity; rapid rate of water intake unless soil is saturated; moderate permeability.	Not needed; depressions and level or nearly level areas.
High water table; permeability slow below depth of 18 to 42 inches; unsuitable.	Naturally poor drainage; permeability moderate in upper part, slow below depth of 18 to 42 inches; outlets for tile difficult to locate.	Rapid seepage rate in upper part, slow below depth of 18 to 42 inches.	Rapid seepage rate in upper 18 to 42 inches, good compaction properties below this depth.	Generally not needed; level or nearly level relief; high water table; use water-tolerant plants.	Medium water-holding capacity; high rate of water intake; drainage required.	Not needed; depressions and level or nearly level areas.
High water table; moderately slow permeability; unsuitable.	Naturally poor drainage; moderately slow permeability; tile functions satisfactorily.	Slow seepage rate; pit-type ponds suitable.	Stable; fair to good compaction properties; slow seepage rate.	Generally not needed; level or nearly level relief; high water table; use water-tolerant plants.	High water-holding capacity; medium rate of water intake; drainage required.	Not needed; depressions and level or nearly level areas.
Moderate permeability.	Generally not needed; moderately well drained; moderate permeability; random tile beneficial.	Slow seepage rate..	Good compaction properties; slow seepage rate.	Hazard of erosion.	Medium rate of water intake; high water-holding capacity.	No restrictions other than short and irregular slopes.
Seasonal high water table; permeability moderate.	Somewhat poor drainage; permeability moderate; tile functions satisfactorily.	Slow seepage rate..	Slow seepage rate; good compaction properties; stable.	No restrictions other than seasonal high water table.	Medium rate of water intake; high water-holding capacity.	Generally not needed; mostly level or nearly level areas; slopes are short and irregular.
Unstable organic soil; high water table.	Very poor drainage; organic material unstable; ditches generally most satisfactory; water-table control structure desirable to prevent over-drainage.	Water table generally near surface; high seepage rate; pit-type ponds suitable.	Unsuitable; organic material.	Generally not needed; unstable organic soil normally in depressions; high water table.	Rapid rate of water intake; very high water-holding capacity.	Not needed; level areas and depressions; unstable organic soil; high water table.
Permeability moderate.	Not needed; moderately well drained; random tile beneficial in wet spots.	Slow seepage rate..	Good compaction properties; slow seepage rate; stable.	Hazard of erosion in sloping areas.	Medium rate of water intake; high water-holding capacity.	No restrictions other than short and irregular slopes.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Ceresco (Cl, Cm). (For Shoals part of Cl, Cm, see Shoals series.)	Good	Unsuitable	Unsuitable	Good; commonly wet below depth of 36 to 48 inches; low volume change.	Seasonal high water table; occasional flooding; slight risk of frost heaving.	Seasonal high water table; occasional flooding; slight risk of frost heaving.
Chelsea (CnA, CnB, CnB2, CnC2, CoA, CoB, CoB2, CoC2.)	Poor to unsuitable; sandy; droughty.	Fair; mostly poorly graded medium to fine sand; a few thin strata of finer textured material.	Unsuitable	Good; readily eroded; low volume change.	Cuts and fills commonly needed.	Good to fair bearing strength; low volume change.
Cohoctah (Cp, Cr) (For Sloan part of Cp, Cr, see Sloan series.)	Good or fair	Unsuitable	Unsuitable	Fair; generally wet.	Seasonal high water table; occasional flooding; moderate risk of frost heaving.	High water table; occasional flooding; moderate risk of frost heaving.
Colwood (Cs)	Good or fair	Unsuitable	Unsuitable	Poor; generally wet; unstable; poor compaction properties.	High water table; severe risk of frost heaving; unstable.	High water table; severe risk of frost heaving; low bearing strength.
Conover (CtA, CtB, CtB2, CuB).	Good	Unsuitable	Unsuitable	Fair; generally wet below depth of 36 to 48 inches.	Seasonal high water table; risk of frost heaving.	Seasonal high water table; risk of frost heaving.
Coral (CvA, CvB, CwA, CwB).	Good	Unsuitable	Unsuitable	Fair or good; wet below depth of 36 to 48 inches.	Seasonal high water table; slight risk of frost heaving.	Seasonal high water table; slight risk of frost heaving.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Moderately rapid permeability; seasonal high water table; occasional flooding.	Somewhat poor drainage; moderately rapid permeability; seasonal high water table; thin, rapidly permeable soil layers commonly occur below depth of 30 inches.	Moderately rapid permeability; moderate seepage rate; thin, rapidly permeable layers commonly occur below depth of 30 inches.	Slow seepage rate when compacted; low shrink-swell potential; fairly stable.	Not needed; nearly level stream bottoms subject to flooding.	Medium rate of water intake; medium water-holding capacity.	Generally not needed; level or nearly level areas; flooding hazard.
Problems on slopes of more than 10 percent; pollution of water supplies possible.	Not needed; well drained or moderately well drained.	Rapid seepage rate; rapid permeability; seal blanket required.	Rapid seepage rate; fair compaction properties; hazard of piping; fair stability.	Generally not needed; droughty; difficult to establish permanent vegetation; little or no runoff.	Rapid rate of water intake; low water-holding capacity; of limited agricultural use.	Generally not needed; little runoff; slopes normally are short and irregular.
High water table; moderate permeability; occasional flooding.	Poor drainage; moderate permeability; thin, rapidly permeable soil layers commonly occur below depth of 30 inches; high water table.	Moderate permeability; moderate seepage rate; high water table; permeable layers commonly occur below depth of 30 inches.	Slow seepage rate when compacted; low shrink-swell potential; fairly stable.	Not needed; nearly level flood plains; high water table.	Medium rate of water intake; medium water-holding capacity; drainage and protection from flooding required.	Generally not needed; level or nearly level areas; high water table.
High water table; moderate permeability.	Naturally poor drainage; moderate permeability; unstable ditch banks make blinding of tile necessary.	Moderate seepage rate; rapidly permeable layers in many places.	Poor compaction properties; moderate seepage rate; low strength and stability.	Generally not needed; nearly level relief; high water table; use water-tolerant plants.	Medium rate of water intake; medium water-holding capacity; drainage required.	Not needed; depressions and level areas; high water table.
Seasonal high water table; permeability ranges from moderate in the upper part to moderately slow in the lower part.	Somewhat poor drainage; permeability ranges from moderate in the upper part to moderately slow in the lower part; tile generally functions satisfactorily.	Slow seepage rate.	Slow seepage rate; good to fair compaction properties.	No restrictions other than seasonal high water table.	Medium rate of water intake; high water-holding capacity.	Generally not needed; level or nearly level areas; short slopes.
Seasonal high water table; moderate permeability.	Somewhat poor drainage; moderate permeability; tile functions satisfactorily; blinding commonly necessary.	Moderate seepage rate.	Slow seepage rate in well compacted fill; fairly stable; good compaction properties.	No restrictions other than seasonal high water table.	Medium rate of water intake; medium water-holding capacity.	Generally not needed; mostly level or nearly level areas; short irregular slopes in gently sloping areas.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Dighton (DgC3, DhA, DhB, DhB2, DhC2).	Good or fair	Good; sand at depth of 18 to 42 inches; overlay of fine material contains some gravel and clay.	Unsuitable	Good or fair; good or fair bearing capacity.	Good or fair bearing strength; low volume change.	No restrictions
Dryden (DrA, DrB, DrB2).	Good	Unsuitable	Unsuitable	Fair or good; some stones and cobblestones.	Loses stability and flows when wet.	Slight risk of frost heaving.
Edmore (Ed)	Fair or good in upper 10 to 12 inches.	Poor; typically loamy sand with 10 to 25 percent silt and clay.	Unsuitable	Fair or good; generally wet.	High water table; hazard of ponding; moderate risk of frost heaving; may overflow when wet.	High water table; hazard of ponding; moderate risk of frost heaving; may overflow when wet.
Edwards (Ek, Em)	Poor; erodible; oxidizes readily.	Unsuitable	Unsuitable	Unsuitable; organic soil material over marl.	Unstable organic soil; high water table.	Unstable organic soil; high water table.
Eel	Good or fair	Unsuitable	Unsuitable	Fair or poor; moderate volume change.	Periodic flooding; risk of frost heaving.	Periodic flooding; fair to poor bearing strength.
Ensley (En)	Good	Unsuitable	Unsuitable	Fair or good; fair to good bearing capacity.	High water table; moderate risk of frost heaving; occasional ponding.	High water table; moderate risk of frost heaving; moderate bearing strength; moderate piping hazard.
Epoufette (Eo, Ep)	Fair or poor	Good; sand and gravel below depth of 18 to 42 inches.	Fair; gravel mixed with sand below depth of 18 to 42 inches.	Good; generally wet below depth of 24 inches.	High water table.	High water table; low volume change.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Permeability moderate in upper 18 to 42 inches, rapid below this depth.	Not needed; well drained or moderately well drained.	Slow seepage rate to depth of 18 to 42 inches, rapid seepage in sandy material below this depth.	Slow seepage rate and good compaction properties in upper 18 to 42 inches; sand below this depth.	No restrictions.	Medium rate of water intake; high water-holding capacity.	Slopes generally are short and irregular.
No restrictions.	Not needed; random tile beneficial in small wet spots.	Moderate seepage rate.	Fairly stable; compacted fill is stable and has slow seepage rate.	No restrictions other than stones in some areas.	Medium rate of water intake; medium water-holding capacity.	Slopes generally are short and irregular.
High water table.	Naturally poor drainage; moderately rapid permeability; title functions satisfactorily if suitable outlets are available.	Rapid seepage rate; high but fluctuating water table; pit-type ponds suitable.	Rapid seepage rate; good compaction properties.	Generally not needed; level or nearly level relief; high water table; use water-tolerant plants.	Rapid rate of water intake; low water-holding capacity; drainage required.	Not needed; depressions and low, level areas.
Unstable organic soil; high water table.	Naturally poor drainage; use of tile questionable because of variable textured material below depth of 12 to 42 inches.	Moderate or high seepage rate to depth of 12 to 42 inches, variable below this depth.	Unsuitable; organic material and marl.	Generally not needed; organic material; high water table; low runoff.	Rapid rate of water intake; high water-holding capacity.	Not needed; level areas; unstable organic soils; high water table.
Periodic flooding; permeability variable.	Not needed; moderately well drained; hazard of flooding.	Slow seepage rate; generally favorable, but coarse strata with rapid seepage rate occur in some places.	Slow seepage rate; good compaction properties; poor to fair stability.	Not needed; nearly level bottom lands subject to flooding.	Medium rate of water intake; high water-holding capacity.	Generally not needed; mostly level or nearly level areas; slopes are short and irregular in gently sloping areas.
High water table; moderate permeability.	Poor drainage; tiling satisfactory if suitable outlets are available; blinding commonly necessary.	Moderate seepage rate; high but fluctuating water table; pit-type ponds suitable.	Fairly stable; good compaction properties; slow seepage in well compacted fill.	Nearly level relief; high water table; use water-tolerant plants.	Medium rate of water intake; medium water-holding capacity; drainage required.	Not needed; depressions and low, level areas.
High water table; moderately rapid permeability.	Naturally poor drainage; sandy material makes tiling difficult; locating suitable outlets is a problem.	Rapid seepage rate; fluctuating water table; pit-type ponds suitable.	Rapid seepage rate; fairly stable; fair to good compaction properties.	Nearly level relief; high water table; use water-tolerant plants.	Rapid rate of water intake; low water-holding capacity; drainage required.	Not needed; level or nearly level areas and depressions.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Fox (FoA, FoB, FoB2, FoC, FoC2, FoD2, FoE2, FoF, FsB, FxC3, FxD3, FxE3, FxF3).	Fair	Good; sand and some gravel below depth of 24 to 42 inches.	Good; gravel mixed with sand below depth of 24 to 42 inches.	Good; low volume change.	Cuts and fills needed.	Good bearing strength; negligible volume change.
Genesee	Good	Unsuitable	Unsuitable	Fair or poor; low volume change.	Periodic flooding.	Periodic flooding.
Gilford (Gf, Gg)	Fair or poor; high water table.	Good; sand and gravel below depth of 24 to 42 inches.	Fair or good; gravel and variable amount of sand below depth of 24 to 42 inches.	Fair or good; high water table; fair bearing capacity.	High water table.	High water table; fair to good bearing strength.
Gladwin (GhA, GhB, GlA, GlB).	Fair or poor	Fair or good; content of sand varies.	Fair or good; contains appreciable amount of sand.	Good; generally wet below depth of 3 or 4 feet; low volume change.	Seasonal high water table.	Seasonal high water table; good bearing strength.
Glendora (Gm, Gn)	Good or fair	Fair; generally contains strata of finer textured material.	Unsuitable	Fair or good; generally wet below depth of 24 inches.	High water table; periodic flooding.	High water table; periodic flooding.
Granby (Go)	Poor in upper 6 to 8 inches; high water table.	Good; well-graded medium and fine sand.	Unsuitable	Good; generally wet below depth of 24 inches; low volume change.	High water table; flows when wet.	High water table; loses stability and flows when wet.
Gravel pits (Gp)	Unsuitable	Fair; some pits contain poorly graded medium and fine sand.	Good; most pits contain poorly graded gravel mixed with some sand.	Good	[3]	[3]

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
No restrictions, except where slope is more than 10 percent.	Not needed	Moderate seepage rate in upper 24 to 42 inches, rapid below this depth.	Good compaction properties in upper 24 to 42 inches; slow seepage rate if compacted; sand and gravel below this depth not suitable.	High runoff and hazard of erosion in sloping or steep areas.	Medium rate of water intake; medium water-holding capacity to depth of 24 to 42 inches; low water-holding capacity below this depth.	No restrictions other than short and irregular slopes or steep slopes.
Periodic flooding; permeability varies.	Not needed; well drained; stream overflow a hazard.	Slow seepage rate, but coarse-textured rapidly permeable strata occur in some places.	Slow seepage rate; fair compaction properties; poor to fair stability.	Not needed; nearly level stream bottoms subject to overflow.	Medium rate of water intake; high water-holding capacity; stream overflow a hazard.	Not needed; nearly level stream bottoms subject to overflow.
High water table; moderately rapid permeability.	Naturally poor drainage; sandy material makes tiling difficult; locating suitable outlets is a problem.	Rapid seepage rate; high but fluctuating water table; pit-type ponds suitable.	Rapid seepage rate; good compaction properties; fair stability.	Nearly level relief; high water table; use water-tolerant plants.	Rapid rate of water intake; low water-holding capacity; drainage required.	Not needed; level or nearly level areas and depressions.
Seasonal high water table; moderately rapid or rapid permeability; possible pollution of water supplies.	Somewhat poor drainage; moderately rapid or rapid permeability; sandy material makes tiling difficult.	Rapid seepage rate; seal blanket required.	Rapid seepage rate; good compaction properties; fair stability.	Not needed; sandy soil; gentle slopes; little runoff.	Rapid rate of water intake; low water-holding capacity.	Generally not needed; little runoff; mostly level or nearly level areas; short irregular slopes in gently sloping areas.
High water table; rapid permeability; periodic flooding.	Naturally poor drainage; sandy material makes tiling difficult, and locating suitable outlets is a problem.	Rapid seepage rate; seal blanket required.	Rapid seepage rate; fair compaction properties; fair stability.	Little runoff; use water-tolerant plants.	Rapid rate of water intake; low water-holding capacity; drainage required.	Not needed; depressions and low, level areas.
High water table; rapid permeability.	Naturally poor drainage; sandy material makes tiling difficult, and locating suitable outlets generally is a problem; over-drainage is a hazard.	Rapid seepage rate; seal blanket required.	Rapid seepage rate; fair compaction properties; piping hazard.	Nearly level relief; high water table; use water-tolerant plants.	Rapid rate of water intake; low water-holding capacity; drainage required.	Not needed; depressions and low, level areas or nearly level areas.
(3)	(3)	(3)	(3)	(3)	(3)	(3).

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Grayling (GrA, GrB2, GrC, GrC2, GrD, GrD2, GrF).	Unsuitable; sandy; droughty.	Good; mostly poorly graded medium sand.	Unsuitable	Good	Easily eroded by wind and water; cuts and fills needed.	Good to fair bearing strength; very low volume change.
Ionia (IoA, IoB, IrA, IrB, IrB2).	Fair or good	Good; some sand mixed with gravel below depth of 24 to 42 inches.	Good; gravel mixed with some sand below depth of 24 to 42 inches.	Good	No restrictions	Good bearing strength; negligible volume change.
Iosco (IsA, IsB)	Poor	Fair; generally upper 18 to 42 inches is poorly graded medium and fine sand.	Unsuitable	Good in upper 18 to 42 inches; poor below this depth; generally wet clay loam or loam below depth of 18 to 42 inches.	Seasonal high water table.	Seasonal high water table; moderate to high volume change.
Kawkawlin (KaA, KaB, KdA, KdB).	Good	Unsuitable	Unsuitable	Good in upper 36 to 48 inches; wet below this depth.	Seasonal high water table; risk of frost heaving.	Seasonal high water table; moderate risk of frost heaving; moderate volume change.
Kendallville (KeA, KeB, KeB2, KeC2, KgC3, KhB, KhB2, KhC2, KhD2).	Fair or good	Unsuitable	Unsuitable	Fair or poor; moderate volume change.	Cuts and fills commonly needed.	Fair to poor bearing strength; moderate volume change.
Kent (KkB, KkC, KkD, KlC3).	Fair or good	Unsuitable	Unsuitable	Poor; poor compaction properties; unstable when wet.	Plastic soil material; risk of frost heaving; scattered seepy spots.	High shrink-swell potential, low shear strength; risk of frost heaving.
Kerston (Km)	Fair or poor; erodible; oxidizes readily.	Unsuitable	Unsuitable	Unsuitable; unstable organic soil.	High water table; unstable organic soil.	Unstable organic soil; high water table.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Problems on slopes of more than 10 percent; possible pollution of water supplies.	Not needed; well drained or moderately well drained.	Rapid seepage rate; very rapid permeability; seal blanket required.	Rapid seepage rate; fair compaction properties; piping hazard.	Generally not needed; little or no runoff; droughty; difficult to establish permanent vegetation.	Rapid rate of water intake; low water-holding capacity; of limited agricultural use.	Generally not needed; little runoff; slopes normally are short and irregular.
No restrictions; rapid permeability at depth of 30 inches.	Generally not needed, except for random tile; permeability moderate in upper 24 to 42 inches, rapid below this depth.	Moderate seepage rate to depth of 24 to 42 inches, rapid below this depth; permeability moderate in upper 24 to 42 inches.	Good compaction properties in upper 24 to 42 inches; slow seepage rate if compacted; gravel and sand below this depth not suitable.	No restrictions, except where sand and gravel substratum is exposed.	Medium rate of water intake and medium water-holding capacity to depth of 24 to 42 inches; low water-holding capacity below this depth.	Generally not needed; mostly level or nearly level areas; slopes are short and irregular.
Seasonal high water table; permeability slow below depth of 18 to 42 inches.	Somewhat poor drainage; permeability rapid in upper 18 to 42 inches, and slow below this depth.	Rapid seepage rate in upper 18 to 42 inches; slow below this depth.	Rapid seepage rate in upper 18 to 42 inches; good compaction properties and slow seepage rate below this depth.	Low available moisture capacity may cause difficulty in establishing vegetation; little runoff.	Rapid rate of water intake; low water-holding capacity in upper part, high water-holding capacity in lower part.	Generally not needed; mostly level or nearly level areas; slopes are short and irregular.
Seasonal high water table; moderately slow permeability.	Somewhat poor drainage; moderately slow permeability; tile functions satisfactorily.	Slow seepage rate; moderately slow permeability.	Slow seepage rate; slopes unstable when wet; fair compaction properties.	No restrictions other than high runoff.	Slow rate of water intake; high water-holding capacity.	Generally not needed; mostly level or nearly level areas; slopes are short and irregular.
Moderate permeability; hillside seepage on slopes of more than 10 percent.	Not needed; well drained.	Slow seepage rate; moderate permeability.	Slow seepage rate; fair compaction properties, especially in the upper 18 to 42 inches.	No restrictions..	Medium rate of water intake; medium or high water-holding capacity.	Slopes commonly are short and irregular or steep.
Slow permeability; clay retards percolation of effluent.	Generally not needed; well drained or moderately well drained; scattered seepy spots.	Slow seepage rate; slow permeability.	Slow seepage rate; low shear strength and stability when wet; high shrink-swell potential.	High runoff may cause some erosion.	Slow rate of water intake; high water-holding capacity.	Cuts should be of minimum depth to avoid exposure of dense sticky subsoil; slopes commonly are short and irregular.
High water table; stream overflow is a hazard.	Very poor drainage in organic soil; hazard of overdrainage and of flooding.	Rapid seepage rate; moderately rapid permeability; water table generally near the surface; pit-type ponds suitable.	Unsuitable; organic material.	Generally not needed; on flood plains and in shallow depressions.	Rapid rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions and low, level areas.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Kibbie (KnA, KnB)	Good	Unsuitable	Unsuitable	Unsuitable; poor compaction properties.	Seasonal high water table; risk of frost heaving; low strength and stability.	Seasonal high water table; risk of frost heaving; low strength and stability.
Kokomo (Ko)	Good	Unsuitable	Unsuitable	Poor; generally wet; good compaction properties when dry.	High water table; risk of frost heaving.	High water table; risk of frost heaving.
Landes (La, Le, Lg, Lh). (For Eel part of La, Le units, see Eel series. For the Genesee part of the Lg, Lh units, see the Genesee series.)	Good or fair	Unsuitable	Unsuitable	Good or fair; good compaction properties.	Flooding hazard	Flooding hazard; low volume change.
Lapeer (LlA, LlB, LlB2, LlC2, LmC3, LmD3, LmF3, LnA, LnB, LnB2, LnC2, LnD2, LnF2).	Fair or good	Unsuitable	Unsuitable	Good or fair; good compaction properties.	Cuts and fills commonly needed.	Slight risk of frost heaving; low volume change.
Linwood (Lo)	Poor; erodible; oxidizes readily.	Unsuitable	Unsuitable	Unsuitable; organic material; high water table.	Unstable organic soil; high water table.	Unstable organic material; high water table.
Locke (LsA, LsB)	Good in upper 6 to 10 inches.	Unsuitable	Unsuitable	Fair; commonly wet below depth of 36 to 48 inches.	Seasonal high water table; risk of frost heaving.	Seasonal high water table; moderate risk of frost heaving.
Lupton (Lt)	Poor; erodible; oxidizes readily.	Unsuitable	Unsuitable	Unsuitable; unstable organic soil.	Unstable organic soil; high water table.	Unstable organic soil; high water table.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Seasonal high water table; material flows when wet, and may plug tile.	Somewhat poor drainage; moderate permeability; tile functions satisfactorily; blinding generally beneficial.	Moderate seepage rate; moderate permeability.	Moderate seepage rate; moderate shrink-swell potential; low strength and stability.	Generally not needed; nearly level relief; little runoff.	Medium rate of water intake; medium water-holding capacity.	Generally not needed; mostly level or nearly level areas; short irregular slopes in gently sloping areas.
High water table; moderately slow permeability.	Very poor drainage; moderately slow permeability.	Slow seepage rate; moderately slow permeability; high water table; pit-type ponds suitable.	Slow seepage rate; moderate shrink-swell potential; moderate strength and stability.	Nearly level relief; use water-tolerant plants.	Medium rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions and low, level areas.
Flooding hazard	Not needed; well drained or moderately well drained; flooding hazard.	Moderate seepage rate; moderate permeability; thin rapidly permeable layers occur in places.	Slow seepage rate when compacted; low shrink-swell potential.	Not needed; nearly level areas subject to flooding.	Medium rate of water intake; medium water-holding capacity.	Generally not needed; mostly level or nearly level areas; slopes are short and irregular.
No restrictions, except where slopes are more than 10 percent.	Not needed; well drained.	Moderate seepage rate; moderate permeability.	Slow seepage rate when compacted; moderate shrink-swell potential; high strength and stability.	Stones hinder construction in some areas.	Medium rate of water intake; medium water-holding capacity.	No restrictions other than some short and irregular slopes or slopes of more than 12 percent.
High water table	Very poor drainage in organic soil; high water table; overdrainage a hazard; use of water control structures generally necessary.	Water table, generally near the surface; permeability rapid to depth of 12 to 42 inches, and slow in medium-textured material below this depth.	Unsuitable organic material to depth of 12 to 42 inches; suitable material below this depth.	Generally not needed; unstable organic material in depressions and low, level areas.	Rapid rate of water intake; very high water-holding capacity; moderate to slow permeability below depth of 12 to 42 inches.	Not needed; depressions and low; level areas; unstable organic material.
Seasonal high water table; moderate permeability.	Somewhat poor drainage; moderate permeability; tile functions satisfactorily.	Moderate seepage rate, moderate permeability.	Slow seepage rate in well-compacted fill; low shrink-swell potential; high strength and stability.	No restrictions other than seasonal high water table.	Medium rate of water intake; medium water-holding capacity.	Generally not needed; mostly level or nearly level areas; slopes are short and irregular.
High water table; unstable organic material.	Very poor drainage in organic soil; water control structures generally necessary to prevent overdrainage.	High seepage rate; high water table; moderately rapid permeability; pit-type ponds suitable.	Unsuitable; organic material.	Generally not needed; soil is in depressions and low flat areas.	Rapid rate of water intake; very high water-holding capacity; drainage required.	Not needed; depressions and low, level areas; unstable organic material.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Macomb (MaA, MaB)	Good	Unsuitable	Unsuitable	Good in upper 36 to 48 inches; wet below this depth.	Seasonal high water table; moderate risk of frost heaving.	Seasonal high water table; moderate risk of frost heaving; moderate volume change.
Mancelona (McB, McC2, MdA, MdB, MdB2, MdC2, MdC3, MdD, MdD2, MdD3, MdE2, MdE3, MdF, MdF2, MdF3, MeA). (For Chelsea part of the MdA, MdB, MdB2, MdC2, MdC3, MdD, MdD2, MdD3, MdE2, MdE3, MdF, MdF2, MdF3, MeA units, see Chelsea series.).	Poor	Good; contains some gravel.	Good; generally mixed with sand.	Good; fair compaction properties; low volume change.	Cuts and fills commonly needed.	Good bearing capacity; negligible volume change.
Marlette (MfC3, MfD3, MfE3, MgA, MgB, MgB2, MgC2, MgD2, MgE2, MgF2, MhB, MhB2, MhC2, MkA, MkB, MkB2, MkC2, MkD2, MkE).	Fair or poor	Unsuitable	Unsuitable	Fair; moderate to high volume change.	Cuts and fills commonly needed.	Fair to poor bearing capacity; medium volume change.
Matherton (MlA, MlB, MmA, MmB).	Good	Good; generally mixed with considerable amount of gravel.	Good; generally mixed with some sand.	Good; fair compaction properties; low volume change.	Seasonal high water table; moderate risk of frost heaving.	Seasonal high water table; good bearing capacity; low volume change.
McBride (MnA, MnB, MnB2, MnC2, MoB3, MoC3, MoD3, MoE3, MpA, MpB, MpB2, MpC, MpC2, MpD2, MpE2, MpF2).	Fair or good	Unsuitable	Unsuitable	Good or fair; good compaction properties.	Cuts and fills commonly needed.	Good to fair bearing strength; low volume change.
Menominee (MrA, MrB, MrB2, MrC2, MrC3, MrD2, MrD3, MrE2).	Poor	Fair; upper 18 to 42 inches is medium to fine sand and some loamy sand.	Unsuitable	Good in upper 18 to 42 inches, poor below this depth.	Cuts and fills commonly needed.	Fair to poor bearing strength; low to moderate volume change.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Seasonal high water table; moderate permeability.	Somewhat poor drainage; permeability moderate in upper 18 to 42 inches, moderately slow below this depth.	Slow seepage rate; moderate permeability.	Slow seepage rate, especially in compacted material from upper 18 to 42 inches; moderate shrink-swell potential.	No restrictions other than seasonal high water table.	Slow rate of water intake; high water-holding capacity.	Generally not needed; mostly level or nearly level areas; some short and irregular slopes.
No restrictions; moderately rapid permeability; possible pollution of water supplies.	Not needed; well drained or moderately well drained.	Rapid seepage rate; moderately rapid permeability; seal blanket required.	Rapid seepage rate; rapid permeability; fair stability.	Low water-holding capacity; droughty; difficult to establish permanent vegetation.	Rapid rate of water intake; low water-holding capacity.	No restrictions other than short and irregular slopes or slopes of more than 12 percent.
Moderate permeability; problems on slopes of more than 10 percent.	Generally not needed; well drained or moderately well drained; moderate permeability.	Slow seepage rate; moderate permeability.	Slow seepage rate; moderate shrink-swell potential; medium strength and stability.	No restrictions, except where slopes are steep.	Slow rate of water intake; high water-holding capacity.	No restrictions other than short and irregular slopes, or slopes of more than 12 percent.
Seasonal high water table; permeability moderate in upper 24 to 42 inches, rapid below this depth.	Somewhat poor drainage; permeability moderate in upper 24 to 42 inches, rapid below this depth.	Slow seepage rate in upper 24 to 42 inches, rapid below this depth; permeability moderate in upper part, rapid in lower part.	Slow seepage rate in well-compacted fill; low shrink-swell potential; slow permeability.	Generally not needed; gentle slopes; little runoff.	Slow rate of water intake, and medium water-holding capacity in upper 24 to 42 inches; low water-holding capacity below this depth.	Generally not needed; mostly level or nearly level areas; slopes generally are short and irregular.
No restrictions, except where slopes are more than 10 percent.	Not needed; well drained or moderately well drained.	Moderate seepage rate.	Compacted fill is stable and has a slow seepage rate; low shrink-swell potential.	High runoff and hazard of erosion in sloping and steep areas.	Medium rate of water intake; medium water-holding capacity.	No restrictions other than short and irregular slopes, or slopes of more than 12 percent.
Slow permeability below depth of 18 to 42 inches.	Not needed; well drained or moderately well drained.	High seepage rate; permeability rapid in upper 18 to 42 inches, slow below this depth.	High seepage rate and rapid permeability in upper 18 to 42 inches; high shrink-swell potential below this depth.	Erodible; droughty; difficult to establish permanent vegetation.	Rapid rate of water intake; low water-holding capacity.	No restrictions other than short and irregular slopes, or slopes that are more than 12 percent and are readily eroded.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Metamora (MsA, MsB)	Fair or poor	Unsuitable	Unsuitable	Fair; commonly wet below depth of 36 to 48 inches.	Seasonal high water table; slight risk of frost heaving.	Seasonal high water table; slight risk of frost heaving; medium volume change.
Miami (MtB3, MtC3, MtD3, MtE3, MtF3, MuA, MuB, MuB2, MuC, MuC2, MuD2, MuE2, MuF, MvB, MvB2, MvC2, MvD2, MwA, MwB, MwB2, MwC2, MwD2). (For Owosso part of the MwA, MwB, MwB2, MwC2, MwD2 units, see Owosso series).	Good	Unsuitable	Unsuitable	Fair; fair compaction properties.	Cuts and fills commonly needed.	Fair to poor bearing strength; medium to high volume change.
Montcalm (MxA, MxB, MxB2, MxC2, MxC3, MxD2, MxD3, MxE2, MxE3, MxF2, MyA, MyB, MyB2, MyC2).	Poor or fair	Fair; some thin layers contain fines.	Unsuitable	Good or fair; good compaction properties.	Cuts and fills commonly needed.	Good to fair bearing strength; low volume change.
Morley (MzC3, MzD3, MzaA, MzaB, MzaB2, MzaC2, MzaD2, MzbB, MzbB2, MzbC2).	Good	Unsuitable	Unsuitable	Fair; slightly plastic soil material.	Slightly plastic soil material; slight risk of frost heaving.	Slightly plastic soil; slight risk of frost heaving; fair to poor bearing strength.
Nester (NcB3, NcC3, NcD3, NcE3, NeB, NeB2, NeC2, NsB, NsB2, NsC2, NsD).	Fair or good	Unsuitable	Unsuitable	Fair; slightly plastic material.	Slightly plastic soil material; slight risk of frost heaving.	Slightly plastic soil material; slight risk of frost heaving; fair to poor bearing strength.
Newaygo (NwC3, NwD3, NyA, NyB, NyB2, NyC2, NyD2, NyF2).	Good	Fair; some sand mixed with gravel below depth of 24 to 42 inches.	Good; gravel mixed with some sand below depth of 24 to 42 inches.	Good; low volume change.	Cuts and fills commonly needed.	No restrictions; good bearing strength; negligible volume change.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Permeability moderately rapid in the upper 18 to 42 inches, and moderate or moderately slow below this depth; seasonal high water table.	Somewhat poor drainage; permeability moderately rapid in upper 18 to 42 inches, and moderate or moderately slow below this depth.	Moderate seepage rate; permeability moderately rapid in upper 18 to 42 inches, and moderate or moderately slow below this depth.	Slow seepage rate in well compacted fill; low shrink-swell potential.	No restrictions other than seasonal high water table.	Moderate rate of water intake; medium water-holding capacity in upper 18 to 42 inches, high water-holding capacity below this depth.	Generally not needed; mostly level or nearly level areas; slopes generally are short and irregular.
Moderate permeability; problems on slopes of more than 10 percent.	Well drained; moderate permeability.	Slow seepage rate; moderate permeability.	Slow seepage rate; moderate strength and stability; moderate permeability; moderate shrink-swell potential.	Stones in some areas; sloping areas subject to runoff and erosion.	Slow rate of water intake; high water-holding capacity.	No restrictions other than short and irregular slopes, or slopes of more than 12 percent.
No restrictions, except where slopes are more than 10 percent.	Not needed; well drained or moderately well drained.	Rapid seepage rate; moderately rapid permeability; seal blanket required.	Moderate seepage rate in compacted fill; piping hazard.	Low available moisture capacity; generally difficult to establish permanent vegetation.	Rapid rate of water intake; low water-holding capacity.	No restrictions other than short and irregular slopes, or slopes of more than 12 percent.
Moderately slow permeability; large filter beds needed.	Moderately well drained; small wet areas may need random tile.	Slow seepage rate; moderately slow permeability.	Slow seepage rate; moderate shrink-swell potential; moderately slow permeability; moderate strength and stability.	High runoff and hazard of erosion in sloping areas.	Slow rate of water intake; high water-holding capacity.	No restrictions other than short and irregular slopes, or slopes of more than 12 percent.
Moderately slow permeability; large filter beds needed.	Well drained to moderately well drained; small wet areas may need random tile.	Slow seepage rate; moderately slow permeability.	Slow seepage rate; moderate shrink-swell potential; moderately slow permeability; moderate strength and stability.	High runoff and hazard of erosion in sloping areas; clayey subsoil.	Slow rate of water intake; high water-holding capacity.	No restrictions other than short and irregular slopes, or slopes of more than 12 percent.
No restrictions except where slopes are more than 10 percent.	Not needed; well drained or moderately well drained.	Slow seepage rate in upper 24 to 42 inches, rapid seepage below this depth.	Slow seepage rate in compacted fill composed of material from upper 24 to 42 inches.	High runoff and hazard of erosion in sloping to steep areas.	Medium rate of water intake; medium water-holding capacity in upper 24 to 42 inches.	No restrictions other than short and irregular slopes, or slopes of more than 12 percent.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Otisco (OcA, OcB, OtA, OtB).	Fair	Poor; generally loamy sand; variable amount of fines.	Unsuitable	Fair or good; wet below depth of 3 or 4 feet.	Seasonal high water table; loses stability when wet.	Seasonal high water table; moderate bearing strength; low volume change.
Owosso	Fair	Unsuitable	Unsuitable	Fair; fair to poor compaction properties.	Cuts and fills commonly needed.	Fair to poor bearing capacity; low volume change.
Perrin (PdA, PdB, PdB2, PeA, PeB).	Poor	Good; sand mixed with gravel below depth of 24 to 42 inches.	Good; gravel mixed with some sand below depth of 24 to 42 inches.	Good; low volume change.	No restrictions; good bearing capacity.	No restrictions; good bearing strength; low volume change.
Pewamo (Pm, Pn)	Good	Unsuitable	Unsuitable	Poor; generally wet; slightly plastic.	High water table; firm somewhat plastic soil material; risk of frost heaving.	High water table; moderate shrink-swell potential; risk of frost heaving.
Plainfield (PoB, PoC2, PoD2, PoE2).	Unsuitable	Good; mostly poorly graded medium sand.	Unsuitable	Good or fair; low volume change.	Cuts and fills commonly needed.	No restrictions; good to fair bearing strength; low volume change.
Rifle (Rm)	Unsuitable; undecomposed organic material; erodible.	Unsuitable	Unsuitable	Unsuitable; organic material; unstable.	High water table; organic soil; unstable.	High water table; organic soil; unstable.
Saranac (Sa, Sc)	Good	Unsuitable	Unsuitable	Poor; generally wet; slightly plastic.	High water table; firm somewhat plastic soil material; risk of frost heaving; flooding hazard.	High water table; moderate shrink swell potential; risk of frost heaving; flooding hazard.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Seasonal high water table.	Somewhat poor drainage; moderately rapid permeability.	Rapid seepage rate; seal blanket required.	Moderate seepage rate in compacted fill; good compaction properties.	Low available moisture capacity; nearly level relief; little runoff.	Rapid rate of water intake; low water-holding capacity.	Generally not needed; nearly level areas with little runoff.
Moderately rapid permeability in upper 18 to 42 inches, and moderately slow below this depth; problems on slopes of more than 10 percent.	Not needed; well drained; moderately slow permeability below depth of 18 to 42 inches.	Moderate seepage rate in upper part, slow seepage rate in lower part.	Slow seepage rate in well-compacted fill; low shrink-swell potential; fair stability.	Erodible; difficult to establish vegetation.	Medium rate of water intake; moderately low water-holding capacity in upper 18 to 42 inches; high water-holding capacity below this depth.	Generally no restrictions, but cuts deeper than 18 to 42 inches may expose dense finer textured material.
No restrictions----	Moderately well drained; random tile commonly needed to drain wet spots.	Rapid seepage rate; moderately rapid permeability; seal blanket commonly needed.	Rapid seepage rate; fairly stable; hazard of piping; good compaction properties.	Low available moisture capacity; difficult to establish vegetation.	High rate of water intake; low water-holding capacity.	No restrictions other than short and irregular slopes.
High water table; moderately slow permeability.	Naturally poor drainage; moderately slow permeability; adequate outlets commonly difficult to locate.	Slow seepage rate; moderately slow permeability.	Slow seepage rate; moderate shrink-swell potential; fair to poor compaction properties.	Level relief; little runoff; use water-tolerant plants.	Medium to slow rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions and low, level areas.
No restrictions, except where slopes are more than 10 percent.	Not needed; well drained.	Rapid seepage rate; seal blanket required.	Rapid seepage rate; fair compaction properties.	Low available moisture capacity; difficult to establish permanent vegetation.	Rapid rate of water intake; very low water-holding capacity.	No restrictions, but seldom needed because of little runoff; steep slopes.
High water table; unstable, organic material.	Very poor drainage in organic soil; water level control structures desirable to prevent overdrainage.	Rapid seepage rate; water table generally near surface; pit-type ponds suitable.	Organic material not suitable for embankments.	Not needed; unstable organic material in depressions.	High rate of water intake; very high water-holding capacity; drainage required.	Not needed; mainly depressions and low, level areas; unstable organic material.
High water table; moderately slow permeability; flooding hazard.	Naturally poor drainage; moderately slow permeability; adequate outlets generally available; flooding hazard.	Slow seepage rate; moderately slow permeability; high water table; pit-type ponds suitable.	Slow seepage rate; moderate shrink-swell potential; fair to good compaction properties.	Level relief; little runoff; use water-tolerant plants.	Medium to slow rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions and low, level areas.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Sebewa (Sd)	Good; high water table.	Good; sand mixed with gravel below depth of 24 to 42 inches.	Good; gravel mixed with some sand below depth of 24 to 42 inches.	Good; generally wet; low volume change in substratum.	High water table; risk of frost heaving.	High water table; risk of frost heaving; good bearing strength.
Selkirk (SeA, SfA)	Good or fair	Unsuitable	Unsuitable	Poor; plastic clay generally wet below depth of 3 feet.	Seasonal high water table; plastic clayey material; risk of frost heaving.	Seasonal high water table; plastic clayey material; risk of frost heaving; high shrink-swell potential; low shear strength.
Shallow sandy land (Sg)	Unsuitable	Poor; mostly loamy sand in upper 7 to 30 inches.	Unsuitable	Good in upper 7 to 30 inches.	No restrictions	No restrictions; rock excavation necessary if basements are constructed.
Shoals (Sh, Sk, Sl)	Good	Unsuitable	Unsuitable	Fair; generally wet below depth of 3 or 4 feet; poor bearing capacity.	Seasonal high water table; moderate risk of frost heaving; flooding hazard.	Seasonal high water table; moderate risk of frost heaving; flooding hazard.
Sims (Sm, Sn)	Good	Unsuitable	Unsuitable	Poor; generally wet; slightly plastic.	High water table; firm somewhat plastic soil material; risk of frost heaving.	High water table; moderate shrink-swell potential; high risk of frost heaving.
Sloan	Good	Unsuitable	Unsuitable	Poor; generally wet; poor bearing capacity.	High water table; moderate risk of frost heaving; flooding hazard.	High water table; moderate risk of frost heaving; flooding hazard.
Spinks (SpA, SpB, SpB2, SpC2, SpC3, SpD2, SpD3)	Poor	Fair; considerable fines.	Unsuitable	Good or fair; low volume change.	Cuts and fills commonly needed; loose sand may hinder hauling.	No restrictions; good to fair bearing strength; low volume change.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
High water table; moderate permeability.	Naturally poor drainage; moderately permeable to depth of 24 to 42 inches, rapidly permeable below this depth.	Slow seepage rate in upper 24 to 42 inches, rapid seepage below this depth; moderately permeable in upper part, rapidly permeable in lower part.	Slow seepage rate; good compaction properties; moderate shrink-swell potential.	Level relief; little runoff; use water-tolerant plants.	Medium to slow rate of water intake; high water-holding capacity to depth of 24 to 42 inches, low water-holding capacity below this depth.	Not needed; depressions and low, level areas.
Seasonal high water table; slow permeability.	Somewhat poor drainage; slow permeability; tile should be closely spaced and blinded.	Slow seepage rate--	Slow seepage rate; high shrink-swell potential; low strength and and stability when wet.	Dense clayey subsoil; high runoff; vegetation difficult to establish.	Slow rate of water intake; high water-holding capacity; slow permeability.	Many level areas; short irregular slopes in gently sloping areas; dense clayey subsoil.
Sandstone bedrock at depth of 7 to 30 inches.	Not needed; well drained or moderately well drained.	Rapid seepage rate; shallow to bedrock; rapid permeability.	Rapid seepage rate; poor compaction properties.	Low fertility; generally difficult to establish vegetation.	Rapid rate of water intake; low water-holding capacity.	Generally not needed; gently sloping areas.
Seasonal high water table; moderate permeability; subject to stream overflow.	Somewhat poor drainage; moderate permeability.	Slow seepage rate; moderate permeability.	Slow seepage rate; fair compaction properties; moderate shrink-swell potential.	Generally not needed; level relief subject to flooding.	Medium rate of water intake; high water-holding capacity.	Generally not needed; flood plains.
High water table; moderately slow permeability.	Naturally poor drainage; moderately slow permeability.	Slow seepage rate--	Slow seepage rate; moderate shrink-swell potential; good compaction properties.	Nearly level relief; little runoff; use water-tolerant plants.	Medium to slow rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions and level or nearly level areas.
High water table; moderate permeability; flooding hazard.	Naturally poor drainage; moderate permeability; flooding hazard.	Slow seepage rate; moderate permeability.	Slow seepage rate; fair compaction properties; moderate shrink-swell potential.	Nearly level relief; little runoff; use water-tolerant plants.	Medium rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions and low, level areas.
No restrictions, except where slopes are more than 10 percent; possible pollution of water supplies.	Not needed; well drained.	Rapid seepage rate; moderately rapid or rapid permeability; seal blanket needed.	Too sandy; compacted fill will have moderate seepage rate.	Erodible; slow runoff on gentle slopes; difficult to establish vegetation.	Rapid rate of water intake; low water-holding capacity.	Sandy soil with little runoff; difficult to establish vegetation; not suitable on steep slopes.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Tawas (Ta)	Poor; erodible; oxidizes readily.	Fair; sand covered with 12 to 42 inches of organic material.	Unsuitable	Unsuitable; organic material; unstable.	Organic soil; high water table; unstable.	Unstable organic soil; high water table.
Tuscola (TsA, TsB, TsB2, TsC2, TuB).	Good	Unsuitable	Unsuitable	Poor; high in silt; poor compaction properties.	Low strength and stability; risk of frost heaving.	Low strength and stability; slight risk of frost heaving.
Ubly (UbC3, UlA, UlB, UlB2, UlC2, UlD2, UlE2).	Fair	Unsuitable	Unsuitable	Good in upper 18 to 42 inches; fair below this depth.	Cuts and fills commonly needed.	Moderate shrink-swell potential below depth of 18 to 42 inches; slight risk of frost heaving.
Wallkill (Wa)	Good	Unsuitable	Unsuitable	Poor; generally wet; fair if not wet; organic substratum.	High water table; unstable substratum.	High water table; unstable substratum.
Wasepi (WeA, WeB, WrA, WrB, WsA, WsB). (For Brady part of the WrA, WrB, WsA, WsB, units, see Brady series).	Fair	Good; upper 18 to 42 inches mostly loamy sand; loose sand and gravel below this depth.	Fair or good below depth of 18 to 42 inches; gravel mixed with an appreciable amount of sand.	Good in upper 36 to 48 inches; generally wet below this depth.	Seasonal high water table.	Seasonal high water table; fair to good bearing strength; low volume change.
Washtenaw (Wt)	Good	Unsuitable	Unsuitable	Poor; generally wet.	High water table; risk of frost heaving; in depressions.	High water table; risk of frost heaving; in depressions.
Willette (Wu) (For Linwood part of Wu, see Linwood series).	Poor; erodible; oxidizes readily.	Unsuitable	Unsuitable	Unsuitable; unstable organic material over wet clay.	Unstable organic soil; high water table.	Unstable organic soil; high water table.

See footnotes at end of table.

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
High water table; unstable organic material.	Very poorly drained organic soil to depth of 12 to 42 inches, sand below this depth; moderately rapid permeability; ditches generally best suited.	Rapid seepage rate; high water table; moderately rapid permeability; pit-type ponds suitable.	Unsuitable; organic material to depth of 12 to 42 inches; high seepage rate in sand below this depth.	Not needed; in depressions; unstable organic material.	Rapid rate of water intake; very high water-holding capacity in organic material in upper part, low water-holding capacity in underlying sand; drainage required.	Not needed; depressions and low, level areas.
Moderate permeability; flows when wet, and may plug filter beds.	Moderately well drained; random tile may be beneficial.	Moderate seepage rate; moderate permeability.	Moderate seepage rate; moderate shrink-swell potential; low strength and stability.	Hazard of erosion in sloping areas.	Moderate rate of water intake; high water-holding capacity.	Generally short irregular slopes.
Moderately rapid permeability in upper 18 to 42 inches, and moderate below this depth.	Not needed; well drained to moderately well drained.	Moderate seepage rate in upper 18 to 42 inches; slow below this depth.	Good compaction properties; slow seepage rate if compacted.	Sloping areas erodible.	Moderate rate of water intake; moderate water-holding capacity.	Some slopes of of more than 12 percent.
High water table; permeability moderate in upper 10 to 40 inches, rapid in organic material below this depth.	Naturally poor drainage; permeability moderate in upper 10 to 40 inches, rapid in organic material below this depth.	Slow seepage rate; rapidly permeable organic material at depth of 10 to 40 inches.	Slow seepage rate in upper 10 to 40 inches; unsuitable below this depth.	Level relief; little runoff; use water-tolerant plants.	Medium rate of water intake; high to very high water-holding capacity; drainage required.	Not needed; depressions and low, level areas.
Seasonal high water table; moderately rapid permeability.	Somewhat poor drainage; moderately rapid permeability; sand makes tiling difficult; blinding needed.	Rapid seepage rate; permeability moderately rapid in upper 18 to 42 inches, rapid below this depth.	Rapid seepage rate; poor compaction properties.	Level relief; little runoff.	High rate of water intake; low water-holding capacity; drainage required.	Generally not needed; mainly level or nearly level areas; short irregular slopes.
High water table; moderate permeability; in depressions.	Naturally poor drainage; moderate permeability; in depressions.	Slow seepage rate; moderate permeability.	Slow seepage rate; fair to poor stability; fair compaction properties.	Not needed; in depressions.	Medium rate of water intake; high water-holding capacity; drainage required.	Not needed; depressions.
High water table; unstable organic material.	Very poorly drained organic material to depth of 12 to 42 inches; slow or very slow permeability below this depth; controlled drainage desirable.	Rapid seepage rate in organic material, slow in underlying clay; permeability rapid in upper 12 to 42 inches, slow below this depth; pit-type ponds suitable.	Unsuitable organic material to depth of 12 to 42 inches; underlying clay has low strength and high shrink-swell potential.	Not needed; in depressions.	High rate of water intake; very high water-holding capacity; drainage required.	Not needed; depressions.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting engineering practices	
	Topsoil [1]	Sand	Gravel	Road fill	Highway location	Foundations for residential buildings [2]
Wind eroded land (Wv, Ww).	Unsuitable; sandy, droughty.	Good; mostly poorly graded medium sand.	Unsuitable	Good	Readily eroded by wind and water; cuts and fills needed.	Good to fair bearing strength; low volume change.

[1] Unless otherwise stated the suitability rating refers to the surface layer.
[2] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

They create homes for insect-eating birds and provide food and cover for pheasants in winter.

Two types of wildlife borders can be developed on most farms. Namely, grass and legume borders, on which to turn machinery, and borders of shrubs in sapped areas next to woodlands, tall shelterbelts, or windbreaks.

Streambank plantings, as part of streambank improvement, will create or improve wildlife habitats.

Technical assistance in developing wildlife habitats can be obtained from your local representative of the Soil Conservation Service, the Michigan Department of Conservation, the U.S. Fish and Wildlife Service, the State or Federal forester, or the Michigan Cooperative Extension Office.

The soils of Ionia County have been placed in eight wildlife suitability groups. All of the soils in one group are estimated to have similar capacity to produce food and cover for wildlife. Table 9 lists important plants for wildlife food and cover, shows the wildlife groups and specific areas to which the plants are suited, and indicates the kinds of wildlife by which the plants are used. The "Guide to Mapping Units" at the back of this survey shows the group in which each soil has been placed. Gravel pits and Made land were not placed in a group, because they ordinarily do not support vegetation or they vary greatly in soil properties. Following is a brief description of each of the wildlife suitability groups in the county.

Group 1 consists of well drained or moderately well drained soils that have a moderately permeable sandy loam, loam, and silt loam subsoil.

Group 2 consists of somewhat poorly drained and poorly drained soils that have a moderately permeable sandy loam, loam, and silt loam subsoil.

Group 3 consists of well drained and moderately well drained soils that have a slowly permeable clay loam, silty clay loam, clay, and silty clay subsoil.

Group 4 consists of somewhat poorly drained and poorly drained soils that have a slowly permeable clay loam, silty clay loam, clay, and silty clay subsoil.

Group 5 consists of well drained and moderately well drained soils that have a moderately rapid to rapidly permeable loamy sand subsoil.

Group 6 consists of somewhat poorly drained and poorly drained soils that have a moderately rapid to rapidly permeable loamy sand and sand subsoil.

Group 7 consists of well drained soils that have a very rapidly permeable sand subsoil.

Group 8 consists of very poorly drained, rapidly permeable organic soils.

Formation and Classification of Soils

This section describes the factors that affect the formation of the soils, and it gives the classification of the soil series in the county by great soil groups.

Factors of Soil Formation

Soil is formed by weathering and other processes that act on the parent material. The characteristics of the soil at any given point depend on (1) parent material; (2) climate; (3) plant and animal life; (4) relief and drainage; and (5) time, or age.

The factors of soil formation are so closely interrelated in their effects that few generalizations can be made about one factor unless conditions are specified for the other four.

Parent material

The soils of Ionia County developed in glacial drift of the late Wisconsin (Cary) glaciation and in recent alluvial and organic material.

The drift covers all of the county, except one small area 2 miles east of Ionia Township, where reddish sandstone is exposed at the surface. It is sufficiently thick to mask completely any direct influence of the underlying bedrock on the character of the soils. Unweathered glacial drift consists of transported limy residue; of frag-

of the soils—Continued

Soil features affecting engineering practices—Continued						
Disposal fields for septic tanks	Agricultural drainage	Farm ponds		Waterways	Sprinkler irrigation	Terraces and diversions
		Reservoir area	Embankments			
Problems on slopes of more than 10 percent; possible pollution of water supplies.	Not needed; well drained or moderately well drained.	Rapid seepage rate; rapid permeability; seal blanket required.	Rapid seepage rate; fair compaction properties; piping hazard.	Generally not needed; little or no runoff; droughty; difficult to establish permanent vegetation.	Rapid rate of water intake; low water-holding capacity; of limited agricultural use.	Generally not needed; little runoff; mainly short and irregular slopes.

[3] Not applicable.

ments of shale, limestone, and sandstone; and of smaller amounts of crystalline rock. These materials were deposited as moraines, till plains, glaciofluvial outwash plains, terraces, and glacial lakebed plains.

The moraines and till plains are deposits of unassorted material left by the melting front of the glacier. These deposits range from predominantly sand to predominantly clay in texture. The Kent, Miami, and McBride soils are examples of soils that formed in this material.

The glaciofluvial outwash plains and terraces are also deposits left by flowing water along the front of the melting glacier, but these deposits are stratified as a result of sorting, and they are predominantly sandy and gravelly material. The Fox, Boyer, and Mancelona soils are examples of soils formed in these deposits.

Glacial lakebed plains formed where bodies of water were impounded for long periods. They are characterized by stratified depoists of silt and clay and some thin layers of fine sand. The Tuscola, Kibbie, and Colwood soils are examples of soils formed in these deposits.

Alluvial sediments that vary in texture were deposited on the bottom lands of the major streams throughout the county. The Genesee and Shoals soils are examples of soils formed in these materials.

The organic materials in depressions throughout the county consist of remains of sedges, grasses, and trees. These materials accumulated in standing water after the retreat of the glaciers. The Carlisle, Tawas, and Edwards soils are examples of soils that developed in this type of material.

Climate

The soils in Ionia County developed under a cool moist climate, influenced to some extent by the close proximity of Lake Michigan. The average annual precipitation of about 33 inches is fairly uniformly distributed throughout the year. Humidity is high throughout most of the year, and the ground commonly is frozen in winter.

The climate of the county is discussed in greater detail in the section "General Nature of the County."

Plant and animal life

Plants, micro-organisms, earthworms, and other forms of life on and in the soils are active in the soil-forming processes.

Originally, dense forest covered all of Ionia County except the scattered swamps and bogs. On the more fertile fine-textured soils, the stands were predominantly northern hardwoods; on the medium-textured soils, there were mixed stands of hardwoods and pine; and on the coarse-textured soils, the stands consisted mainly of pine and oak. Tamarack, white-cedar, poplar, and water-tolerant shrubs were common in the swamps, and leatherleaf, reeds, sedges, and shrubs covered the bogs.

The differences in the original vegetation are reflected in the characteristics of the soils, particularly those of the surface layer. For example, the chemical and physical properties of the organic matter in the surface layer are directly related to those of the original vegetation, and the depth and color of the leached mineral layer can be attributed in part to the original vegetation, although this factor is tempered by other factors of soil formation, notably climate and parent material.

The remains of leaves, twigs, and fallen trees that accumulate on the surface of forest soils provide food and habitats for living organisms, such as worms and insects. These organisms burrow into the soil to some depth, causing both soil mixing and some changes in aeration and drainage. Bacteria in the soil help to break down organic matter so that it can be used by growing plants.

Relief

Relief affects the formation of soils largely by modifying internal drainage, runoff, rate of erosion, and other results of water action.

Organic soils, such as the Carlisle or Tawas, formed in low areas where water accumulated and remained continuously. Their properties depend principally on the kinds of plants from which they formed, on the level of the water table, and on the mineral content of the water.

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TABLE 9.—*Suitability of specified plants for wildlife food and cover*

Plants	Wildlife groups to which plant is suited [1]	Wildlife areas to which plant is suited	Kinds of wildlife by which plant is used—	
			For food	For cover
Shrubs:				
Bayberry	1, 2, 3, 4, and 5	Fence rows, windbreaks, wildlife borders, odd areas.	Pheasant, bobwhite quail, ruffed grouse.	Pheasant, bobwhite quail, ruffed grouse, waterfowl, cottontail rabbit.
Bessey cherry	1, 3, 5, and 7	Odd areas	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit.
Sand cherry	1, 3, 5, and 7	Odd areas	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit.
Coralberry	1, 2, 3, 4, and 7	Wildlife borders, odd areas.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit.
Siberian crab	1, 5, and 7	Odd areas	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, waterfowl, cottontail rabbit.
Highbush cranberry.	1, 2, 3, 4, and 8	Fence rows, windbreaks, wildlife borders, odd areas, streambanks.	Pheasant, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, waterfowl, cottontail rabbit.
Gray dogwood	1, 2, 3, 4, and 8	Fence rows, wildlife borders, odd areas, marshes, pond areas, streambanks.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, waterfowl, cottontail rabbit.
Silky dogwood	1, 2, 3, 4, and 8	Fence rows, wildlife borders, odd areas, marshes, pond areas, streambanks.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, waterfowl, cottontail rabbit.
Wild grape	1 and 5	Fence rows, wildlife borders, odd areas, streambanks.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit.
American hazelnut (filbert hybrid).	1, 5, and 7	Wildlife borders, odd areas.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel.
Washington hawthorn.	1 and 5	Wildlife borders, odd areas.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel.
Tartarian honeysuckle.	1, 2, 3, 4, 5, and 6	Ditchbanks, fence rows, windbreaks, wildlife borders, odd areas, pond areas.	Pheasant, bobwhite quail, ruffed grouse.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel.
Autumn olive	1, 3, and 5	Ditchbanks, fence rows, windbreaks, wildlife borders, odd areas, streambanks.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel.
Multiflora rose	1, 2, 3, 4, 5, 6, and 8.	Ditchbanks, fence rows, windbreaks, wildlife borders, odd areas, pond areas, streambanks.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel.
Fragrant sumac	1 and 5	Odd areas	Bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Cottontail rabbit.
Trees:				
Black locust	1 and 3	Odd areas		Cottontail rabbit.
Austrian pine	1 and 3	Windbreaks, odd areas	Squirrel, white-tailed deer	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.
Jack pine	1 and 5	Windbreaks, odd areas	White-tailed deer	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.

See footnotes at end of table.

TABLE 9.—*Suitability of specified plants for wildlife food and cover*—Continued

Plants	Wildlife groups to which plant is suited [1]	Wildlife areas to which plant is suited	Kinds of wildlife by which plant is used—	
			For food	For cover
Trees—Continued				
Red pine	1 and 5	Windbreaks, odd areas	Squirrel, white-tailed deer	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.
Scotch pine	1, 3, and 5	Windbreaks, odd areas	Squirrel, white-tailed deer	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.
White pine	1, 3, and 8	Windbreaks, odd areas, marshes, streambanks.	Squirrel, white-tailed deer	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.
Norway spruce	1 and 3	Windbreaks, odd areas, streambanks.	Squirrel	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.
White spruce	1, 2, 3, 4, and 8	Windbreaks, odd areas, marshes, pond areas, streambanks.		Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, squirrel, white-tailed deer.
Grasses, legumes, and grain:				
Arrowhead; duck-potato.	8	Marshes	Waterfowl.	
Alfalfa; brome	1, 3, and 5	Ditchbanks, windbreaks, wildlife borders, odd areas.	Cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, waterfowl, cottontail rabbit.
Crownvetch	1, 2, 3, and 4	Ditchbanks, windbreaks, wildlife borders, odd areas, pond areas.	Pheasant, bobwhite quail, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, waterfowl, cottontail rabbit.
Birdsfoot trefoil	1, 2, 3, and 4	Ditchbanks, windbreaks, wildlife borders, odd areas, pond areas, streambanks.	Pheasant, bobwhite quail, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, waterfowl, cottontail rabbit.
Alsike clover; red clover; timothy.	1, 2, 3, 4, 5, and 6	Wildlife borders, odd areas, pond areas.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, waterfowl, cottontail rabbit.
Ladino clover; brome.	2 and 4	Wildlife borders, odd areas, pond areas.	Pheasant, bobwhite quail, ruffed grouse, cottontail rabbit, white-tailed deer.	Pheasant, bobwhite quail, waterfowl, cottontail rabbit.
Sweetclover; orchardgrass.	1, 3, and 5	Ditchbanks, windbreaks, wildlife borders, odd areas, pond areas.	Pheasant, bobwhite quail, cottontail rabbit.	Pheasant, bobwhite quail, waterfowl, cottontail rabbit.
Reed canarygrass	2, 4, and 8	Ditchbanks, windbreaks, wildlife borders, odd areas, marshes, pond areas, streambanks.		Pheasant, waterfowl, cottontail rabbit, white-tailed deer.
Bulrush	8	Marshes	Bobwhite quail, waterfowl	
Buckwheat	1, 2, 3, and 4	Wildlife borders, odd areas.	Pheasant, bobwhite quail, ruffed grouse, waterfowl, squirrel, white-tailed deer.	Pheasant, bobwhite quail, cottontail rabbit.
Corn	1, 2, 3, and 4	Wildlife borders, odd areas.	Pheasant, bobwhite quail, ruffed grouse, waterfowl, cottontail rabbit, squirrel, white-tailed deer.	
Soybeans	2 and 4	Wildlife borders, odd areas.	Pheasant, bobwhite quail, waterfowl, white-tailed deer.	
Sudangrass	2 and 4	Wildlife borders, odd areas.		Pheasant, bobwhite quail, waterfowl, cottontail rabbit.

[1] Wildlife suitability groups described on page 158.

Poorly drained or very poorly drained mineral soils, such as the Brookston, formed in level or nearly level areas and depressions where water did not cover the soil material completely or continuously. Because of poor aeration, the organic material in these soils is better preserved than in the better drained soils, and it is mixed with the mineral soil to a greater depth. Beneath the layer of organic-mineral material, the soils are gray in color as a result of poor aeration and the subsequent reduction of iron.

Well-drained soils, such as the Miami, formed in level to steeply sloping areas where natural drainage and aeration are good. The surface layer of these soils is dark grayish brown and is moderately low in organic-matter content. The horizons below the surface layer are bright colored, an indication of good aeration.

Somewhat poorly drained soils, such as the Conover and Capac, occur at elevations above the poorly drained soils and below the well-drained soils. These soils are saturated during part of the year. Consequently, their surface layer is moderately dark colored, and the horizons below the surface layer are mottled.

Time

The degree of development of the soil profile depends somewhat on the length of time that the parent material has been subjected to soil-forming processes.

The soils of Ionia County are relatively young, geologically speaking. Yet, sufficient time has elapsed since the retreat of the last glacier to permit the formation of distinct horizons in soils that formed in glacial deposits, such as the Miami. On the other hand, such soils as the Genesee and Landes, which formed in recent alluvium, have not been in place long enough for distinct horizons to develop. The characteristics of these soils are very much like those of the parent materials. The thickness of the organic soils, such as the Lupton and Carlisle, depends somewhat on the length of time the organic material has remained in place.

Classification of Soils

In this subsection, the soils of Ionia County have been classified into great soil groups. The soils in any one group have similar kinds of horizons in the same sequence in their profiles, but they may differ greatly in other characteristics, such as relief, texture, or thickness of the profile. Many soils have significant characteristics of more than one great soil group and are called intergrades.

The classification of the soil series into great soil groups is shown in the list that follows. Then each great soil group is discussed.

Great soil group	*Series*
Podzol	Au Gres, Belding, Capac, Chelsea, Coral, Gladwin, Iosco, Mancelona, Marlette, McBride, Menominee, Montcalm, Newaygo, Otisco, Ubly.
Brown Podzolic	Grayling.
Gray Wooded	Dighton, Kawkawlin, Kent, Nester, Selkirk.
Gray-Brown Podzolic	Blount, Boyer, Brady, Cadmus, Celina, Conover, Dryden, Fox, Ionia, Kendallville, Kibbie, Lapeer, Locke, Macomb, Matherton, Metamora, Miami, Morley, Owosso, Perrin, Spinks, Tuscola.
Regosol	Plainfield, slightly acid variant.
Humic Gley	Barry, Bergland, Berville, Breckenridge, Brevort, Brookston, Cohoctah, Colwood, Edmore, Ensley, Epoufette, Gilford, Glendora, Granby, Kokomo, Pewamo, Saranac, Sebewa, Sims, Sloan, Wasepi.
Bog (organic)	Carlisle, Edwards, Linwood, Lupton, Rifle, Tawas, Willette.
Alluvial	Abscota, Algansee, Alluvial land, Ceresco, Eel, Genesee, Kerston, Landes, Shoals, Shoals, heavy subsoil variant, Wallkill, Washtenaw.

Podzols.—In Ionia County these soils formed in sandy material and are well drained, moderately well drained or somewhat poorly drained. In undisturbed areas, they have a thin O1 horizon and a thin dark-colored A1 horizon, underlain by an eluviated gray A2 horizon. There is an abrupt boundary between the A2 horizon and the underlying dark reddish-brown, dark-brown, or yellowish-brown Bh or Bir horizon. Iron oxides and organic carbon, leached from the O1 and A horizons, have accumulated in the B horizon. The practical significance of this accumulation has not been completely evaluated, but it is known that iron oxide reacts with phosphate to form a relatively insoluble compound.

Some soils in Ionia County have a Podzol upper sequum and a Gray Wooded lower sequum. Generally, the Podzol sequence of A1, A2, Bh, or Bir horizons is underlain by a Gray Wooded sequence of A′2 and A′2&B′21 or B′t horizons. In some soils the Podzol A2 horizon is thin, and in cultivated areas it is incorporated into the Ap horizon. The Gray Wooded A′2 horizon generally is grayish brown and, in some soils, is very thin or lacking. In the A′2&B′21 horizon or the B′21&A′2 horizon, the A′2 material occurs as thick coats on ped surfaces, in cracks, in root and worm channels, or along structure planes. In the upper part of the B′2 horizon, small chunks of B′2 material are partly or wholly surrounded by A′2 material. The B′22 or B′t horizon is enriched either by clay that washed from the overlying horizons or by clay that developed in place, or both. In soils that developed in loamy sand, the B′t horizon occurs as thin and commonly discontinuous layers that are separated by layers of the A′2 horizon. The Au Gres soils are classified as Podzols. The soils in Ionia County that have a Podzol upper sequum and a Gray Wooded lower sequum are those of the Belding, Capac, Chelsea, Coral, Gladwin, Iosco, Mancelona, Marlette, McBride, Menominee, Montcalm, Newaygo, Otisco, and Ubly series.

Brown Podzolic soils.—In Ionia County, these soils formed in sand. They have a fairly thin, dark-colored A1 horizon, a yellowish-brown B horizon, and a very pale brown C horizon. The A2 horizon commonly is thin or lacking. Only small amounts of iron oxide and humus have accumulated in the B horizon. This accumulation is considerably less than that in the B horizon of Podzols, either because the A horizon lacks enough iron to permit leaching and subsequent accumulation in the B horizon, or the organic acids are of a kind not favorable for this leaching and accumulation. The Grayling soils represent this great soil group in Ionia County.

Gray Wooded soils.—Gray Wooded soils formed in moderately fine textured and fine textured materials in areas where Podzols are dominant on the coarser textured materials. These soils have a thin, dark-colored A1 horizon; a grayish-brown to gray eluviated A2 horizon; a B2&A2 or A2&B2 horizon in which the A2 material occurs as thick coats around peds, in worm and root channels, and along cleavage planes; a B2 horizon that has an accumulation of clay; and a C horizon. The A2 horizon of the Gray Wooded soils is grayer than that of the Gray-Brown Podzolic soils in southern Michigan, Indiana, and western Ohio, and the upper part of their B horizon occurs as peds partially or wholly surrounded by A2 material. The Dighton, Kawkawlin, Kent, Nester, and Selkirk soils represent this great soil group in Ionia County.

Gray-Brown Podzolic soils.—In Ionia County, these soils formed in calcareous soil materials, under deciduous forest, in a humid temperate climate. They range widely in texture and are well drained, moderately well drained, or somewhat poorly drained.

In undisturbed areas they have a thin slightly acid or moderately acid layer of leaf litter and mild humus over an organic-mineral horizon; a thin grayish-brown mineral A1 horizon; a light grayish-brown or grayish-yellow leached A2 horizon; and a yellowish or brownish B horizon that is higher in content of clay than the horizon above or below and that is lighter colored with depth.

Gray-Brown Podzolic soils are similar to Gray Wooded soils in some respects, but they differ from these soils in that they have a gradual or clear boundary between the A2 horizon and the B1 horizon; little, if any, gray coatings of A2 material on the surface of peds in the B horizon; and no fingering of A2 material into the B horizon.

The somewhat poorly drained soils, classified as Gray-Brown Podzolic soils, have general characteristics of these soils but also have some characteristics of Low-Humic Gley soils, which are not represented in Ionia County. The subsoil is somewhat gleyed but lacks the intense gleying associated with the Low-Humic Gley soils, and also the gleying occurs deeper in the profile than is common in Low-Humic Gley soils.

The soils in the county that have been classified as Gray-Brown Podzolic soils belong to Blount, Boyer, Brady, Cadmus, Celina, Conover, Dryden, Fox, Ionia, Kendallville, Kibbie, Lapeer, Locke, Macomb, Matherton, Metamora, Miami, Morley, Owosso, Perrin, Spinks and Tuscola series.

Regosols.—These soils consist of deep sand in which there is little or no profile development. The A horizon is thin. The B horizon either is lacking or is very faintly developed. The rest of the profile is the C horizon. The Plainfield soils, slightly acid variant, are the only soils in Ionia County that are classified as Regosols.

Humic Gley soils.—Humic Gley soils formed in nearly level areas or depressions and are poorly drained or very poorly drained. They have a thick black to very dark gray or very dark brown A1 horizon that is relatively high in organic-matter content; a gray or grayish-brown B or Bg horizon that, in some areas, is mottled with yellow or brown; and a C horizon. In some areas there is as much as 12 inches of peat or muck on the surface. These soils receive water that runs off higher areas. As a result, they remain waterlogged much of the time. Organic matter that accumulates under these conditions becomes mixed with the mineral material to some depth. The gray colors of the B or Bg horizon are the result of poor drainage and aeration and the reduction of iron in the presence of organic matter.

The typical Humic Gley soils in Ionia County are those of the Barry, Bergland, Berville, Breckenridge, Brevort, Brookston, Colwood, Edmore, Ensley, Epoufette, Gilford, Granby, Kokomo, Pewamo, Sebewa, Sims, and Wasepi series. These soils range from sand to clay or silty clay in texture and from acid to calcareous in reaction.

Some soils in Ionia County are classified as Humic Gley soils that are intergrading to Alluvial soils. These soils are in nearly level areas and depressions on flood plains, generally on that part of the flood plain that is farthest from the stream or river. They have a very dark gray to black A1 horizon that is from 6 to 14 inches thick. New material that is deposited on the surface by recurrent floods contains enough in organic matter to maintain the dark color of the surface layer. The Cohoctah, Glendora, Saranac, and Sloan soils are Humic Gley soils that are intergrading to Alluvial soils.

Bog (organic) soils.—Bog soils consist of organic materials that accumulated in water, which prevented or retarded rapid decomposition and oxidation. These soils are more than 12 inches thick and in places extend to a depth of more than 20 feet. They occupy old lakebeds or marshes and range from muck to raw peat. The degree of composition is controlled largely by the kinds of original plant materials and the height of the water table. The Carlisle, Edwards, Linwood, Lupton, Rifle, Tawas, and Willette soils represent this great soil group in Ionia County.

Alluvial soils.—Soils of this great soil group are on flood plains and first bottoms adjacent to streams. They consist of recently deposited soil materials that vary considerably in texture. Their characteristics depend largely on the original soil materials and the manner in which those materials were sorted and deposited. These soils have not been in place long enough for distinct horizons to form. However, because of natural drainage, there are some differences in the color of the soil material and in the amount of organic matter in the surface layer. The typical Alluvial soils in the county are the Abscota, Algansee, Ceresco, Eel, Genesee, Landes, Shoals, Shoals,

heavy subsoil variant, and Washtenaw soils, and Alluvial land, marl substratum.

Some soils in the county are classified as Alluvial soils that are intergrading to Bog (organic) soils. These soils are poorly drained or very poorly drained and consist of alternate layers of mineral alluvium and organic material. The thickness and sequence of the layers vary considerably within short distances. The mineral layers are largely loamy sand but range to sand or to sandy loam. The Kerston and Wallkill soils are classified as Alluvial soils that are intergrading to Bog (organic) soils.

General Nature of the County

This section provides some general information about the early settlement of the county, discusses the geology and climate, and gives some important farming statistics. The statistics are from reports published by the U.S. Bureau of the Census.

Early settlement

Prior to the arrival of the first white settlers, the area that is now Ionia County was under the control of the Sauk and Ottawa Indians. The first white settlers to reach the area came as a small group of 62 from New York. Traveling first by canalboat to Buffalo, then by steamboat to Detroit, and finally overland through the wilderness, they reached the present site of the city of Ionia in June 1833. In 1837 the area was laid out as a county. By 1870 the county had a population of 27,681.

Geology

As little as 15,000 years ago, the area that makes up Ionia County was covered by glacial ice. As a result, except for one small area, the underlying bedrock is covered by 50 to 500 feet of glacial material. Large ridges, or end moraines, developed along the front of the glacier as it halted in its retreat toward the northeast. These moraines are from ¼ mile to 1½ miles in width and from 10 to 40 feet in height. They form a concentric pattern that extends from the northeastern corner of the county toward the southwestern part. Level to undulating ground moraines formed as materials carried by the glacier were deposited. The outwash plains in the county are the old gravelly and sandy channels of swift streams that formed as the glacier melted.

Small glacial lakes are scattered throughout the county but are mainly in the western part. The largest of these lakes are Lake Odessa, Lake Morrison, Woodward Lake, and Long Lake. Small glacial lakebeds near Clarksville, west of Berlin Center, and north of Potters Corners are filled with muck or peat. Two large depressions, or old lakebeds, are in the northwestern part of the county. A glacial drainageway that entered the county near Matherton and left it west of Saranac is now the channel of the Maple and Grand Rivers.

The one small area not covered by glacial drift occurs along the south side of the Grand River, 1½ miles east of the city of Ionia. Here the reddish sandstone bedrock is exposed.

Climate [5]

Ionia County has a modified continental climate. The county is in the Lower Peninsula of Michigan, near Lake Michigan. Prevailing westerly winds cross the lake and pick up warm moist air in winter and cool moist air in summer. As a result, throughout the Lower Peninsula the winters are milder and the summers cooler than in areas at the same latitude west of the lake.

Annual temperature and precipitation data, compiled from records of the U.S. Weather Bureau, are shown in table 10. The temperature varies widely in the county. Two years in 10, there will be at least 4 days in July when the temperature will be 95°F. or higher, and 2 years in 10, there will be at least 4 days in January when the temperature will be 7° or lower. The temperature is zero or lower on an average of 7 days in winter, and it is 90° or higher on an average of 14 days in summer. The highest temperature ever recorded in the county was 103°, and the lowest was 21° below zero. A spread of 110° between the hottest and the coldest temperatures during a single year is not uncommon.

The precipitation during the growing season is sufficient for a wide variety of crops. It is well distributed, and severe periods of drought are rare. In the 6-month period from April through September, the rainfall averages 20.6 inches, or almost two-thirds of the total annual precipitation. Evaporation and transpiration rates are relatively low because the air is cool, the humidity is high, and many days are cloudy or partly cloudy. Consequently, the level of moisture in the soil generally is adequate for all crops, except those growing in very sandy soils.

Most soils in the county are near the saturation point in spring after the snow melts. Subsequent rainfall on sloping cultivated soils often causes severe erosion unless the soils are protected from runoff. Poorly drained or somewhat poorly drained soils remain wet until late in spring. Unless these soils are adequately drained, planting must be delayed. Damaging rains of high intensity commonly occur during the summer. A rain of the intensity of 1.05 inches per hour occurs on the average of once every year; a rain of the intensity of 1.8 inches per hour, 1 year in 10; and a rain of 2.05 inches per hour, 1 year in 25. A rain of the intensity of 2.2 inches in a 24-hour period occurs about once each year.

Cool temperatures and relatively high soil moisture during the bloom stage are conducive to good yields of oats. Hay and pasture are favored by a cool moist growing season, particularly if grown on soils that are not too sandy and that are well fertilized. In fall, moisture generally is adequate for the preparation of seedbeds and the germination of seeded grain. In most winters, enough snow falls to protect fields of winter grain. Snow covers the ground on an average of 58 days each winter, and the average annual snowfall is 41 inches. During 6 months of each year, there is measurable amount of snow on the ground.

[5] A. EICHMEIER, State climatologist, Weather Bureau, U.S. Department of Commerce, assisted in the preparation of this subsection.

TABLE 10.—*Temperature and precipitation, Ionia County, Mich.*[1]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with —		Average total	One year in 10 will have—		Days with snow cover	Average depth of snow on days with snow cover of 1 inch or more
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	31.3	16.2	46	7	1.61	0.2	3.0	18	2.5
February	32.9	15.9	44	9	1.26	1.0	2.6	18	3.7
March	43.7	24.5	66	20	2.38	.8	3.6	6	2.9
April	59.0	35.3	79	28	3.15	1.1	5.3	0	0
May	68.7	44.7	84	37	4.25	2.0	6.9	0	0
June	79.7	55.5	91	48	3.60	2.1	5.1	0	0
July	84.5	58.7	95	53	3.21	1.1	7.1	0	0
August	83.0	57.2	94	50	3.44	1.6	4.2	0	0
September	74.8	50.2	88	41	2.98	.5	6.1	0	0
October	64.1	40.1	80	33	2.37	1.0	3.7	0	0
November	46.2	30.4	64	25	2.40	1.5	3.5	5	2.8
December	34.8	21.6	55	14	2.07	1.1	3.4	11	3.7
Year	58.6	37.5	----	----	32.72	----	----	58	----

[1] Based on a 21-year record through 1940 to 1961.

The length of the frost-free growing season depends to some extent on elevation and air drainage. On cool evenings the heavier cold air tends to flow into low areas. Thus, such areas often have frost when adjacent higher areas do not. The average frost-free growing season at the Saranac Weather Station is 135 days. At the Webber Dam Station, it is 157 days.

Table 11 shows the probabilities of the last freezing temperatures in spring and first freezing temperatures in fall. These figures indicate that 1 year in 10 temperatures of 32° or lower will occur as late as May 24 and as early as September 10. However, there is little likelihood that freezing temperatures will occur this late in spring and this early in fall in the same year. The growing season in the county generally is sufficiently long for corn grown for grain to mature. Varieties of corn that mature in 100 to 118 days can be grown. However, the varieties commonly grown in the county mature in 100 to 105 days.

Farming

The total land area of Ionia County is about 368,000 acres. Of this, slightly more than 80 percent, or 295,677 acres, is in farms. The rest consists mainly of State forest; privately owned woodland; abandoned farmland; and resort, urban, recreational, and industrial areas. Of the acreage in farms in 1964, about 54 percent was in harvested crops, and nearly 8 percent was in cropland used only for pasture.

Corn is the chief row crop grown, and in 1964 there were 46,427 acres of corn harvested for grain, and 9,983 acres cut for silage. Small grain is also important in the county, and in 1964 there were 28,356 acres in wheat, 15,084 acres in oats, 890 acres in barley, 595 acres in rye, and 651 acres in buckwheat. Of the hay crops harvested, 30,179 acres were in alfalfa and alfalfa mixtures, 7,245 acres in clover or timothy, and 387 acres in other hay crops. Red clover seed was grown on 3,236 acres. Pota-

TABLE 11.—*Probabilities of last freezing temperatures in spring and first freezing temperatures in fall, Ionia County, Mich.*

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	April 1	April 10	May 2	May 14	May 24
2 years in 10 later than	March 27	April 5	April 27	May 9	May 19
5 years in 10 later than	March 17	March 26	April 17	April 29	May 9
Fall:					
1 year in 10 earlier than	November 13	November 3	October 23	September 21	September 10
2 years in 10 earlier than	November 18	November 8	October 28	September 26	September 15
5 years in 10 earlier than	November 29	November 19	November 8	October 7	September 26

toes were grown on 222 acres; tree fruits, nuts, and grapes on 2,757 acres; and vegetables harvested for sale on 1,748 acres.

Apples are the main tree fruit crop. In 1964 there were 28,058,520 pounds of apples harvested, 513,451 pounds of peaches, 136,493 pounds of pears, 258,217 pounds of plums and prunes, and 458,466 pounds of sour cherries.

There were 1,838 farms in the county in 1964. Of these, 295 were from 1 to 49 acres in size; 429 were from 50 to 99 acres; 811, from 100 to 259 acres; 246, from 260 to 499 acres; and 56, from 500 to 999 acres. There was 1 farm larger than 1,000 acres.

Of the 1,838 farms in the county, 554 were miscellaneous or unclassified farms; 507 were dairy farms; 300, poultry and livestock farms, other than dairy; and the rest were vegetable, field crop, fruit and nut, and general farms.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available moisture capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in a soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

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; soil will not hold together in a mass.

Friable. When moist, soil crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, soil 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.

Drainage, artificial. The removal of excess water on or within the soil by means of surface or tile drains.

Drainage, natural. Refers to the conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Several different classes of natural drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and 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 C horizons.

Somewhat poorly drained soils are wet for significant periods but not all of the time; the water table is within 12 to 24 inches of the surface during part of the year; and, in podzolic soils, mottlings are below 6 to 16 inches in the lower A horizon and in the B and C horizons. Synonymous with *imperfectly drained* soils.

Poorly drained soils remain wet for a large part of the time. The water table commonly is at or near the surface during a considerable part of the year. Podzolic soils commonly are light gray from the surface downward and may or may not be mottled.

Very poorly drained soils are frequently ponded. The water table commonly is at or near the surface during the greatest part of the year. Podzolic soils commonly have a dark-gray or black surface layer. The deeper part of the profile generally is gray and may or may not be mottled.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand. The layer is seemingly cemented when dry, has a hard or very hard consistence, and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Green manure (agronomy). 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.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Leaching. The removal of soluable materials from soils or other material by percolating water.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are these: Terminal, lateral, medial, 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 these: *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 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Neutral soil. In practice, a soil having a pH value between 6.6 and 7.3. Strictly speaking, a soil that has a pH value of 7.0.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

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 or alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum. 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).

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, a 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 proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

[All wildlife suitability groups are described on page 158. See table 1, page 6, for approximate acreage and proportionate extent of the soils and table 3, page 102, for the predicted yields per acre of the principal crops. For facts about the engineering properties of the soils, turn to the section beginning on page 115]

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
Ab	Abscota loamy sand	10	L-4aA (IIIw)	100	O	115	5
Ac	Abscota loam	9	L-4aA (IIIw)	100	O	115	5
Ad	Abscota sandy loam	10	L-4aA (IIIw)	100	O	115	5
Ae	Algansee loam	10	L-4cA (IIIw)	101	O	115	6
Ag	Algansee loamy sand	10	L-4cA (IIIw)	101	O	115	6
Ah	Algansee sandy loam	10	L-4cA (IIIw)	101	O	115	6
Am	Alluvial land, marl substratum	11	M/mcA (VIw)	101	O	115	6
As	Au Gres sand	11	5bA (IVw)	100	F	114	6
Ba	Barry loam	12	3cA (IIw)	93	W	115	2
Bd	Barry sandy loam	12	3cA (IIw)	93	W	115	2
BeA	Belding sandy loam, 0 to 2 percent slopes	12	3/2bAB (IIw)	94	G	114	2
BeB	Belding sandy loam, 2 to 6 percent slopes	12	3/2bAB (IIw)	94	G	114	2
Bg	Bergland silty clay loam	13	1cA (IVw)	87	P	115	4
Bh	Berville loam	13	3/2cA (IIw)	94	P	115	2
Bk	Berville sandy loam	13	3/2cA (IIw)	94	P	115	2
BlA	Blount loam, 0 to 2 percent slopes	14	1.5bAB (IIw)	89	Z	115	4
BlB	Blount loam, 2 to 6 percent slopes	14	1.5bAB (IIw)	89	Z	115	4
BlB2	Blount loam, 2 to 6 percent slopes, moderately eroded	14	1.5bAB (IIw)	89	Z	115	4
BmA	Boyer loamy sand, 0 to 2 percent slopes	14	4aA (IIIs)	95	M	114	5
BmB	Boyer loamy sand, 2 to 6 percent slopes	15	4aB (IIIs)	95	M	114	5
BmB2	Boyer loamy sand, 2 to 6 percent slopes, moderately eroded	15	4aB (IIIs)	95	M	114	5
BmC2	Boyer loamy sand, 6 to 12 percent slopes, moderately eroded	15	4aC (IIIe)	95	M	114	5
BmD2	Boyer loamy sand, 12 to 18 percent slopes, moderately eroded	15	4aD (IVe)	96	M	114	5
BnA	Boyer sandy loam, 0 to 2 percent slopes	15	4aA (IIIs)	95	M	114	5
BnB	Boyer sandy loam, 2 to 6 percent slopes	15	4aB (IIIs)	95	M	114	5
BnB2	Boyer sandy loam, 2 to 6 percent slopes, moderately eroded	15	4aB (IIIs)	95	M	114	5
BnC2	Boyer sandy loam, 6 to 12 percent slopes, moderately eroded	16	4aC (IIIe)	95	M	114	5
BnD2	Boyer sandy loam, 12 to 18 percent slopes, moderately eroded	16	4aD (IVe)	96	M	114	5
BoA	Boyer very stony loamy sand, 0 to 2 percent slopes	16	4aABC (Vs)	96	M	114	5
BoB	Boyer very stony loamy sand, 2 to 6 percent slopes	16	4aABC (Vs)	96	M	114	5
BoC	Boyer very stony loamy sand, 6 to 12 percent slopes	16	4aABC (Vs)	96	M	114	5
BpE2	Boyer loamy sand, 18 to 25 percent slopes, moderately eroded	15	4aE (VIe)	96	M	114	5
BpF2	Boyer loamy sand, 25 to 40 percent slopes, moderately eroded	15	4aF (VIIe)	97	M	114	5
BsA	Boyer and Spinks loamy sands, 0 to 2 percent slopes	16	4aA (IIIs)	95	M	114	5
BsB	Boyer and Spinks loamy sands, 2 to 6 percent slopes	16	4aB (IIIs)	95	M	114	5
BsB2	Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded	17	4aB (IIIs)	95	M	114	5

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
BsC2	Boyer and Spinks loamy sands, 6 to 12 percent slopes, moderately eroded	17	4aC (IIIe)	95	M	114	5
BsD2	Boyer and Spinks loamy sands, 12 to 18 percent slopes, moderately eroded	17	4aD (IVe)	96	M	114	5
BsE2	Boyer and Spinks loamy sands, 18 to 25 percent slopes, moderately eroded	17	4aE (VIe)	96	M	114	5
BsF	Boyer and Spinks loamy sands, 25 to 40 percent slopes	17	4aF (VIIe)	97	M	114	5
BsF3	Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded	17	4aF3 (VIIe)	97	M	114	5
Bt	Breckenridge sandy loam	18	3/2cA (IIw)	94	W	115	2
Bv	Brevort loamy sand	19	4/2cA (IIIw)	98	W	115	6
Bw	Brookston loam	19	2.5cA (I)	91	P	115	2
CaA	Cadmus loam, 0 to 2 percent slopes	20	3/2aA (I)	93	U	115	1
CaB	Cadmus loam, 2 to 6 percent slopes	20	3/2aB (IIe)	94	U	115	1
CdA	Cadmus sandy loam, 0 to 2 percent slopes	20	3/2aA (I)	93	U	115	1
CdB	Cadmus sandy loam, 2 to 6 percent slopes	20	3/2aB (IIe)	94	U	115	1
CeA	Capac loam, 0 to 2 percent slopes	20	2.5bAB (IIw)	91	Z	115	2
CeB	Capac loam, 2 to 6 percent slopes	21	2.5bAB (IIw)	91	Z	115	2
CfA	Capac sandy loam, 0 to 2 percent slopes	21	2.5bAB (IIw)	91	Z	115	2
CfB	Capac sandy loam, 2 to 6 percent slopes	21	2.5bAB (IIw)	91	Z	115	2
Cg	Carlisle muck	21	McA (IIIw)	101	J	114	8
ChA	Celina loam, 0 to 2 percent slopes	22	2.5aA (I)	89	D	114	1
ChB	Celina loam, 2 to 6 percent slopes	22	2.5aB (IIe)	90	D	114	1
ChB2	Celina loam, 2 to 6 percent slopes, moderately eroded	22	2.5aB (IIe)	90	D	114	1
ChC2	Celina loam, 6 to 12 percent slopes, moderately eroded	22	2.5aC (IIIe)	90	D	114	1
Cl	Ceresco-Shoals loams	22	L-2cA (IIIw)	100	O	115	2
Cm	Ceresco-Shoals sandy loams	23	L-2cA (IIIw)	100	O	115	2
CnA	Chelsea loamy sand, 0 to 2 percent slopes	23	5aAB (IVs)	99	E	114	5
CnB	Chelsea loamy sand, 2 to 6 percent slopes	23	5aAB (IVs)	99	E	114	5
CnB2	Chelsea loamy sand, 2 to 6 percent slopes, moderately eroded	23	5aAB (IVs)	99	E	114	5
CnC2	Chelsea loamy sand, 6 to 12 percent slopes, moderately eroded	23	5aC (VIs)	99	E	114	5
CoA	Chelsea sand, 0 to 2 percent slopes	24	5aAB (IVs)	99	E	114	5
CoB	Chelsea sand, 2 to 6 percent slopes	24	5aAB (IVs)	99	E	114	7
CoB2	Chelsea sand, 2 to 6 percent slopes, moderately eroded	24	5aAB (IVs)	99	E	114	5
CoC2	Chelsea sand, 6 to 12 percent slopes, moderately eroded	24	5aC (VIs)	99	E	114	5
Cp	Cohoctah-Sloan loams	24	L-2cA (IIIw)	100	O	115	2
Cr	Cohoctah-Sloan sandy loams	24	L-2cA (IIIw)	100	O	115	2
Cs	Colwood loam	25	2.5cA (I)	91	W	115	2
CtA	Conover loam, 0 to 2 percent slopes	26	2.5bAB (IIw)	91	Z	115	2
CtB	Conover loam, 2 to 6 percent slopes	26	2.5bAB (IIw)	91	Z	115	2
CtB2	Conover loam, 2 to 6 percent slopes, moderately eroded	26	2.5bAB (IIw)	91	Z	115	2
CuB	Conover extremely stony loam, 2 to 6 percent slopes	26	4aABC (Vs)	96	Z	115	2
CvA	Coral loam, 0 to 2 percent slopes	27	3bAB (IIw)	93	G	114	2
CvB	Coral loam, 2 to 6 percent slopes	27	3bAB (IIw)	93	G	114	2
CwA	Coral sandy loam, 0 to 2 percent slopes	27	3bAB (IIw)	93	G	114	2
CwB	Coral sandy loam, 2 to 6 percent slopes	27	3bAB (IIw)	93	G	114	2
DgC3	Dighton clay loam, 6 to 12 percent slopes, severely eroded	27	1.5aC3 (IVe)	88	B	113	4
DhA	Dighton sandy loam, 0 to 2 percent slopes	28	1.5aA (I)	87	B	113	4
DhB	Dighton sandy loam, 2 to 6 percent slopes	28	1.5aB (IIe)	88	B	113	4

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
DhB2	Dighton sandy loam, 2 to 6 percent slopes, moderately eroded	28	1.5aB (IIe)	88	B	113	4
DhC2	Dighton sandy loam, 6 to 12 percent slopes, moderately eroded	28	1.5aC (IIIe)	88	B	113	4
DrA	Dryden sandy loam, 0 to 2 percent slopes	28	3aA (IIs)	91	U	115	1
DrB	Dryden sandy loam, 2 to 6 percent slopes	29	3aB (IIe)	91	U	115	1
DrB2	Dryden sandy loam, 2 to 6 percent slopes, moderately eroded	29	3aB (IIe)	91	U	115	2
Ed	Edmore sandy loam	29	4cA (IIIw)	97	W	115	6
Ek	Edwards muck	30	M/mcAB (IVw)	101	J	114	8
Em	Edwards muck, sloping	30	M/mcAB (IVw)	101	J	114	8
En	Ensley loam	30	3cA (IIw)	93	W	115	2
Eo	Epoufette loamy sand	31	4cA (IIIw)	97	W	115	6
Ep	Epoufette sandy loam	31	4cA (IIIw)	97	W	115	6
FoA	Fox sandy loam, 0 to 2 percent slopes	31	3aA (IIs)	91	U	115	1
FoB	Fox sandy loam, 2 to 6 percent slopes	31	3aB (IIe)	91	U	115	1
FoB2	Fox sandy loam, 2 to 6 percent slopes, moderately eroded	31	3aB (IIe)	91	U	115	1
FoC	Fox sandy loam, 6 to 12 percent slopes	32	3aC (IIIe)	92	U	115	1
FoC2	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	32	3aC (IIIe)	92	U	115	1
FoD2	Fox sandy loam, 12 to 18 percent slopes, moderately eroded	32	3aD (IVe)	92	U	115	1
FoE2	Fox sandy loam, 18 to 25 percent slopes, moderately eroded	32	3aE (VIe)	93	U	115	1
FoF	Fox sandy loam, 25 to 40 percent slopes	32	3aEF (VIIe)	93	U	115	1
FsB	Fox stony sandy loam, 2 to 6 percent slopes	32	4aABC (Vs)	96	U	115	1
FxC3	Fox sandy clay loam, 6 to 12 percent slopes, severely eroded	32	3aC3 (IVe)	92	U	115	1
FxD3	Fox sandy clay loam, 12 to 18 percent slopes, severely eroded	32	3aD3 (VIe)	92	U	115	1
FxE3	Fox sandy clay loam, 18 to 25 percent slopes, severely eroded	32	3aEF3 (VIIe)	93	U	115	1
FxF3	Fox sandy clay loam, 25 to 40 percent slopes, severely eroded	33	3aEF3 (VIIe)	93	U	115	1
Gf	Gilford loamy sand	33	4cA (IIIw)	97	W	115	6
Gg	Gilford sandy loam	33	4cA (IIIw)	97	W	115	6
GhA	Gladwin loamy sand, 0 to 2 percent slopes	34	4bAB (IIIw)	97	F	114	6
GhB	Gladwin loamy sand, 2 to 6 percent slopes	34	4bAB (IIIw)	97	F	114	6
GlA	Gladwin sandy loam, 0 to 2 percent slopes	34	4bAB (IIIw)	97	F	114	6
GlB	Gladwin sandy loam, 2 to 6 percent slopes	34	4bAB (IIIw)	97	F	114	6
Gm	Glendora loam	34	L-4cA (IIIw)	101	O	115	6
Gn	Glendora sandy loam	35	L-4cA (IIIw)	101	O	115	6
Go	Granby loamy sand	35	5cA (IIIw)	100	O	115	6
Gp	Gravel pits	35	Sa (VIIIs)	100	---	---	---
GrA	Grayling sand, 0 to 6 percent slopes	36	5.7aA-F (VIIs)	100	N	114	7
GrB2	Grayling sand, 2 to 6 percent slopes, moderately eroded	36	5.7aA-F (VIIs)	100	N	114	7
GrC	Grayling sand, 6 to 12 percent slopes	36	5.7aA-F (VIIs)	100	N	114	7
GrC2	Grayling sand, 6 to 12 percent slopes, moderately eroded	36	5.7aA-F (VIIs)	100	N	114	7
GrD	Grayling sand, 12 to 18 percent slopes	36	5.7aA-F (VIIs)	100	N	114	7
GrD2	Grayling sand, 12 to 18 percent slopes, moderately eroded	36	5.7aA-F (VIIs)	100	N	114	7
GrF	Grayling sand, 18 to 40 percent slopes	36	5.7aA-F (VIIs)	100	N	114	7
IoA	Ionia loam, 0 to 2 percent slopes	37	3aA (IIs)	91	U	115	1
IoB	Ionia loam, 2 to 6 percent slopes	37	3aB (IIe)	91	U	115	1
IrA	Ionia sandy loam, 0 to 2 percent slopes	37	3aA (IIs)	91	U	115	1
IrB	Ionia sandy loam, 2 to 6 percent slopes	37	3aB (IIe)	91	U	115	1

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
IrB2	Ionia sandy loam, 2 to 6 percent slopes, moderately eroded	37	3aB (IIe)	91	U	115	1
IsA	Iosco loamy sand, 0 to 2 percent slopes	38	4/2bAB (IIIw)	98	G	114	6
IsB	Iosco loamy sand, 2 to 6 percent slopes	38	4/2bAB (IIIw)	98	G	114	6
KaA	Kawkawlin loam, 0 to 2 percent slopes	38	1.5bAB (IIw)	89	Z	115	4
KaB	Kawkawlin loam, 2 to 6 percent slopes	38	1.5bAB (IIw)	89	Z	115	4
KdA	Kawkawlin sandy loam, 0 to 2 percent slopes	39	1.5bAB (IIw)	89	Z	115	4
KdB	Kawkawlin sandy loam, 2 to 6 percent slopes	39	1.5bAB (IIw)	89	Z	115	4
KeA	Kendallville loam, 0 to 2 percent slopes	39	3/2aA (I)	93	U	115	1
KeB	Kendallville loam, 2 to 6 percent slopes	39	3/2aB (IIe)	94	U	115	1
KeB2	Kendallville loam, 2 to 6 percent slopes, moderately eroded	39	3/2aB (IIe)	94	U	115	1
KeC2	Kendallville loam, 6 to 12 percent slopes, moderately eroded	39	3/2aC (IIIe)	94	U	115	1
KgC3	Kendallville sandy clay loam, 6 to 12 percent slopes, severely eroded	40	2.5aC3 (IVe)	90	U	115	1
KhB	Kendallville sandy loam, 2 to 6 percent slopes	40	3/2aB (IIe)	94	U	115	1
KhB2	Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded	40	3/2aB (IIe)	94	U	115	1
KhC2	Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded	40	2.5aC (IIIe)	90	U	115	1
KhD2	Kendallville sandy loam, 12 to 18 percent slopes, moderately eroded	40	2.5aD (IVe)	90	U	115	1
KkB	Kent soils, 2 to 6 percent slopes	40	1aBC (IIIe)	87	B	113	3
KkC	Kent soils, 6 to 12 percent slopes	41	1aBC (IIIe)	87	B	113	3
KkD	Kent soils, 12 to 18 percent slopes	41	1.5aD (IVe)	89	B	113	3
KlC3	Kent silty clay, 6 to 12 percent slopes, severely eroded	41	1.5aC3 (IVe)	88	B	113	3
Km	Kerston muck	41	L-4cA (IIIw)	101	J	114	8
KnA	Kibbie loam, 0 to 2 percent slopes	42	2.5bAB (IIw)	91	G	114	2
KnB	Kibbie loam, 2 to 6 percent slopes	42	2.5bAB (IIw)	91	G	114	2
Ko	Kokomo clay loam	42	2.5cA (I)	91	P	115	2
La	Landes-Eel loams	43	L-2aA (IIw)	100	P	115	1
Le	Landes-Eel sandy loams	43	L-2aA (IIw)	100	O	115	1
Lg	Landes-Genesee loams	43	L-2aA (IIw)	100	O	115	1
Lh	Landes-Genesee sandy loams	43	L-2aA (IIw)	100	O	115	1
L1A	Lapeer loam, 0 to 2 percent slopes	44	3aA (IIs)	91	U	115	1
L1B	Lapeer loam, 2 to 6 percent slopes	44	3aB (IIe)	91	U	115	1
L1B2	Lapeer loam, 2 to 6 percent slopes, moderately eroded	44	3aB (IIe)	91	U	115	1
L1C2	Lapeer loam, 6 to 12 percent slopes, moderately eroded	44	3aC (IIIe)	92	U	115	1
LmC3	Lapeer sandy clay loam, 6 to 12 percent slopes, severely eroded	44	3aC3 (IVe)	92	U	115	1
LmD3	Lapeer sandy clay loam, 12 to 18 percent slopes, severely eroded	44	3aD3 (VIe)	92	U	115	1
LmF3	Lapeer sandy clay loam, 18 to 40 percent slopes, severely eroded	45	3aEF3 (VIIe)	93	U	115	1
LnA	Lapeer sandy loam, 0 to 2 percent slopes	45	3aA (IIs)	91	U	115	1
LnB	Lapeer sandy loam, 2 to 6 percent slopes	45	3aB (IIe)	91	U	115	1
LnB2	Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	45	3aB (IIe)	91	U	115	1
LnC2	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	45	3aC (IIIe)	92	U	115	1
LnD2	Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	45	3aD (IVe)	92	U	115	1
LnF2	Lapeer sandy loam, 18 to 40 percent slopes, moderately eroded	45	3aEF (VIIe)	93	U	115	1
Lo	Linwood muck	46	M/4cA (IVw)	101	J	114	8

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
LsA	Locke sandy loam, 0 to 2 percent slopes	46	3bAB (IIw)	93	G	114	2
LsB	Locke sandy loam, 2 to 6 percent slopes	46	3bAB (IIw)	93	G	114	2
Lt	Lupton muck	47	McA (IIIw)	101	G	114	8
MaA	Macomb loam, 0 to 2 percent slopes	47	3/2bAB (IIw)	94	G	114	2
MaB	Macomb loam, 2 to 6 percent slopes	47	3/2bAB (IIw)	94	G	114	2
Mb	Made land	47	Sa (VIIIs)	100	---	---	---
McB	Mancelona loamy sand, loamy substratum, 2 to 6 percent slopes	48	4aB (IIIs)	95	M	114	5
McC2	Mancelona loamy sand, loamy substratum, 6 to 12 percent slopes, moderately eroded	48	4aC (IIIe)	95	M	114	5
MdA	Mancelona-Chelsea loamy sands, 0 to 2 percent slopes	48	4aA (IIIs)	95	C	113	5
MdB	Mancelona-Chelsea loamy sands, 2 to 6 percent slopes	48	4aB (IIIs)	95	C	113	5
MdB2	Mancelona-Chelsea loamy sands, 2 to 6 percent slopes, moderately eroded	48	4aB (IIIs)	95	C	113	5
MdC2	Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, moderately eroded	49	4aC (IIIe)	95	C	113	5
MdC3	Mancelona-Chelsea loamy sands, 6 to 12 percent slopes, severely eroded	49	4aC3 (IVe)	96	C	113	5
MdD	Mancelona-Chelsea loamy sands, 12 to 18 percent slopes	49	4aD (IVe)	96	C	113	5
MdD2	Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, moderately eroded	49	4aD (IVe)	96	C	113	5
MdD3	Mancelona-Chelsea loamy sands, 12 to 18 percent slopes, severely eroded	49	4aD3 (VIe)	96	C	113	5
MdE2	Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, moderately eroded	49	4aE (VIe)	96	C	113	5
MdE3	Mancelona-Chelsea loamy sands, 18 to 25 percent slopes, severely eroded	50	4aE3 (VIIe)	96	C	113	5
MdF	Mancelona-Chelsea loamy sands, 25 to 40 percent slopes	50	4aF (VIIe)	97	C	113	5
MdF2	Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, moderately eroded	50	4aF (VIIe)	97	C	113	5
MdF3	Mancelona-Chelsea loamy sands, 25 to 40 percent slopes, severely eroded	50	4aF3 (VIIe)	97	C	113	5
MeA	Mancelona-Chelsea stony complex, 0 to 2 percent slopes	50	4aABC (Vs)	96	C	113	5
MfC3	Marlette clay loam, 6 to 12 percent slopes, severely eroded	50	2.5aC3 (IVe)	90	D	114	1
MfD3	Marlette clay loam, 12 to 18 percent slopes, severely eroded	51	2.5aD3 (VIe)	90	D	114	1
MfE3	Marlette clay loam, 18 to 25 percent slopes, severely eroded	51	2.5aE (VIe)	91	D	114	1
MgA	Marlette loam, 0 to 2 percent slopes	51	2.5aA (I)	89	D	114	1
MgB	Marlette loam, 2 to 6 percent slopes	51	2.5aB (IIe)	90	D	114	1
MgB2	Marlette loam, 2 to 6 percent slopes, moderately eroded	51	2.5aB (IIe)	90	D	114	1
MgC2	Marlette loam, 6 to 12 percent slopes, moderately eroded	51	2.5aC (IIIe)	90	D	114	1
MgD2	Marlette loam, 12 to 18 percent slopes, moderately eroded	51	2.5aD (IVe)	90	D	114	1
MgE2	Marlette loam, 18 to 25 percent slopes, moderately eroded	51	2.5aE (VIe)	91	D	114	1
MgF2	Marlette loam, 25 to 40 percent slopes, moderately eroded	51	2.5aF (VIIe)	91	D	114	1
MhB	Marlette loamy sand, 2 to 6 percent slopes	52	2.5aB (IIe)	90	D	114	1
MhB2	Marlette loamy sand, 2 to 6 percent slopes, moderately eroded	52	2.5aB (IIe)	90	D	114	1

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
MhC2	Marlette loamy sand, 6 to 12 percent slopes, moderately eroded	52	2.5aC (IIIe)	90	D	114	1
MkA	Marlette sandy loam, 0 to 2 percent slopes	52	2.5aA (I)	89	D	114	1
MkB	Marlette sandy loam, 2 to 6 percent slopes	52	2.5aB (IIe)	90	D	114	1
MkB2	Marlette sandy loam, 2 to 6 percent slopes, moderately eroded	52	2.5aB (IIe)	90	D	114	1
MkC2	Marlette sandy loam, 6 to 12 percent slopes, moderately eroded	52	2.5aC (IIIe)	90	D	114	1
MkD2	Marlette sandy loam, 12 to 18 percent slopes, moderately eroded	52	2.5aD (IVe)	90	D	114	1
MkE	Marlette sandy loam, 18 to 25 percent slopes	52	2.5aE (VIe)	91	D	114	1
MlA	Matherton loam, 0 to 2 percent slopes	53	3bAB (IIw)	93	G	114	2
MlB	Matherton loam, 2 to 6 percent slopes	53	3bAB (IIw)	93	G	114	2
MmA	Matherton sandy loam, 0 to 2 percent slopes	53	3bAB (IIw)	93	G	114	2
MmB	Matherton sandy loam, 2 to 6 percent slopes	53	3bAB (IIw)	93	G	114	2
MnA	McBride loamy sand, 0 to 2 percent slopes	54	3aA (IIs)	91	A	113	1
MnB	McBride loamy sand, 2 to 6 percent slopes	54	3aB (IIe)	91	A	113	1
MnB2	McBride loamy sand, 2 to 6 percent slopes, moderately eroded	54	3aB (IIe)	91	A	113	1
MnC2	McBride loamy sand, 6 to 12 percent slopes, moderately eroded	54	3aC (IIIe)	92	A	113	1
MoB3	McBride sandy clay loam, 2 to 6 percent slopes, severely eroded	54	3aB3 (IIIe)	92	A	113	1
MoC3	McBride sandy clay loam, 6 to 12 percent slopes, severely eroded	54	3aC3 (IVe)	92	A	113	1
MoD3	McBride sandy clay loam, 12 to 18 percent slopes, severely eroded	55	3aD3 (VIe)	92	A	113	1
MoE3	McBride sandy clay loam, 18 to 25 percent slopes, severely eroded	55	3aEF3 (VIIe)	93	A	113	1
MpA	McBride sandy loam, 0 to 2 percent slopes	55	3aA (IIs)	91	A	113	1
MpB	McBride sandy loam, 2 to 6 percent slopes	55	3aB (IIe)	91	A	113	1
MpB2	McBride sandy loam, 2 to 6 percent slopes, moderately eroded	55	3aB (IIe)	91	A	113	1
MpC	McBride sandy loam, 6 to 12 percent slopes	55	3aC (IIIe)	92	A	113	1
MpC2	McBride sandy loam, 6 to 12 percent slopes, moderately eroded	55	3aC (IIIe)	92	A	113	1
MpD2	McBride sandy loam, 12 to 18 percent slopes, moderately eroded	55	3aD (IVe)	92	A	113	1
MpE2	McBride sandy loam, 18 to 25 percent slopes, moderately eroded	55	3aE (VIe)	93	A	113	1
MpF2	McBride sandy loam, 25 to 40 percent slopes, moderately eroded	56	3aEF (VIIe)	93	A	113	1
MrA	Menominee loamy sand, 0 to 2 percent slopes	56	4/2aAB (IIIs)	97	C	113	5
MrB	Menominee loamy sand, 2 to 6 percent slopes	56	4/2aAB (IIIs)	97	C	113	5
MrB2	Menominee loamy sand, 2 to 6 percent slopes, moderately eroded	56	4/2aAB (IIIs)	97	C	113	5
MrC2	Menominee loamy sand, 6 to 12 percent slopes, moderately eroded	56	4/2aC (IIIe)	98	C	113	5
MrC3	Menominee loamy sand, 6 to 12 percent slopes, severely eroded	57	4/2aC3 (IVe)	98	C	113	5
MrD2	Menominee loamy sand, 12 to 18 percent slopes, moderately eroded	57	4/2aDE (VIe)	98	C	113	5
MrD3	Menominee loamy sand, 12 to 18 percent slopes, severely eroded	57	4/2aDE (VIe)	98	C	113	5
MrE2	Menominee loamy sand, 18 to 25 percent slopes, moderately eroded	57	4/2aDE (VIe)	98	C	113	5
MsA	Metamora sandy loam, 0 to 2 percent slopes	57	3/2bAB (IIw)	94	G	114	2
MsB	Metamora sandy loam, 2 to 6 percent slopes	57	3/2bAB (IIw)	94	G	114	2
MtB3	Miami clay loam, 2 to 6 percent slopes, severely eroded	58	2.5aC3 (IIIe)	90	D	114	1

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
MtC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	58	2.5aC3 (IIIe)	90	D	114	1
MtD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	58	2.5aD3 (VIe)	90	D	114	1
MtE3	Miami clay loam, 18 to 25 percent slopes, severely eroded	58	2.5aE (VIe)	91	D	114	1
MtF3	Miami clay loam, 25 to 40 percent slopes, severely eroded	59	2.5aF (VIIe)	91	D	114	1
MuA	Miami loam, 0 to 2 percent slopes	59	2.5aA (I)	89	D	114	1
MuB	Miami loam, 2 to 6 percent slopes	59	2.5aB (IIe)	90	D	114	1
MuB2	Miami loam, 2 to 6 percent slopes, moderately eroded	59	2.5aB (IIe)	90	D	114	1
MuC	Miami loam, 6 to 12 percent slopes	59	2.5aC (IIIe)	90	D	114	1
MuC2	Miami loam, 6 to 12 percent slopes, moderately eroded	59	2.5aC (IIIe)	90	D	114	1
MuD2	Miami loam, 12 to 18 percent slopes, moderately eroded	59	2.5aD (IVe)	90	D	114	1
MuE2	Miami loam, 18 to 25 percent slopes, moderately eroded	59	2.5aE (VIe)	91	D	114	1
MuF	Miami loam, 25 to 40 percent slopes	59	2.5aF (VIIe)	91	D	114	1
MvB	Miami sandy loam, 2 to 6 percent slopes	59	2.5aB (IIe)	90	D	114	1
MvB2	Miami sandy loam, 2 to 6 percent slopes, moderately eroded	60	2.5aB (IIe)	90	D	114	1
MvC2	Miami sandy loam, 6 to 12 percent slopes, moderately eroded	60	2.5aC (IIIe)	90	D	114	1
MvD2	Miami sandy loam, 12 to 18 percent slopes, moderately eroded	60	2.5aD (IVe)	90	D	114	1
MwA	Miami-Owosso sandy loams, 0 to 2 percent slopes	60	2.5aA (I)	89	D	114	1
MwB	Miami-Owosso sandy loams, 2 to 6 percent slopes	60	2.5aB (IIe)	90	D	114	1
MwB2	Miami-Owosso sandy loams, 2 to 6 percent slopes, moderately eroded	60	2.5aB (IIe)	90	D	114	1
MwC2	Miami-Owosso sandy loams, 6 to 12 percent slopes, moderately eroded	60	2.5aC (IIIe)	90	D	114	1
MwD2	Miami-Owosso sandy loams, 12 to 18 percent slopes, moderately eroded	60	2.5aD (IVe)	90	D	114	1
MxA	Montcalm loamy sand, 0 to 2 percent slopes	61	4aA (IIIs)	95	C	113	5
MxB	Montcalm loamy sand, 2 to 6 percent slopes	61	4aB (IIIs)	95	C	113	5
MxB2	Montcalm loamy sand, 2 to 6 percent slopes, moderately eroded	61	4aB (IIIs)	95	C	113	5
MxC2	Montcalm loamy sand, 6 to 12 percent slopes, moderately eroded	61	4aC (IIIe)	95	C	113	5
MxC3	Montcalm loamy sand, 6 to 12 percent slopes, severely eroded	62	4aC3 (IVe)	96	C	113	5
MxD2	Montcalm loamy sand, 12 to 18 percent slopes, moderately eroded	62	4aD (IVe)	96	C	113	5
MxD3	Montcalm loamy sand, 12 to 18 percent slopes, severely eroded	62	4aD3 (VIe)	96	C	113	5
MxE2	Montcalm loamy sand, 18 to 25 percent slopes, moderately eroded	62	4aE (VIe)	96	C	113	5
MxE3	Montcalm loamy sand, 18 to 25 percent slopes, severely eroded	62	4aE3 (VIIe)	96	C	113	5
MxF2	Montcalm loamy sand, 25 to 40 percent slopes, moderately eroded	62	4aF (VIIe)	97	C	113	5
MyA	Montcalm sandy loam, 0 to 2 percent slopes	62	4aA (IIIs)	95	C	113	5
MyB	Montcalm sandy loam, 2 to 6 percent slopes	63	4aB (IIIs)	95	C	113	5
MyB2	Montcalm sandy loam, 2 to 6 percent slopes, moderately eroded	63	4aB (IIIs)	95	C	113	5

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
MyC2	Montcalm sandy loam, 6 to 12 percent slopes, moderately eroded	63	4aC (IIIe)	95	C	113	5
MzC3	Morley clay loam, 6 to 12 percent slopes, severely eroded	63	1.5aC3 (IVe)	88	B	113	5
MzD3	Morley clay loam, 12 to 18 percent slopes, severely eroded	63	1.5aDE3 (VIe)	89	B	113	3
MzaA	Morley loam, 0 to 2 percent slopes	64	1.5aA (I)	87	B	113	3
MzaB	Morley loam, 2 to 6 percent slopes	64	1.5aB (IIe)	88	B	113	3
MzaB2	Morley loam, 2 to 6 percent slopes, moderately eroded	64	1.5aB (IIIe)	88	B	113	3
MzaC2	Morley loam, 6 to 12 percent slopes, moderately eroded	64	1.5aC (IIIe)	88	B	113	3
MzaD2	Morley loam, 12 to 18 percent slopes, moderately eroded	64	1.5aD (IVe)	89	B	113	3
MzbB	Morley sandy loam, 2 to 6 percent slopes	64	1.5aB (IIe)	88	B	113	3
MzbB2	Morley sandy loam, 2 to 6 percent slopes, moderately eroded	64	1.5aB (IIIe)	88	B	113	3
MzbC2	Morley sandy loam, 6 to 12 percent slopes, moderately eroded	64	1.5aC (IIIe)	88	B	113	3
NcB3	Nester clay loam, 2 to 6 percent slopes, severely eroded	65	1.5aB (IIIe)	88	B	113	3
NcC3	Nester clay loam, 6 to 12 percent slopes, severely eroded	65	1.5aC3 (IVe)	88	B	113	3
NcD3	Nester clay loam, 12 to 18 percent slopes, severely eroded	65	1.5aDE3 (VIe)	89	B	113	3
NcE3	Nester clay loam, 18 to 25 percent slopes, severely eroded	65	1.5aDE3 (VIe)	89	B	113	3
NeB	Nester loam, 2 to 6 percent slopes	66	1.5aB (IIe)	88	B	113	3
NeB2	Nester loam, 2 to 6 percent slopes, moderately eroded	66	1.5aB (IIIe)	88	B	113	3
NeC2	Nester loam, 6 to 12 percent slopes, moderately eroded	66	1.5aC (IIIe)	88	B	113	3
NsB	Nester sandy loam, 2 to 6 percent slopes	66	1.5aB (IIe)	88	B	113	3
NsB2	Nester sandy loam, 2 to 6 percent slopes, moderately eroded	66	1.5aB (IIIe)	88	B	113	3
NsC2	Nester sandy loam, 6 to 12 percent slopes, moderately eroded	66	1.5aC (IIIe)	88	B	113	3
NsD	Nester sandy loam, 12 to 18 percent slopes	66	1.5aD (IVe)	89	B	113	3
NwC3	Newaygo sandy clay loam, 6 to 12 percent slopes, severely eroded	67	3aC3 (IVe)	92	A	113	1
NwD3	Newaygo sandy clay loam, 12 to 18 percent slopes, severely eroded	67	3aD3 (VIe)	92	A	113	1
NyA	Newaygo sandy loam, 0 to 2 percent slopes	67	3aA (IIs)	91	A	113	1
NyB	Newaygo sandy loam, 2 to 6 percent slopes	67	3aB (IIe)	91	A	113	1
NyB2	Newaygo sandy loam, 2 to 6 percent slopes, moderately eroded	67	3aB (IIe)	91	A	113	1
NyC2	Newaygo sandy loam, 6 to 12 percent slopes, moderately eroded	68	3aC (IIIe)	92	A	113	1
NyD2	Newaygo sandy loam, 12 to 18 percent slopes, moderately eroded	68	3aD (IVe)	92	A	113	1
NyF2	Newaygo sandy loam, 18 to 40 percent slopes, moderately eroded	68	3aE (VIe)	93	A	113	1
OcA	Otisco loamy sand, 0 to 2 percent slopes	68	4bAB (IIIw)	97	G	114	6
OcB	Otisco loamy sand, 2 to 6 percent slopes	68	4bAB (IIIw)	97	G	114	6
OtA	Otisco sandy loam, 0 to 2 percent slopes	69	4bAB (IIIw)	97	G	114	6
OtB	Otisco sandy loam, 2 to 6 percent slopes	69	4bAB (IIIw)	97	G	114	6
PdA	Perrin loamy sand, 0 to 2 percent slopes	70	4aA (IIIs)	95	M	114	5
PdB	Perrin loamy sand, 2 to 6 percent slopes	70	4aB (IIIs)	95	M	114	5
PdB2	Perrin loamy sand, 2 to 6 percent slopes, moderately eroded	70	4aB (IIIs)	95	M	114	5

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
PeA	Perrin sandy loam, 0 to 2 percent slopes	70	4aA (IIIs)	95	M	114	5
PeB	Perrin sandy loam, 2 to 6 percent slopes	70	4aB (IIIs)	95	M	114	5
Pm	Pewamo clay loam	70	1.5cA (I)	89	P	115	4
Pn	Pewamo loam	70	1.5cA (I)	89	P	115	4
PoB	Plainfield sand, slightly acid variant, 0 to 6 percent slopes	71	5aAB (IVs)	99	E	114	7
PoC2	Plainfield sand, slightly acid variant, 6 to 12 percent slopes, moderately eroded	71	5aC (VIs)	99	E	114	7
PoD2	Plainfield sand, slightly acid variant, 12 to 18 percent slopes, moderately eroded	71	5aD (VIIs)	99	E	114	7
PoE2	Plainfield sand, slightly acid variant, 18 to 25 percent slopes, moderately eroded	71	5aEF (VIIs)	99	E	114	7
Rm	Rifle muck	72	McA (IIIw)	101	J	114	8
Sa	Saranac clay loam	72	L-2cA (IIIw)	100	O	115	4
Sc	Saranac silt loam	72	L-2cA (IIIw)	100	O	115	4
Sd	Sebewa loam	73	3cA (IIw)	93	W	115	2
SeA	Selkirk loamy sand, 0 to 2 percent slopes	73	1bAB (IIIw)	87	Z	115	4
SfA	Selkirk silt loam, 0 to 2 percent slopes	73	1bAB (IIIw)	87	Z	115	4
Sg	Shallow sandy land	73	4/RaB (IVs)	99	C	113	5
Sh	Shoals clay loam, heavy subsoil variant	74	L-2cA (IIIw)	100	O	115	4
Sk	Shoals loam, heavy subsoil variant	74	L-2cA (IIIw)	100	O	115	4
Sl	Shoals sandy loam, heavy subsoil variant	75	L-2cA (IIIw)	100	O	115	4
Sm	Sims clay loam	75	1.5cA (I)	89	P	115	4
Sn	Sims loam	75	1.5cA (I)	89	P	115	4
SpA	Spinks loamy sand, 0 to 2 percent slopes	76	4aA (IIIs)	95	E	114	5
SpB	Spinks loamy sand, 2 to 6 percent slopes	76	4aB (IIIs)	95	E	114	5
SpB2	Spinks loamy sand, 2 to 6 percent slopes, moderately eroded	76	4aB (IIIs)	95	E	114	5
SpC2	Spinks loamy sand, 6 to 12 percent slopes, moderately eroded	76	4aC (IIIe)	95	E	114	5
SpC3	Spinks loamy sand, 6 to 12 percent slopes, severely eroded	77	4aC3 (IVe)	96	E	114	5
SpD2	Spinks loamy sand, 12 to 18 percent slopes, moderately eroded	77	4aD (IVe)	96	E	114	5
SpD3	Spinks loamy sand, 12 to 18 percent slopes, severely eroded	77	4aD3 (VIe)	96	E	114	5
Ta	Tawas muck	78	M/4cA (IVw)	101	J	114	8
TsA	Tuscola soils, 0 to 2 percent slopes	78	2.5aA (I)	89	U	115	1
TsB	Tuscola soils, 2 to 6 percent slopes	78	2.5aB (IIe)	90	U	115	1
TsB2	Tuscola soils, 2 to 6 percent slopes, moderately eroded	78	2.5aB (IIe)	90	U	115	1
TsC2	Tuscola soils, 6 to 12 percent slopes, moderately eroded	79	2.5aC (IIIe)	90	U	115	1
TuB	Tuscola loamy fine sand, 2 to 6 percent slopes	79	2.5aB (IIe)	90	U	115	1
UbC3	Ubly sandy clay loam, 6 to 12 percent slopes, severely eroded	79	2.5aC3 (IVe)	90	A	113	1
UlA	Ubly sandy loam, 0 to 2 percent slopes	79	3/2aA (I)	93	A	113	1
UlB	Ubly sandy loam, 2 to 6 percent slopes	79	3/2aB (IIe)	94	A	113	1
UlB2	Ubly sandy loam, 2 to 6 percent slopes, moderately eroded	80	3/2aB (IIe)	94	A	113	1
UlC2	Ubly sandy loam, 6 to 12 percent slopes, moderately eroded	80	3/2aC (IIIe)	94	A	113	1
UlD2	Ubly sandy loam, 12 to 18 percent slopes, moderately eroded	80	3/2aD (IVe)	94	A	113	1
UlE2	Ubly sandy loam, 18 to 25 percent slopes, moderately eroded	80	4/2aDE (VIe)	98	A	113	1
Wa	Wallkill soils	80	L-2cA (IIIw)	100	J	114	2
WeA	Wasepi sandy loam, 0 to 2 percent slopes	81	4bAB (IIIw)	97	G	114	6
WeB	Wasepi sandy loam, 2 to 6 percent slopes	81	4bAB (IIIw)	97	G	114	6

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Soil management unit		Woodland suitability group		Wildlife suitability group
			Symbol	Page	Letter	Page	Number
WrA	Wasepi-Brady loamy sands, 0 to 2 percent slopes	81	4bAB (IIIw)	97	G	114	6
WrB	Wasepi-Brady loamy sands, 2 to 6 percent slopes	81	4bAB (IIIw)	97	G	114	6
WsA	Wasepi-Brady sandy loams, 0 to 2 percent slopes	81	4bAB (IIIw)	97	G	114	6
WsB	Wasepi-Brady sandy loams, 2 to 6 percent slopes	81	4bAB (IIIw)	97	G	114	6
Wt	Washtenaw soils	82	L-2cA (IIIw)	100	P	115	2
Wu	Willette-Linwood mucks	82	M/4cA (IVw)	101	J	114	8
Wv	Wind eroded land, sloping	82	5.7aA-F (VIIs)	100	N	114	7
Ww	Wind eroded land, steep	83	5.7aA-F (VIIs)	100	N	114	7

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