SOIL SURVEY

Macomb County Michigan

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

Issued September 1971

Major fieldwork for this soil survey was done in the period 1964–66. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the Michigan Agricultural Experiment Station. It is part of the technical assistance furnished to the Macomb County Soil Conservation District.

Preparation of this soil survey was partly financed by the Macomb County Planning Commission under provisions of an agreement with the Soil Conservation Service, United States Department of Agriculture, and partly by an urban planning grant from the Department of Housing and Urban Development under provisions of Section 701 of the Housing Act of 1954, as amended.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification and woodland classification of each soil. It also shows the page where each soil and each classification is described.

Other classifications can be developed by using the map and information in the text to group 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 from the soil descriptions and from the discussions of the capability units and woodland suitability groups.

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

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Use of the Soils for Community Development."

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

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

Newcomers in Macomb 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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Soil Survey of Macomb County, Michigan

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

MACOMB COUNTY is in the southeastern part of Michigan (fig. 1). It has a total area of 307,840 acres, or 481 square miles. Mount Clemens is the county seat. In 1965, the population totaled nearly 520,000.

Farming, especially dairy farming, is the major enterprise. Most forested areas have been cleared and are used for such crops as small grain, corn, beans, vegetables, and hay. Some areas are in pasture, and some are in trees or are idle.

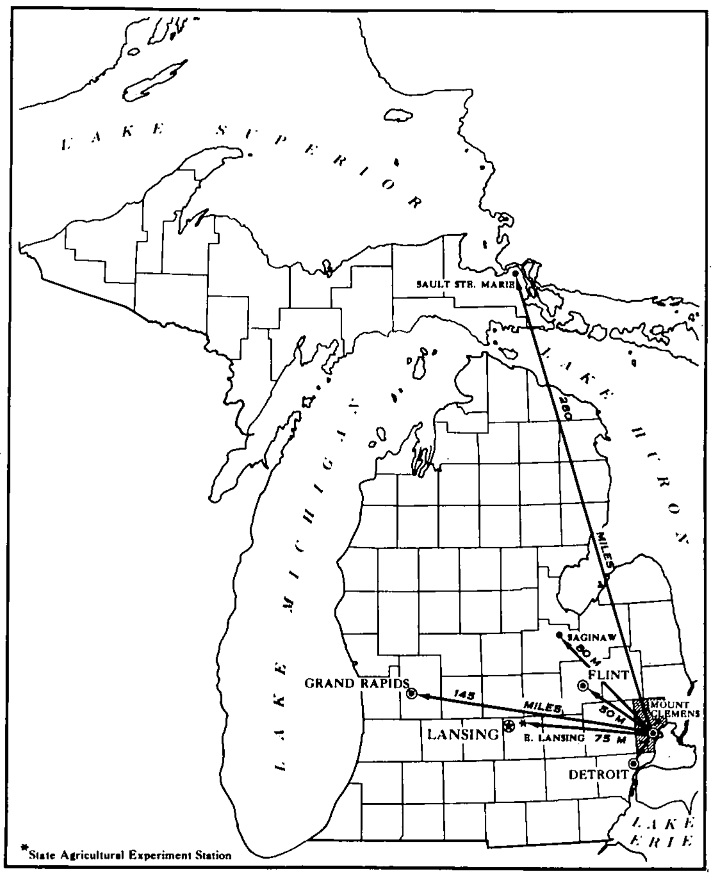

Figure 1.—Location of Macomb County in Michigan.

Small industries occur throughout the county, and industry is expanding rapidly in the southern part, which is in the metropolitan area of Detroit. There is a great demand for vegetables, ornamental shrubs, sod for lawns, and tree fruits.

How This Survey Was Made

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

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*7*).[1]

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. Boyer and Lapeer, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially

[1] Italic numbers in parentheses refer to Literature Cited, page 108.

alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of their surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Boyer loamy sand, 0 to 2 percent slopes, is one of several phases within the Boyer series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. One such mapping unit shown on the soil map of Macomb County is a soil complex. A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils. and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Brevort-Selfridge complex is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Made land is a land type in Macomb County.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are also 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.

The soil scientists set up trial groups of soils on the basis of yield and practice tables and other data they have collected. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they adjust the groups according to the results of their studies and 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 Macomb County, Michigan. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

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

The nine soil associations in the county are discussed in the following pages.

1. Lapeer-Miami-Celina association

Gently sloping to rolling, well drained and moderately well drained soils that have a dominantly medium textured and moderately fine textured subsoil; on uplands

This association is made up of well drained and moderately well drained, gently sloping to rolling soils that formed in glacial till consisting of sandy loam, loam, and silt loam. It is on low moraines in the uplands. The areas occur in the western two-thirds of Bruce Township and extend through the center of Washington Township and into Shelby Township. This is the most hilly part of the county. Next to the major drainageways are small areas that are steeper than elsewhere. This association covers about 7 percent of the county.

Lapeer soils make up about 35 percent of this association, Miami soils 30 percent, and Celina soils 10 percent. Lapeer and Miami soils are well drained, and Celina soils, which are below them on the landscape, are moderately well drained. The rest of the acreage consists of moderately well drained Dryden soils, well drained Sisson soils, somewhat poorly drained Locke soils, and many small, wet depressions that contain poorly drained mineral and organic soils.

This association is fairly well suited to crops, and most of it is cultivated. Some areas are in woodlots less than 40 acres in size, and some are in orchards. Most farms have a few areas that are too steep or too wet for cultivated crops. Control of erosion is the chief management problem.

Slope is the main limitation to use of these soils as residential and recreational areas. The limitation is slight on the gently sloping soils, but it is severe on the steeper soils. The slope causes difficulty in laying out streets and utility lines and in constructing houses.

Most of the soils are suitable for use as foundation material for houses, streets, and highways.

2. *Conover-Parkhill-Locke association*

Nearly level to gently sloping, somewhat poorly drained and poorly drained soils that have a moderately fine textured and medium-textured subsoil; on uplands

This association is made up of somewhat poorly drained and poorly drained, nearly level to gently sloping soils that formed in glacial till consisting of loam, silt loam, and sandy loam. It is on glacial till plains and moraines in the uplands. The areas occur in Richmond and Armada Townships, the northern part of Ray Township, and the eastern third of both Bruce and Washington Townships. The association also covers the large water-laid moraine that extends southward from the center of Lenox Township through the city of Mount Clemens. This part of the county is gently undulating and has broad drainageways and depressions. This association covers about 40 percent of the county.

Conover soils make up about 30 percent of this association, Parkhill soils 25 percent, and Locke soils 25 percent. The rest of the acreage is 10 percent Ensley soils and 10 percent small areas of Blount, Sims, Dryden, and Celina soils. Parkhill and Ensley soils are slightly lower on the landscape than the rest of the soils and are more poorly drained.

This association is one of the best in the county for crops. The soils in it are medium to high in fertility and respond readily to management. Nearly all areas have been cleared and are cultivated. Excessive wetness is the main limitation.

Excessive wetness and slow runoff are severe limitations to use of this association as residential and recreational areas. These limitations cause difficulty in laying out streets and utility lines and in constructing houses. Highways break up readily because of frost heaving and excessive wetness.

3. *Hoytville-Sims-Nappanee-Blount association*

Nearly level to gently sloping, poorly drained and somewhat poorly drained soils that have a dominantly fine textured subsoil; on uplands

This association is made up of poorly drained and somewhat poorly drained, nearly level to gently sloping soils that formed in glacial till consisting of clay loam, silty clay loam, or clay. It is on glacial till plains and moraines in the uplands. The areas occur in the northeastern corner and southern part of Richmond Township, in parts of Ray, Lenox, Macomb, and Chesterfield Townships, and on a water-laid moraine in the south-central part of the county. These parts of the county have broad drainageways and depressions. The association covers about 8 percent of the county.

Hoytville soils make up about 25 percent of this association, Sims soils 25 percent, Nappanee soils 20 percent, and Blount soils 20 percent. Hoytville and Sims soils, which are in drainageways and depressions, are poorly drained. Nappanee and Blount soils, which are in slightly higher areas, are somewhat poorly drained. The rest of the acreage consists of small areas of Conover, Parkhill, Locke, and Ensley soils, all of which are coarser textured than the major soils.

This association is well suited to crops. Drainage is a major problem, especially in areas of Hoytville and Sims soils. Water ponds in low places and hinders farmwork in spring and after rains. Drainage is difficult in some areas because suitable outlets are lacking and the soils are high in clay content.

Most of this association has severe limitations for use as residential and recreational areas. A high water table and poor surface drainage cause difficulty in laying out streets and utility lines and in constructing houses.

4. *Toledo-Paulding association*

Nearly level, poorly drained soils that have a fine-textured subsoil; on lake plains

This association is made up of poorly drained, nearly level soils that formed in lake-laid clay. The main area extends along Lake St. Clair from New Baltimore to the southern border of the county. The landscape ranges from slightly depressional to gently sloping. This association covers about 4 percent of the county.

Toledo soils make up about 45 percent of this association, and Paulding soils 40 percent. The rest of the acreage is made up of a few small areas of Brevort, Selfridge, and Lenawee soils.

This association has moderate limitations for farming because the soils are clayey and are difficult to drain. They are the finest textured soils in the county. The water table is near the surface in undrained areas, and the soils dry out slowly in spring and after rains. Planting and harvesting are difficult because farm machinery bogs down readily during wet periods.

Most of this association has severe limitations for use as residential and recreational areas. The high water table and the clayey soil material cause difficulty in laying out streets and utility lines and in constructing houses. Highways heave and crack readily because the soils swell when wet and shrink when dry.

5. *Lenawee-Corunna-Lamson association*

Nearly level, poorly drained soils that have a moderately fine textured to moderately coarse textured subsoil; on lake plains

This association is made up of poorly drained, nearly level soils that formed in lake-laid sediments and other sediments. It is on lake plains throughout the southern half of the county where the relief is slightly depressional to gently sloping. This association covers about 20 percent of the county.

Lenawee soils make up about 40 percent of this association, Corunna soils 30 percent, and Lamson soils 10 percent. These soils are level or nearly level, but Corunna soils generally are lower on the landscape and, in many places, are in natural drainageways. Lenawee soils have clay loam in the surface layer and upper part of the subsoil and silty clay loam in the lower part of the subsoil. Corunna soils have sandy loam in the surface layer and subsoil. Lamson soils have fine sandy loam in the surface layer and subsoil. The rest of the association consists of small areas of Brevort, Del Rey, Fulton, Minoa, Selfridge, and Toledo soils.

This association is well suited to crops. The water table is high, however, and drainage is the chief management problem. Water ponds in low places and hinders farmwork in spring and after rains. Drainage is difficult in some places because suitable outlets are lacking.

Most of this association has severe limitations for use as residential and recreational areas. The high water table and poor surface drainage cause difficulty in laying out streets and utility lines and in constructing houses.

6. *Oakville-Boyer-Spinks association*

Nearly level to hilly, well-drained soils that are coarse textured or moderately coarse textured throughout; on lake plains, beach ridges, and outwash plains

This association is made up of well-drained, nearly level to hilly soils that formed in lake-laid sediments, other sediments, and glacial outwash. The largest area is in the western part of Washington and Shelby Townships. Another area is a prominent ridge in the northern part of the county. The landscape is one of hilly areas, numerous narrow outwash plains, and small wet depressions. This association covers about 8 percent of the county.

Oakville soils make up about 60 percent of the association, Boyer soils 20 percent, and Spinks soils 10 percent. Boyer soils are underlain by sand and gravel; Oakville and Spinks soils are sand throughout. The remaining 10 percent of the acreage consists of small areas of Au Gres, Dryden, Gilford, and Wasepi soils.

Most of this association has severe limitations for use as cropland. Many areas are too steep or too sandy and generally are droughty in midsummer. The slopes, which are short and irregular, make contour farming and construction of terraces difficult.

Slope is the main limitation to use of this association as residential and recreational areas. The limitation is slight in the nearly level and gently sloping areas. It is severe in the steeper areas, where it is difficult to lay out streets and utility lines and to construct houses. Boyer soils are a potential source of sand and gravel and of good foundation material for houses, streets, and highways.

7. *Selfridge-Au Gres, loamy substratum-Metamora association*

Nearly level to gently sloping, somewhat poorly drained soils that have a coarse-textured to moderately fine textured subsoil; on lake plains and glacial till plains

This association is made up of somewhat poorly drained, nearly level to gently sloping soils that formed in sandy and loamy sediments underlain by finer textured material at a depth of 18 to 60 inches. It is chiefly in Macomb and Sterling Townships. This association covers about 6 percent of the county.

Selfridge soils make up about 40 percent of this association, Au Gres, loamy substratum, 30 percent, and Metamora soils 20 percent. Au Gres soils are underlain by loam to silty clay. Metamora and Selfridge soils are underlain by loam to silty clay loam. The remaining 10 percent of the acreage consists of small areas of Au Gres, Brevort, and Lenawee soils.

Large areas of this association are used for vegetables. Selfridge and Au Gres soils are low in natural fertility and are subject to soil blowing. All the soils need drainage.

Most areas have severe limitations for use as residential sites. A seasonal high water table limits the functioning of septic tank filter fields and causes wet basements. The underlying material makes a fair to poor foundation for buildings. The limitations for use as recreational areas are moderate. Depressions in the association are wet and dry out slowly in spring and after rains. The sandy areas are good for trails and campgrounds.

8. *Wasepi-Au Gres association*

Nearly level to gently sloping, somewhat poorly drained soils that are coarse textured or moderately coarse textured throughout; on outwash plains and lake plains

This association is made up of somewhat poorly drained, nearly level to gently sloping soils that formed in water-laid sand to sandy loam over sand or sand and gravel. The areas are on outwash plains and lake plains. The largest area is in the eastern part of Shelby and Sterling Townships. Another area extends from the town of Richmond southward through the center of Lenox Township. A third area is in the southwestern corner of the county. The association covers about 5 percent of the county.

Wasepi soils make up about 45 percent of this association, and Au Gres soils 40 percent. Wasepi soils are underlain by stratified sand and gravel; Au Gres soils are underlain by sand to a depth of 5 feet or more. The remaining 15 percent of the acreage consists of small areas of Boyer soils and of Au Gres and Oakville soils that have a loamy substratum.

Most of this association is cultivated. Fairly extensive areas are used for vegetables. Overcoming low fertility and controlling wetness are the main problems.

This association has moderate to severe limitations for use as residential sites. A seasonal high water table limits the functioning of septic tank filter fields and causes wet basements. Also, effluent moves rapidly through the sandy material and can contaminate a water supply that is near the surface. The limitations for use as recreational areas are moderate because depressions in this association are wet in spring and after heavy rains. Some areas are a good source of base material for trails, roads, and buildings.

9. *Cohoctah-Ceresco-Shoals-Sloan association*

Nearly level, poorly drained and somewhat poorly drained soils that are moderately coarse textured or medium textured throughout; on flood plains

This association is made up of poorly drained and somewhat poorly drained, nearly level soils that formed in material deposited by streams. It occurs along the major drainageways. The widest area borders the Clinton River and the North Branch. This association covers about 2 percent of the county.

Cohoctah soils make up about 25 percent of this association, Ceresco soils 20 percent, Shoals soils 20 percent, and Sloan soils 20 percent. The rest is about 10 percent Saranac soils and 5 percent small, mucky areas.

Excess wetness and meandering streams severely limit use of the association for crops. Flooding is common in spring and during wet periods.

The limitations for residential and recreational uses are severe. Periodic flooding causes damage to buildings, roads, and lawns and, at times, causes the malfunction of sewage systems.

Descriptions of the Soils

In this section the soils of Macomb County are described in detail. The procedure is to describe first 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 both the description of that unit and 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 publication.

The soil series contains a brief description of the surface layer, subsoil, and underlying material and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. The profile is considered typical, or representative, of all the mapping units of the series. If the profile of 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 assigns a 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 refers to that of the soil when moist.

Soil structure is an indication of the way the individual soil particles are arranged in larger clusters, 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 publication lists all of the mapping units in the county and shows the capability unit and the woodland suitability group. The page where each of these groups is described is also given.

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

Soil	Acres	Percent
Au Gres sand, 0 to 6 percent slopes	6,708	2.2
Au Gres sand, loamy substratum, 0 to 6 percent slopes	5,170	2.0
Blount loam, 0 to 2 percent slopes	6,229	2.0
Blount loam, 2 to 6 percent slopes	1,415	.5
Boyer loamy sand, 0 to 2 percent slopes	3,565	1.2
Boyer loamy sand, 2 to 6 percent slopes	4,278	1.4
Boyer loamy sand, 6 to 12 percent slopes	569	.2
Boyer sandy loam, 0 to 2 percent slopes	2,385	.8
Boyer sandy loam, 2 to 6 percent slopes	3,569	1.2
Boyer sandy loam, 6 to 12 percent slopes	809	.3
Boyer sandy loam, 12 to 18 percent slopes	583	.2
Boyer sandy loam, 18 to 25 percent slopes	190	(1)
Boyer gravelly loamy sand, loamy subsoil variant, 2 to 6 percent slopes	590	.2
Brevort-Selfridge complex	3,721	1.2
Celina loam, 0 to 2 percent slopes	768	.3
Celina loam, 2 to 6 percent slopes	2,880	.9
Ceresco fine sandy loam	2,025	.7
Cohoctah fine sandy loam	2,171	.7
Conover loam, 0 to 2 percent slopes	24,670	8.0
Conover loam, 2 to 6 percent slopes	2,054	.7
Corunna sandy loam	4,276	1.4
Del Rey loam, 0 to 2 percent slopes	4,618	1.5
Del Rey loam, 2 to 6 percent slopes	618	.2
Del Rey-Metamora sandy loams, 0 to 2 percent slopes	2,161	.7
Del Rey-Metamora sandy loams, 2 to 6 percent slopes	253	(1)
Dryden sandy loam, 0 to 2 percent slopes	1,848	.6

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

Soil	Acres	Percent
Dryden sandy loam, 2 to 6 percent slopes	1,273	.4
Edwards muck	130	([1])
Ensley-Parkhill complex	4,714	1.5
Fulton sandy loam, 0 to 2 percent slopes	453	.1
Fulton loam, 0 to 2 percent slopes	2,063	.7
Gilford sandy loam	3,175	1.0
Gilford sandy loam, silty subsoil variant	889	.3
Granby loamy fine sand	5,447	1.8
Hoytville clay loam	7,627	2.5
Lamson fine sandy loam	5,030	1.6
Lapeer sandy loam, 2 to 6 percent slopes	4,591	1.5
Lapeer sandy loam, 6 to 12 percent slopes	2,911	.9
Lapeer sandy loam, 12 to 18 percent slopes	632	.2
Lapeer sandy loam, 18 to 25 percent slopes	264	([1])
Lenawee clay loam	25,635	8.3
Lenawee-Selfridge complex	1,437	.5
Linwood muck	778	.3
Locke sandy loam, 0 to 2 percent slopes	11,006	3.6
Locke sandy loam, 2 to 6 percent slopes	383	.1
Locke very cobbly sandy loam, 0 to 6 percent slopes	159	([1])
Lupton muck	1,477	.5
Made land	5,579	1.8
Metamora fine sandy loam, 0 to 2 percent slopes	2,710	.9
Metamora fine sandy loam, 2 to 6 percent slopes	417	.1
Metea sand, 0 to 2 percent slopes	384	.1
Metea sand, 2 to 6 percent slopes	670	.2
Miami loam, 2 to 6 percent slopes	3,069	1.0
Miami loam, 6 to 12 percent slopes	3,105	1.0
Miami loam, 12 to 18 percent slopes	623	.2
Miami loam, 18 to 25 percent slopes	136	([1])
Minoa fine sandy loam, 0 to 4 percent slopes	2,732	.9
Nappanee loam, 0 to 2 percent slopes	884	.3
Nappanee clay loam, 0 to 2 percent slopes	4,424	1.4
Nappanee clay loam, 2 to 6 percent slopes	1,289	.4
Oakville fine sand, 0 to 6 percent slopes	6,380	2.1
Oakville fine sand, loamy substratum, 0 to 6 percent slopes	2,839	.9
Parkhill loam	17,525	5.7
Paulding clay	2,225	.7
Sanitary land fill	851	.3
Saranac clay loam	1,346	.4
Selfridge fine sand, 0 to 2 percent slopes	17,680	5.8
Selfridge fine sand, 2 to 6 percent slopes	2,326	.8
Selfridge-Lamson complex, 0 to 2 percent slopes	910	.3
Selfridge-Lenawee complex, 0 to 4 percent slopes	2,200	.7
Shoals loam	1,212	.4
Sims clay loam	14,484	4.7
Sisson fine sandy loam, 2 to 6 percent slopes	608	.2
Sisson fine sandy loam, 6 to 12 percent slopes	111	([1])
Sloan loam	2,800	.9
Spinks loamy sand, 0 to 2 percent slopes	1,371	.5
Spinks loamy sand, 2 to 6 percent slopes	795	.3
Spinks loamy sand, 6 to 12 percent slopes	271	([1])
Tawas muck	599	.2
Toledo silty clay loam	16,705	5.4
Toledo clay	1,135	.4
Urban land	1,700	.6
Wasepi loamy sand, 0 to 2 percent slopes	2,301	.7
Wasepi loamy sand, 2 to 6 percent slopes	400	.1
Wasepi sandy loam, 0 to 2 percent slopes	4,393	1.3
Wasepi sandy loam, silty subsoil variant, 0 to 4 percent slopes	2,385	.8
Wasepi-Au Gres complex, 0 to 4 percent slopes	1,099	.4
Willette muck	43	([1])
Miscellaneous	6,927	2.2
Total	307,840	100.0

[1] Less than 0.1 percent.

Au Gres Series

The Au Gres series consists of somewhat poorly drained soils that formed in deep sand. These soils have nearly level to gentle slopes and occur throughout the county. Au Gres soils were mapped alone and also in a complex with the Wasepi soils.

The surface layer of a typical Au Gres soil is very dark gray sand about 8 inches thick. The subsurface layer, about 1 inch thick, is light brownish-gray, loose sand. The subsoil is dark-brown, yellowish-brown, and pale-brown, loose sand about 31 inches thick. The underlying material is light brownish-gray and gray, loose, neutral to calcareous sand.

Au Gres soils are moderate in organic-matter content and low in natural fertility. Permeability is very rapid, and the available moisture capacity is very low. Runoff is very slow. These soils are sometimes difficult to work because of a seasonal high water table.

The native vegetation consists of hardwoods, chiefly aspen, oak, and maple. Most areas are used for grain, hay, and pasture. Small areas are wooded or are idle.

A typical profile of Au Gres sand, 0 to 6 percent slopes, SE¼SW¼SE¼ sec. 12, T. 3 N., R. 12 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) sand; weak, fine, granular structure; very friable; many roots; slightly acid; abrupt, smooth boundary.

A2—8 to 9 inches, light brownish-gray (10YR 6/2) sand; single grain; loose; few roots; slightly acid; abrupt, wavy boundary.

B21ir—9 to 13 inches, dark-brown (10YR 3/3) sand; common, fine and medium, distinct mottles of light brownish gray (10YR 6/2); single grain; loose; few roots; slightly acid; clear, wavy boundary.

B22ir—13 to 24 inches, yellowish-brown (10YR 5/4) sand; many, fine, faint mottles of yellowish brown (10YR 5/6) and many, medium, distinct mottles of light brownish gray (10YR 6/2); single grain; loose; few roots; slightly acid; clear, wavy boundary.

B3—24 to 40 inches, pale-brown (10YR 6/3) sand; many, medium, distinct mottles of yellowish brown (10YR 5/6); single grain; loose; few roots; slightly acid; clear, wavy boundary.

C1—40 to 54 inches, light brownish-gray (10YR 6/2) sand; many, coarse, distinct mottles of yellowish brown (10YR 5/4); single grain; loose; neutral; clear, wavy boundary.

C2—54 to 72 inches, gray (10YR 6/1-5/1) sand; common, coarse, faint mottles of brown (10YR 5/3); single grain; loose; calcareous.

The solum is typically slightly acid in reaction but ranges from neutral to medium acid. It ranges from 30 to 60 inches in thickness. The Ap horizon ranges from very dark gray to very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) in color and from 7 to 9 inches in thickness. The A2 horizon is not present in some areas, but where it occurs, it ranges up to 2 inches in thickness. The B21ir horizon ranges from dark brown to dark yellowish brown (10YR 4/4) in matrix color and from 2 to 15 inches in thickness. Mottling in the B22ir horizon is yellowish brown and light brownish gray to gray (10YR 5/1-6/1). The thickness ranges from 8 to 20 inches. The B3 horizon ranges from pale brown to grayish brown (10YR 5/2) and yellowish brown (10YR 5/4-5/6) in matrix color and from 10 to 30 inches in thickness. The color of the C horizon ranges from light brownish gray and gray to grayish brown (10YR 5/2) and pale brown (10YR 6/3). The C horizon is neutral to calcareous. It does not occur in all places.

These somewhat poorly drained Au Gres soils formed in material similar to that giving rise to the well-drained Oakville soils and the poorly drained Granby soils.

Figure 2.—Rye used as a cover crop to reduce soil blowing. The soil is Au Gres sand, 0 to 6 percent slopes.

Au Gres sand, 0 to 6 percent slopes (AsB).—This soil occurs throughout the county. It is generally near the Oakville, Granby, and Locke soils.

Included with this soil in mapping were small areas of somewhat poorly drained Selfridge soils, Locke soils, and Au Gres soils, loamy substratum. Also included were areas of Granby, Ensley, and Lamson soils in shallow depressions and narrow natural drainageways and, in some areas, Oakville soils on slightly higher elevations.

This Au Gres soil is used mainly for grain, hay, and pasture. Some areas are wooded, and small areas are idle. The major limitations of this soil are a seasonal high water table, droughtiness after drainage, and the risk of soil blowing. Artificial drainage is required for nearly all uses of this soil. Cover crops (fig. 2) and windbreaks help to prevent soil blowing. Capability unit IVw-2 (5b); woodland suitability group L.

Au Gres sand, loamy substratum, 0 to 6 percent slopes (AuB).—This soil occupies areas on outwash plains and lake plains. It has a profile similar to the one described as typical of the series, except that at a depth ranging from 40 to 66 inches the underlying material is loam to silty clay. Permeability of the upper 40 to 66 inches is very rapid, whereas below this depth it is slow. The available moisture capacity is very low. Runoff is very slow, and natural fertility is low.

Included with this soil in mapping were areas of Selfridge soils, other Au Gres soils, Granby soils in depressions, and Oakville soils, loamy substratum, on low ridges.

This Au Gres soil is used primarily for vegetable crops, corn, wheat, oats, and hay. A seasonal high water table is the main limitation, and artificial drainage is needed. If drained, the upper 40 to 66 inches of this soil tends to be droughty in dry periods. Providing a regular supply of organic matter and maintaining fertility are the major concerns of management. Soil blowing is a hazard. Capability unit IVw-2 (5/2b); woodland suitability group L.

Blount Series

In the Blount series are nearly level to gently sloping, somewhat poorly drained soils on till plains and moraines. These soils are 20 to 40 inches deep to calcareous clay loam or silty clay loam glacial till.

The surface layer of a typical Blount soil is dark grayish-brown loam about 8 inches thick. The upper part of the subsoil, about 7 inches thick, is brown, firm silty clay loam mottled with yellowish brown. The lower part is grayish-brown, very firm silty clay mottled with yellowish brown. It is about 9 inches thick. The underlying material is gray, firm, calcareous silty clay loam with mottles of strong brown.

The Blount soils are high in natural fertility. Permeability is moderately slow, and the available moisture capacity is high. Runoff is slow to medium. A seasonal high water table limits the use of the soils in wet periods.

The native vegetation is hardwood forest, consisting mainly of elm, ash, hickory, soft maple, and basswood. Most areas are used for corn, wheat, oats, and legume-grass hay and pasture.

A typical profile of Blount loam, 0 to 2 percent slopes, in a pasture, NW¼SW¼SW¼ sec. 31, T. 5 N., R. 14 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam, pale brown (10YR 6/3) when dry; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

B21t—8 to 15 inches, brown (10YR 5/3) silty clay loam; common, fine, distinct mottles of yellowish brown (10YR 5/6); moderate, coarse, angular blocky structure; firm; slightly acid; gradual, wavy boundary.

B22tg—15 to 24 inches, grayish-brown (10YR 5/2) silty clay; common, medium, distinct mottles of yellowish brown (10YR 5/6); moderate, coarse, angular blocky structure; very firm; neutral; abrupt, wavy boundary.

Cg—24 to 36 inches, gray (5Y 5/1) silty clay loam; common, medium, distinct mottles of strong brown (7.5YR 5/6); weak, medium, angular blocky structure; firm; light-gray calcium carbonate concretions; calcareous.

The solum ranges from 20 to 40 inches in thickness but is generally from 24 to 36 inches thick. It ranges from slightly acid to neutral in reaction. The Ap horizon ranges from 7 to 9 inches in thickness. It ranges in structure from weak, fine, granular to weak, medium, subangular blocky. An A2 horizon of grayish brown (10YR 5/2) or brown (10YR 5/3) loam is present in some areas. The B22tg horizon ranges in color from dark grayish brown (10YR 4/2) to light brownish gray (10YR 6/2) and in texture from heavy clay loam to silty clay. The structure of the B horizon ranges from weak, fine, subangular blocky to moderate, coarse, angular blocky. The texture of the C horizon is clay loam or silty clay loam.

The clay content in the C horizon is lower in the Blount soils (27 to 34 percent) than in the Nappanee soils (35 to 48 percent). Though similar in texture to the Del Rey soils, which developed in stratified lacustrine deposits, the Blount soils developed in glacial till. Blount soils are finer textured in the B and C horizons than the Conover soils, which developed in loam or silt loam till. They are better drained than the poorly drained Sims soils and are not so gray in color as those soils.

Blount loam, 0 to 2 percent slopes (BlA).—This soil occurs on till plains and moraines. It has the profile described as typical of the series. The available moisture capacity is high, permeability is moderately slow, and runoff is slow. The natural fertility is high.

In some places on the outer edge of areas mapped as this soil, small areas of Nappanee and Conover soils were included in mapping. Also included were areas of Sims soils in depressions.

Most areas of this Blount soil are used for corn, wheat, oats, and legume-grass hay and pasture. A seasonal high water table, moderately slow permeability of the substratum, and a moderate shrink-swell potential are the main limitations. Artificial drainage is needed. Maintenance of fertility and drainage are the major management problems. Capability unit IIw–2 (1.5b); woodland suitability group J.

Blount loam, 2 to 6 percent slopes (BlB).—This soil is on till plains and moraines. Runoff is slow to medium. The surface layer is thinner and lighter in color than that described as typical of the series.

In some places on the outer edge of areas mapped as this soil, small areas of Conover and Nappanee soils were included in mapping. Also included were areas of Sims soils in depressions.

Most areas of this Blount soil are used for corn, wheat, oats, and legume-grass hay and pasture. A seasonal high water table, moderately slow permeability of the substratum, and a moderate shrink-swell potential are the main limitations. Artificial drainage is needed. Maintenance of fertility and adequate drainage are major concerns of management. Capability unit IIw–3 (1.5b); woodland suitability group J.

Boyer Series

Soils of the Boyer series formed on glacial outwash plains and on old beach ridges, mainly in the western part of the county. Calcareous sand and gravel are at a depth of 24 to 40 inches. These well-drained, moderately coarse textured soils have level to steep slopes.

The surface layer of a typical Boyer soil is dark-brown to brown sandy loam about 12 inches thick. The upper part of the subsoil, about 12 inches thick, is yellowish-brown to reddish-brown sandy loam. The lower part is reddish-brown gravelly sandy loam and is about 12 inches thick. The underlying material is pale-brown stratified sand and gravel.

Permeability of these soils is moderately rapid or rapid, and the available moisture capacity is medium. These soils tend to be droughty. Their natural fertility is moderately low.

The native vegetation is deciduous hardwoods, chiefly oak, hickory, and maple. These soils are used mainly for vegetable crops, corn, wheat, soybeans, and hay. The stronger slopes are wooded or are in permanent pasture. Many areas have been used as a source of gravel.

A typical profile of Boyer sandy loam, 2 to 6 percent slopes, in an idle field 200 feet south of the northwest corner, SW¼ sec. 16, T. 4 N., R. 12 E. This soil profile, taken from a roadside bank, was sampled for mechanical analysis. The high pH in the solum is from road dust.

Ap—0 to 7 inches, dark-brown (10YR 4/3) sandy loam; weak, medium, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

A2—7 to 12 inches, brown (10YR 5/3) sandy loam; weak, fine, subangular blocky structure; friable; very dark grayish-brown (10YR 3/2) coatings and stains; mildly alkaline; clear, wavy boundary.

B1—12 to 16 inches, yellowish-brown (10YR 5/4) sandy loam; weak, fine, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.

B21—16 to 24 inches, reddish-brown (5YR 4/4) sandy loam; weak, medium, subangular blocky structure; firm; mildly alkaline; clear, wavy boundary.

B22t—24 to 30 inches, reddish-brown (5YR 4/3) gravelly heavy sandy loam; weak, medium, subangular blocky structure; firm; thin continuous clay films of dark brown (7.5YR 4/4); mildly alkaline; clear, wavy boundary.

B23—30 to 36 inches, reddish-brown (5YR 4/3) gravelly sandy loam; weak, medium, subangular blocky structure; firm; neutral, abrupt, irregular boundary.

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

The solum ranges from 24 to 40 inches in thickness and from slightly acid to mildly alkaline in reaction. The A horizon ranges from dark brown to dark gray (10YR 4/1) to brown in color and from loamy sand to sandy loam in texture. The B1 horizon is yellowish-brown (10YR 5/6-5/4) loamy sand to sandy loam. It has granular to subangular blocky structure and friable to very friable consistence. The B2 horizon includes hues of 7.5YR and 5YR, a value of 4, and a chroma of 3 or 4. The texture of the B2 horizon is sandy loam to heavy sandy loam and may contain gravel. The IIC horizon ranges from grayish brown or pale brown to light yellowish brown (10YR 6/4) in color and consists of stratified sand and gravel.

The Boyer soils have a finer textured B2 horizon than the Oakville soils.

Boyer loamy sand, 0 to 2 percent slopes (BrA).—This soil occupies glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series, except that the surface layer is loamy sand and the subsoil is thinner and contains less gravel. In some areas the calcareous underlying sand and gravel material occurs at a depth greater than 40 inches. Runoff is very slow, infiltration is very rapid, and permeability is moderately rapid or rapid. The available moisture capacity is medium.

Included with this soil in mapping were small moderately eroded areas where the lighter colored subsoil is exposed at the surface. Also included were many small areas of Boyer sandy loam soils and Spinks soils.

This Boyer soil is used largely for corn, small grain, soybeans, hay, and pasture. Many areas are used as a source of gravel. Other uses are for building sites, woodland, and recreation and as wildlife habitat. Limitations are moderate because of droughtiness, the risk of soil blowing, and moderately low fertility. The fertility, organic-matter content, and available moisture capacity are slightly lower in this soil than in Boyer sandy loam soils. Soil blowing, which can be reduced by cover crops and windbreaks, is a greater hazard than on Boyer sandy loam soils. Green-manure crops and barnyard manure help to raise the organic-matter content, the fertility, and the available moisture capacity. Capability unit IIIs–3(4a); woodland suitability group M.

Boyer loamy sand, 2 to 6 percent slopes (BrB).—This soil is on glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series, except that the surface layer is loamy sand and the subsoil is thinner and contains less gravel. In some places the calcareous underlying sand and gravel material is at a depth greater than 40 inches. Permeability is moderately rapid or rapid, runoff is slow, and infiltration is very rapid. The available moisture capacity is medium.

Included with this soil in mapping were small moderately eroded areas where the lighter colored subsoil is exposed at the surface. Also included were strips of Boyer loamy sand, 6 to 12 percent slopes, along the streambanks and ridges and small areas of Spinks soils that occur at the outer edge of areas mapped as this soil.

This Boyer soil is used largely for corn, small grain, soybeans, hay, and pasture. Many areas are used as a source of gravel, and others are used for building sites, woodland, recreation, and wildlife habitat. Limitations are moderate because of droughtiness, the hazard of soil blowing, moderately low fertility, and low organic-matter content. The organic-matter content, fertility, and available moisture capacity are slightly lower in this soil than in Boyer sandy loam soils. The risk of soil blowing is greater than on Boyer sandy loam soils. Capability unit IIIs–4(4a); woodland suitability group M.

Boyer loamy sand, 6 to 12 percent slopes (BrC).—This soil occurs on glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series, except that the surface layer is loamy sand and the subsoil is thinner and contains less gravel. In some areas the calcareous underlying sand and gravel material occurs at a depth greater than 40 inches. The available moisture capacity is medium, and permeability is moderately rapid or rapid. Infiltration is moderately rapid, and runoff is slow.

Included with this soil in mapping were some eroded areas, which have a lighter colored surface layer. Some inclusions have gentle slopes, whereas others are on short slopes of 12 to 18 percent along streams and ridges. Many small sloping areas of Boyer sandy loam soils and Spinks loamy sand soils were also included.

This Boyer soil is used largely for corn, small grain, soybeans, hay, and pasture. Some areas are used as a source of gravel, and others are used for building sites, woodland, and recreation. The major limitation is the hazard of soil blowing. Other limitations—water erosion and droughtiness—are moderate. The fertility, organic-matter content, and available moisture capacity are slightly lower in this soil than in Boyer sandy loam soils. Capability unit IIIe–9 (4a); woodland suitability group M.

Boyer sandy loam, 0 to 2 percent slopes (BsA).—This soil is on glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series. In some areas, the calcareous underlying sand and gravel material occurs at a depth greater than 40 inches. This soil has medium available moisture capacity and moderately rapid or rapid permeability. Infiltration is very rapid, and runoff is slow.

Included with this soil in mapping were areas on slopes of 2 to 6 percent, a few moderately eroded areas that have the lighter colored subsoil exposed at the surface, and small areas of moderately eroded Boyer loamy sand soils. Areas of Spinks loamy sand soils were also included, especially on the outer edge of areas mapped as the soil.

This Boyer soil is used largely for corn, small grain, soybeans, hay, and pasture. Some areas are used as a source of gravel or borrow material for construction purposes. Other uses are for building sites, woodland, and recreation. The main limitation of this soil is droughtiness. Management to control soil blowing, reduce droughtiness, supply organic matter, and maintain fertility is less extensive on this soil than on Boyer loamy sand soils. The available moisture capacity is slightly higher than in the Boyer loamy sand soils. Capability unit IIIs–3 (4a); woodland suitability group M.

Boyer sandy loam, 2 to 6 percent slopes (BsB).—This soil occupies glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series. In some areas, calcareous sand and gravel material occurs at a depth greater than 40 inches. This soil has a medium available moisture capacity and moderately rapid or rapid permeability. Infiltration is very rapid, and runoff is slow.

Included with this soil in mapping were many small areas of Boyer loamy sand soils and Spinks soils. Along streams small inclusions having slopes of 6 to 12 percent are moderately eroded and have a lighter colored subsoil exposed at the surface.

This Boyer soil is used largely for corn, small grain, soybeans, hay, and pasture. Some areas are used as a source of gravel or borrow material for construction purposes. Other uses are for building sites, woodland, and recreation. The main limitation of this soil is droughtiness. Control of soil blowing, reducing droughtiness, regularly providing organic matter, and maintaining fertility are lesser management problems on this soil than on Boyer loamy sand soils. The available moisture capacity is slightly higher than in the Boyer loamy sand soils. Capability unit IIIs–4 (4a); woodland suitability group M.

Boyer sandy loam, 6 to 12 percent slopes (BsC).—This soil is on glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series. In some places, the depth to calcareous underlying sand and gravel is greater than 40 inches. This soil has a medium available moisture capacity and moderately rapid or rapid permeability. Infiltration is rapid, and runoff is slow.

Included with this soil in mapping were small areas of Boyer loamy sand soils and Spinks soils. Along streams and ridges, small moderately eroded areas having slopes of 12 to 18 percent were included. These eroded inclusions have a lighter colored subsoil, which is exposed at the surface. Some small gently sloping areas were also included.

This Boyer soil is used largely for corn, small grain, soybeans, hay, and pasture. Some areas are used as a source of gravel or borrow material for construction purposes. Other areas are used for building sites, woodland, and recreation. Droughtiness is a limitation of this soil. Management problems include regular additions of organic matter, maintaining fertility, and the control of soil blowing and water erosion. The organic-matter content, fertility, and available moisture capacity are slightly higher than in the Boyer loamy sand soils. Capability unit IIIe–9 (4a); woodland suitability group M.

Boyer sandy loam, 12 to 18 percent slopes (BsD).—This soil occupies moderately steep slopes on glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series. This soil has a medium available moisture capacity and moderately rapid or rapid permeability. Infiltration is moderately rapid, and runoff is medium.

In many places on the outer edge of areas mapped as this soil, small areas of Spinks loamy sand soils were included with this soil in mapping. Small areas of Boyer loamy sand soils having slopes of 6 to 25 percent were also included.

This Boyer soil is used largely for small grain, hay, and pasture. Some small areas are idle or are used for woodland, wildlife habitat, and recreation. Limitations of this soil are droughtiness and moderately steep slopes. Management problems include supplying organic matter, maintaining fertility, and control of soil blowing and water erosion. Capability unit IVe–9 (4a); woodland suitability group M.

Boyer sandy loam, 18 to 25 percent slopes (BsE).—This soil is on glacial outwash plains and old beach ridges. It has a profile similar to that described as typical of the series. This soil has a medium available moisture capacity and moderately rapid or rapid permeability. Infiltration is moderate, and runoff is medium.

Small moderately steep to very steep areas that are moderately eroded were included with this soil in mapping. These eroded areas are lighter in color because the subsoil has been mixed with the surface layer. Many small steep areas of Spinks loamy sand soils were also included.

This Boyer soil is used largely for pasture, woodland, or wildlife habitat. The management problems and limitations on this soil are severe. Steep slopes limit the use of equipment and increase the hazard of erosion. Droughtiness is also a limitation. Providing a regular supply of the organic matter and maintaining fertility are concerns of management. Capability unit VIe–2 (4a); woodland suitability group M.

Boyer Series, Loamy Subsoil Variant

The Boyer series, loamy subsoil variant, occupies nearly level to gently sloping areas on outwash plains, till plains, and lake plains. These are well drained to moderately well drained, moderately coarse textured soils that overlie calcareous sand and gravel. Calcareous loam to silty clay loam deposits occur at a depth of 20 to 40 inches.

The surface layer of a typical Boyer soil, loamy subsoil variant, is dark-brown gravelly loamy sand about

10 inches thick. The subsoil is about 22 inches thick. It grades from brown gravelly loamy sand and dark-brown gravelly sandy loam to light yellowish-brown sand. The upper substratum, about 5 inches thick, is brown, calcareous, loose sand and gravel. The lower substratum is light-gray, calcareous, firm silty clay loam with mottles of strong brown.

The Boyer soils, loamy subsoil variant, are moderately low in natural fertility. They have a medium available moisture capacity. Permeability is moderately rapid to a depth of about 20 to 40 inches, and below this, is slow. Runoff is slow.

The native vegetation consists of hardwoods, chiefly oak, hickory, and maple. These soils have been cleared and are used for corn, wheat, cats, and legume-grass hay.

A typical profile of Boyer gravelly loamy sand, loamy subsoil variant, on a slope of 3 percent, SE¼SW¼SE¼SE¼ sec. 5, T. 3 N., R. 14 E:

Ap—0 to 10 inches, dark-brown (10YR 4/3) gravelly loamy sand; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

B21—10 to 17 inches, brown (7.5YR 5/4) gravelly loamy sand; weak, fine, granular structure; very friable; neutral; gradual, wavy boundary.

B22t—17 to 28 inches, dark-brown (7.5YR 4/4) gravelly sandy loam; weak, coarse, granular structure; friable; neutral; abrupt, irregular bounday.

B3—28 to 32 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; mildly alkaline; abrupt, smooth boundary.

IIC1—32 to 37 inches, brown (10YR 5/3) sand and gravel; single grain; loose; calcareous; abrupt, smooth boundary.

IIIC2g—37 to 55 inches, light-gray (5YR 6/1) silty clay loam; common, medium, distinct mottles of strong brown (7.5YR 5/6); moderate, medium, angular blocky structure; firm; calcareous.

The reaction of the solum ranges from neutral to mildly alkaline. The Ap horizon ranges from dark brown to brown (10YR 5/3) in color. In some uncultivated areas, a yellowish-brown (10YR 5/4) A2 horizon is present. The B2 horizon ranges in color from brown (10YR 5/3) to dark yellowish brown (10YR 4/4) to dark brown. The IIC1 horizon occurs at a depth ranging from 14 to 36 inches and is 4 to 20 inches thick. The depth to the IIIC2g horizon ranges from 20 to 40 inches but is generally from 34 to 40 inches. The IIC2g horizon ranges from light gray to dark gray (N 4/0) in color and from loam to silty clay loam in texture.

The Boyer soils, loamy subsoil variant, are underlain at a depth of 20 to 40 inches by loam to silty clay loam, whereas the typical Boyer soils are underlain by calcareous sand and gravel. The upper horizons of these loamy subsoil variant soils have more gravel and are finer textured than those of the Metea soils.

Boyer gravelly loamy sand, loamy subsoil variant, 2 to 6 percent slopes (BvB).—This soil occupies areas on outwash plains, till plains, and lake plains. Dryden, Conover, Blount, and typical Boyer soils occur nearby.

Included with this soil in mapping were small areas of Blount, Conover, Dryden, Sisson, and other Boyer soils.

This soil has been cleared and is used for corn, wheat, oats, and hay. The main limitation is the slow permeability of the loam to silty clay loam material below a depth of 20 to 40 inches. This soil tends to be droughty in dry periods. The main management concerns are the regular additions of organic matter, the maintenance of fertility, and the control of soil blowing. Capability unit IIIs–4 (4/2a); woodland suitability group G.

Brevort Series

The Brevort series consists of level or nearly level, poorly drained soils that formed in sand and loamy sand underlain at a depth of 20 to 40 inches by loam to silty clay loam. These soils are on lowlands and in natural drainageways throughout the county. They are mapped in a complex with the Selfridge soils.

The surface layer of a typical Brevort soil is very dark grayish-brown loamy sand about 8 inches thick. The subsoil is dark-gray and light brownish-gray, very friable loamy sand and sand about 28 inches thick. The substratum is grayish-brown, friable, calcareous clay loam.

Brevort soils are high in organic-matter content and moderately low in natural fertility. The available moisture capacity is low in the sandy layers and high in the underlying material. Permeability is rapid in the sandy layers and slow in the underlying material. Runoff is very slow or ponded. The water table is high much of the year, and consequently, workability is sometimes difficult.

These soils are used largely for grain, hay, pasture, vegetable crops, sod production, and building sites. Small areas are wooded or are idle. Because of the high water table, artificial drainage is necessary for a good growth of crops.

A typical profile of Brevort loamy sand on a slope of 0 percent, in a cultivated field, NW¼SW¼SE¼ sec. 17, T. 3 N., R. 13 E.:

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

B21g—8 to 29 inches, dark-gray (10YR 4/1) loamy sand; few, fine, distinct mottles of yellowish brown (10YR 5/6); very weak, coarse, granular structure; very friable; few roots; very dark grayish-brown (10YR 3/2) loamy sand in root channels; slightly acid; clear, wavy boundary.

B22g—29 to 36 inches, light brownish-gray (10YR 6/2) sand; many, medium, distinct mottles of yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6); single grain; loose; few roots; very dark grayish-brown (10YR 3/2) loamy sand in root channels; neutral; abrupt, smooth boundary.

IICg—36 to 66 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct mottles of yellowish brown (10YR 5/4-5/6); massive; friable; thin silt varves that are 1 to 2 millimeters thick; calcareous.

The depth to calcareous loam to silty clay loam material ranges from 20 to 40 inches but is typically from 30 to 36 inches. The reaction of the solum is slightly acid to neutral. The color of the Ap horizon ranges from very dark grayish brown to very dark gray (10YR 3/1) and very dark brown (10YR 2/2). The matrix color of the B horizon ranges from dark gray and light brownish gray to gray (10YR 5/1–6/1), light gray (10YR 7/2), or grayish brown (10YR 5/2). The texture of the B horizon ranges from loamy sand to sand. The matrix color of the IICg horizon ranges from grayish brown to gray (N6/0). The texture of this calcareous horizon ranges from loam to silty clay loam but is typically clay loam.

The Brevort soils have coarser textured A and B horizons than the Corunna soils.

Figure 3.—**An area of Brevort-Selfridge complex used for the production of sod crops.**

Brevort-Selfridge complex (0 to 2 percent slopes) (Bx).—This complex consists of level and nearly level soils on lowlands and in natural drainageways throughout the county. The Brevort soil makes up nearly 75 percent of this complex, and the Selfridge soil, nearly 25 percent. The Selfridge soil occurs throughout the complex but is too small in area to be mapped separately. In most places, the Selfridge soil has a slight rise in elevation. The soils of this complex have a profile similar to the one described as typical of their respective series. The Brevort soil is poorly drained, and the Selfridge, somewhat poorly drained.

Included with this complex in mapping were small areas of somewhat poorly drained Metamora soils on knolls and slight rises. Also included were areas of the poorly drained Corunna, Granby, and Lamson soils and Gilford soils, silty subsoil variant, all of which occur inconsistently throughout the complex.

This soil complex is used largely for corn, small grain, hay, pasture, sod production (fig. 3), and vegetable crops. Some small areas are idle, are wooded, or are used as wildlife habitat. Strawberries and raspberries are grown on some areas. Limitations are moderate because of the high water table much of the year. Artificial drainage is a major management requirement for all uses. Crop yields are generally considerably higher on drained areas than on undrained ones. Management that provides regular additions of organic matter, maintains fertility, and controls soil blowing is helpful. Capability unit IIIw–10 (4/2c); woodland suitability group S.

Celina Series

In the Celina series are nearly level to gently sloping, moderately well drained, medium-textured soils that developed in calcareous loam glacial till. These soils occupy areas on till plains and moraines.

The surface layer of a typical Celina soil is dark grayish-brown loam about 8 inches thick. The subsoil, about 21 inches thick, is brown, friable loam grading to dark yellowish-brown and dark-brown, friable to firm clay loam that contains mottles of yellowish brown. Dark grayish-brown mottles are in the lower subsoil. The underlying material is yellowish-brown, friable, calcareous loam with mottles of faint yellowish brown.

The Celina soils are moderately high in natural fertility. They have a high available moisture capacity and moderate or moderately slow permeability. Runoff is slow on nearly level areas and medium on the gentle slopes. Infrequently during very wet seasons, the water table is high.

The native vegetation consists of hardwoods, mainly oak, maple, hickory, and ash. Most areas of these soils are used for corn, wheat, oats, and hay. Large areas in the north-central and northwestern parts of the county are in fruit orchards.

A typical profile of Celina loam on a slope of 3 percent, in an idle field, SW¼SE¼SW¼ sec. 3, T. 4 N., R. 12 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; many fine roots; slightly acid; abrupt, smooth boundary.

B1—8 to 11 inches, brown (10YR 4/3) loam; weak, medium, granular structure; friable; many fine roots; neutral; abrupt, wavy boundary.

B21t—11 to 17 inches, dark yellowish-brown (10YR 4/4) clay loam; common, medium, faint mottles of yellowish brown (10YR 5/6); moderate, medium, subangular blocky structure; firm; few medium and fine roots; dark-brown (7.5YR 4/2) clay films on some ped faces; neutral; gradual, wavy boundary.

B22t—17 to 24 inches, dark yellowish-brown (10YR 4/4) clay loam; common, medium, faint mottles of yellowish brown (10YR 5/4) and few, fine, faint mottles of dark grayish brown (10YR 4/2); moderate, medium, subangular blocky structure; firm; few medium and fine roots; dark-brown (7.5YR 4/2) clay films on many ped faces; neutral; gradual, wavy boundary.

B23t—24 to 29 inches, dark-brown (10YR 4/3) clay loam; common, medium, faint mottles of yellowish brown (10YR 5/6) and few faint mottles of dark grayish brown (10YR 4/2); moderate, medium, subangular blocky structure; firm; few medium and fine roots; dark-brown (7.5YR 4/2) clay films on some ped faces; neutral; clear, wavy boundary.

C—29 to 60 inches, yellowish-brown (10YR 5/4) loam; common, medium, faint mottles of yellowish brown (10YR 5/6); massive; friable; few medium and fine roots to a depth to 31 inches; calcareous.

The solum is typically 20 to 36 inches thick but ranges from 18 to 42 inches in thickness. It ranges from medium acid to neutral in reaction. In some undisturbed areas, a thin A2 horizon of brown (10YR 5/3) loam is present. The texture of the B horizon ranges from loam to light silty clay loam. Mottling occurs at a depth ranging from 9 to 24 inches, and in some areas, faint mottling is in the B1 horizon.

Celina soils are finer textured than the Dryden soils, which developed in sandy loam glacial till. They are better drained and less mottled than the Conover soils and more poorly drained than the Miami soils.

Celina loam, 0 to 2 percent slopes (CeA).—This soil occupies areas on till plains and moraines throughout the county. Runoff is slow and infiltration is moderate. Permeability is moderate or moderately slow, and the available moisture capacity is high. The quantity of stones varies from few to many.

Included with this soil in mapping were some small areas of the well drained Miami, Lapeer, and Spinks soils on knolls and small areas of the moderately well drained Dryden soils. Also included were some areas of the somewhat poorly drained Conover, Locke, and Minoa soils and of the poorly drained Parkhill, Ensley, and Sims soils in wet spots, in depressions, and in drainageways. Some inclusions have a sandy loam surface layer; others have slopes of 2 to 6 percent.

This Celina soil is used largely for corn, small grains, hay, pasture, vegetable crops, and peach and apple orchards. Some small areas are idle, are wooded, or are used for building sites. Limitations are slight and relatively easy to overcome. Seep spots and wet spots remain wet later in spring than on better drained soils of similar texture, mainly because of the seasonal high water table. The poorly drained and somewhat poorly drained areas, the wet spots, and the seep spots require random tiling and minimum tillage. This soil becomes hard and cloddy if worked when wet. Management that regularly supplies organic matter, and maintains fertility and soil structure is helpful. Capability unit I–1 (2.5a); woodland suitability group B.

Celina loam, 2 to 6 percent slopes (CeB).—This soil is on till plains and moraines throughout the county. Runoff is medium, and infiltration is moderate. Permeability is moderate or moderately slow, and the available moisture capacity is high. A few to many stones are present.

Included with this soil in mapping were some small areas of moderately well drained Dryden soils and, on the stronger slopes, small areas of the well drained Miami, Lapeer, Sisson, and Spinks soils. Also included were areas of the somewhat poorly drained Conover, Locke, Minoa, and Blount soils on foot slopes, on the upper edge of natural drainageways, and in depressions. In many areas, the poorly drained Parkhill, Ensley, Lamson, and Sims soils were included in wet spots, in wet depressions, and in narrow natural drainageways. Small areas were included that have a sandy loam surface layer and that have slopes of 0 to 2 percent.

This Celina soil is used chiefly for corn, small grain, hay, pasture, peach and apple orchards, and building sites. Some small areas are idle or are wooded. Limitations are slight and easy to overcome. The poorly drained and somewhat poorly drained areas and the seep spots require artificial drainage and minimum tillage for optimum crop production. If wet, this soil has poor bearing capacity for farm machinery, and it becomes hard and cloddy if worked. Management that maintains organic-matter content, fertility, and soil structure and controls water erosion is helpful. Capability unit IIe–2 (2.5a); woodland suitability group B.

Ceresco Series

The Ceresco series consists of level or nearly level, somewhat poorly drained, moderately coarse textured soils. These soils formed on flood plains of rivers and streams. They are subject to flooding one or more times each year. The quantity of deposition is highly variable.

The surface layer of a typical Ceresco soil is very dark grayish-brown fine sandy loam about 10 inches thick. The subsurface layer, also about 10 inches thick, is very dark grayish-brown, very friable fine sandy loam. The underlying material consists of yellowish-brown, pale-brown, and gray, very friable fine sandy loam over light brownish-gray sand. This material has mottles of yellowish brown, grayish brown, light gray, and brownish yellow.

The surface layer of these soils is moderate in organic-matter content. Infiltration is moderately rapid to rapid, permeability is moderately rapid, and the available moisture capacity is medium. Runoff is slow. The water table is intermittently high.

The native vegetation consists of elm, oak, maple, ash, willow, and grass. The high water table and periodic flooding restrict use of these soils largely to wildlife habitat and intermittent pasture.

A typical profile of Ceresco fine sandy loam in a level pasture, NW¼NW¼NW¼ sec. 1, T. 5 N., R. 14 E.:

A11—0 to 10 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, fine, granular structure; very friable; neutral; clear, smooth boundary.

A12—10 to 20 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, subangular blocky structure; very friable; neutral; clear, smooth boundary.

C1—20 to 29 inches, yellowish-brown (10YR 5/4) fine sandy loam; common, fine, faint mottles of yellowish-brown (10YR 5/6) and grayish brown (10YR 5/2) and few, fine, faint mottles of light gray (10YR 6/1); weak, medium, subangular blocky structure; very friable; neutral; abrupt, smooth boundary.

C2—29 to 40 inches, pale-brown (10YR 6/3) fine sandy loam; few, fine, faint mottles of light gray (10YR 6/1) and common, medium, distinct mottles of yellowish brown (10YR 5/4); weak, thin, platy structure; very friable; mildly alkaline; abrupt, smooth boundary.

C3g—40 to 48 inches, gray (5Y 6/1) fine sandy loam; common, fine, faint mottles of light gray (10YR 6/1) and common, fine, distinct mottles of brownish yellow (10YR 6/6); moderate, thin, platy structure; very friable; mildly alkaline; abrupt, smooth boundary.

C4—48 to 60 inches, light brownish-gray (10YR 6/2) sand; few, fine, distinct mottles of yellowish brown (10YR 5/5); single grain; loose; calcareous.

The A horizon ranges from 6 to 20 inches in thickness, from very dark gray (10YR 3/1) to very dark grayish brown in color, and from sandy loam to loam in texture. This horizon is calcareous in some areas. The C horizon ranges from neutral to moderately alkaline in reaction. It ranges from sand to fine sandy loam and has strata of coarser textured and finer textured alluvial sediments. The strata range from 1/2 inch to 6 inches in thickness and from none to six or more in number.

Ceresco soils are coarser textured than Shoals soils, which are somewhat poorly drained and medium textured. Ceresco soils are similar to Cohoctah soils, which are poorly drained.

Ceresco fine sandy loam (0 to 2 percent slopes) (Cf).—This soil occurs on flood plains throughout the county.

Included in mapping were spots of well-drained, coarse-textured soils on low ridges at the edges of streams, small areas where the surface layer is loam, poorly drained areas of Cohoctah soils in narrow depressions, and a few small spots of muck soils.

Nearly all of this Ceresco soil is wooded or is idle. A few areas are used for pasture, small grain, and turf sod. An intermittently high water table and frequent flooding are the major limitations. Capability unit Vw-3 (L-2c) ; woodland suitability group O.

Cohoctah Series

Soils of the Cohoctah series are level or nearly level, poorly drained, and moderately coarse textured. These soils formed on flood plains of rivers and streams. They are subject to flooding one or more times each year. The quantity of deposition is highly variable.

The surface layer of a typical Cohoctah soil is very dark gray fine sandy loam about 11 inches thick. The subsurface layer, about 7 inches thick, is very dark gray, friable fine sandy loam with mottles of yellowish brown. The underlying material is gray, friable fine sandy loam, which is underlain by gray, loose sand and gravel.

The surface layer of these soils is moderate in organic-matter content. Infiltration is rapid, permeability is moderately rapid, and the available moisture capacity is medium. Runoff is very slow to ponded. The water table is seasonally high.

The native vegetation consists of elm, oak, maple, ash, willows, grasses, and reeds. The high water table and periodic flooding restrict use of these soils mainly to wildlife habitat and intermittent pasture.

A typical profile of Cohoctah fine sandy loam in a nearly level idle field, NE¼NW¼NW¼ sec. 19, T. 3 N., R. 12 E.:

A11—0 to 11 inches, very dark gray (10YR 3/1) fine sandy loam; weak, medium, granular structure; friable; calcareous; abrupt, wavy boundary.

A12—11 to 18 inches, very dark gray (10YR 3/1) fine sandy loam; few, fine, distinct mottles of yellowish brown (10YR 5/4); weak, medium, granular structure; friable; calcareous; abrupt, smooth boundary.

C1g—18 to 36 inches, gray (5Y 5/1) fine sandy loam; common, medium, distinct mottles of brownish yellow (10YR 6/8) and few, fine, faint mottles of grayish brown (10YR 5/2); massive; friable; calcareous; clear, smooth boundary.

C2g—36 to 42 inches, gray (N 5/0) fine sandy loam; many, medium, distinct mottles of yellowish brown (10YR 5/4); massive; friable; calcareous; abrupt, smooth boundary.

C3g—42 to 60 inches, gray (10YR 5/1) sand and gravel; single grain; loose; calcareous.

The A11 horizon ranges from 10 to 15 inches in thickness and from very dark gray to dark brown (10YR 3/3) in color. The texture of the A horizon ranges from loam to sandy loam. Reaction throughout the profile ranges from neutral to moderately alkaline. The C1g and C2g horizons range from loamy fine sand to fine sandy loam in texture and contain strata of coarser textured and finer textured alluvial sediments. The strata range from 1/2 inch to 6 inches in thickness and from none to six or more in number.

The Cohoctah soils are coarser textured than the medium-textured Sloan soils and moderately fine textured Saranac soils but are similar to the Ceresco soils. Cohoctah, Sloan, and Saranac soils are poorly drained; Ceresco soils are somewhat poorly drained.

Cohoctah fine sandy loam (0 to 2 percent slopes) (Cm).—This soil is on flood plains of rivers and streams throughout the county. Flooding occurs one or more times each year. Infiltration is rapid.

Included with this soil in mapping were many areas of well-drained, coarse-textured soils on slightly higher elevations at the edges of streams, small areas with a loam surface layer, narrow strips of somewhat poorly drained Ceresco soils, and a few spots of muck soils.

Nearly all of this Cohoctah soil is wooded or is idle. A few areas are used for pasture or small grain. Ponds for wildlife and for irrigation are in a few places. A high water table and frequent flooding are the major limitations. Capability unit Vw-3 (L-2c); woodland suitability group O.

Conover Series

In the Conover series are level to gently sloping, somewhat poorly drained, medium-textured soils on moraines and glacial till plains. These soils developed in loamy glacial till and are less than 42 inches deep to carbonates.

The surface layer of a typical Conover soil (fig. 4) is dark-brown loam about 8 inches thick. The subsur-

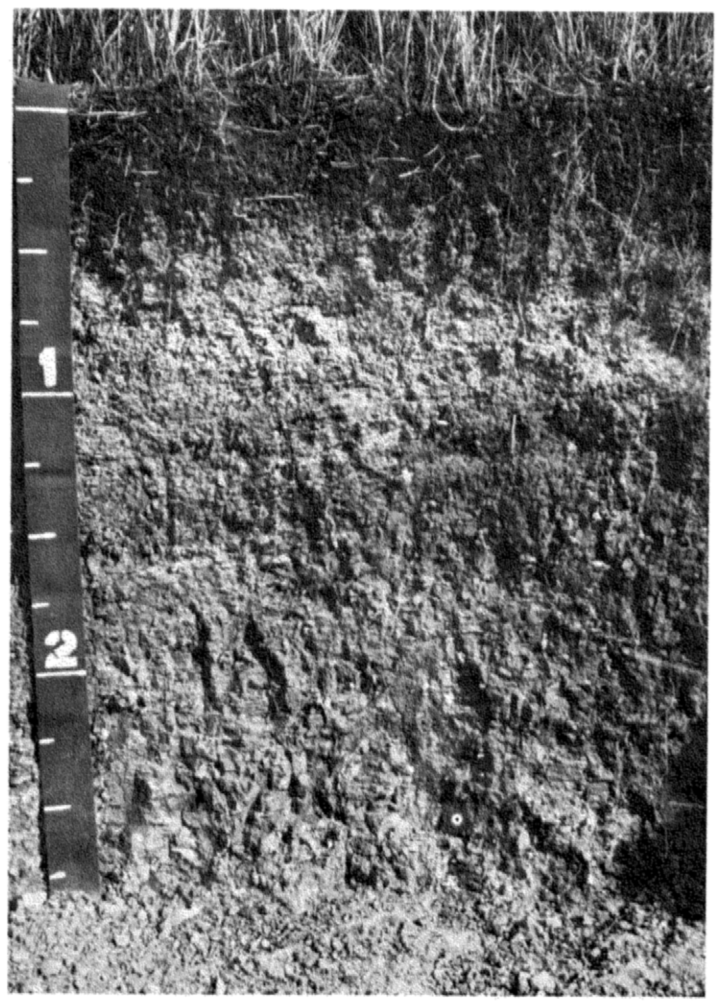

Figure 4.—Typical profile of Conover loam, 0 to 2 percent slopes, showing the dark-colored surface layer and depth of root penetration. The depth to limy material is less than 42 inches.

face layer, about 4 inches thick, is pale-brown, friable loam that contains mottles of brownish yellow. The subsoil is brown and grayish-brown, firm clay loam and is mottled with brownish yellow and grayish brown. It is about 18 inches thick. The substratum is brown, friable, calcareous loam with mottles of brownish yellow.

The Conover soils have moderately high and high natural fertility, moderate organic-matter content, and high available moisture capacity. Permeability is moderately slow, runoff is slow to medium, and infiltration is moderate. These soils are easily worked under proper moisture conditions, but because of a seasonal high water table, workability is difficult during the wet seasons.

The native vegetation consists of mixed hardwoods, including beech, elm, hickory, and maple. These soils are used for small grain, corn, beans, hay, and vegetable crops. Some areas are in pasture, are wooded, or are idle.

A typical profile of Conover loam, 0 to 2 percent slopes, in an idle field, NE¼SE¼SE¼ sec. 13, T. 5 N., R. 13 E.:

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

A2—8 to 12 inches, pale-brown (10YR 6/3) loam; few, fine, distinct mottles of brownish yellow (10YR 6/6); weak, fine, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B21t—12 to 17 inches, brown (10YR 5/3) light clay loam; common, medium, distinct mottles of brownish yellow (10YR 6/6) and common, fine, faint mottles of grayish brown (10YR 5/2); moderate, medium, subangular blocky structure; firm; few clay films; slightly acid; clear, wavy boundary.

B22tg—17 to 30 inches, grayish-brown (10YR 5/2) clay loam; common, medium, distinct mottles of brownish yellow (10YR 6/8); moderate, medium, subangular blocky structure; firm; clay films on many ped faces; neutral; abrupt, wavy boundary.

C—30 to 60 inches, brown (10YR 5/3) loam; common, medium, distinct mottles of brownish yellow (10YR 6/8); massive; friable; calcareous.

The Ap horizon ranges from dark brown to very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2–2/3) in color and from 7 to 9 inches in thickness. The Ap and A2 horizons range from silt loam to sandy loam in texture and are medium acid to slightly acid. The A2 horizon ranges from grayish brown (10YR 5/2) to pale brown in color and contains faint to distinct mottles. The color of the B horizon ranges from brown (7.5YR 5/4) and dark yellowish brown (10YR 4/4) to grayish brown. Present in these horizons are grayish-brown or light brownish-gray (10YR 6/2) coatings and mottles that range from light brownish gray (10YR 6/2) to yellowish brown (10YR 5/4) and brownish yellow. The C horizon is at a depth ranging from 20 to 42 inches and has a texture ranging from light loam to silt loam. In some places, the C horizon has a weak, coarse, subangular blocky structure.

Although they developed in similar material, the Conover soils are more poorly drained than the moderately well drained Celina and the well drained Miami soils but are better drained than the poorly drained Parkhill soils. The coarser textured Locke soils have a sandy loam C horizon in contrast to the loam to silt loam C horizon in the Conover soils. Blount soils have a finer textured B horizon than that of the Conover soils and a clay loam or silty clay loam C horizon.

Conover loam, 0 to 2 percent slopes (CvA).—Areas of this soil are on moraines and on glacial till plains. This soil has moderately slow permeability, slow runoff, and moderate infiltration. A seasonal high water table makes workability difficult during the wet seasons, but the soil is easily worked under proper moisture conditions. The organic-matter content is moderate, the natural fertility is moderately high and high, and the available moisture capacity is high.

Small areas of Locke, Blount, and Celina soils were included with this soil in mapping. In some areas, Parkhill, Ensley, and Sims soils were included in depressed areas and in natural drainageways. The surface layer is sandy loam in a few inclusions.

This Conover soil is used for small grain, corn, beans, hay, pasture, and vegetable crops. Some small areas are idle or wooded or used for recreational purposes. Limitations are a seasonal high water table, maintenance of soil structure, and poor trafficability under wet conditions. Artificial drainage is a major management requirement. Tillage under proper moisture conditions helps to maintain good soil structure. Capability unit IIw–4 (2.5b); woodland suitability group J.

Conover loam, 2 to 6 percent slopes (CvB).—This soil occupies areas on moraines and on glacial till plains. It has moderately slow permeability, medium runoff, and moderate infiltration. A seasonal high water table makes workability difficult during the wet seasons, but under the proper moisture conditions tillage is easy. The organic-matter content is moderate, natural fertility is moderately high, and the available moisture capacity is high.

Small areas of Locke, Blount, and Celina soils were included with this soil in mapping. Also included were areas of the poorly drained Parkhill, Ensley, and Sims soils in depressed areas and in drainageways. Some inclusions have a sandy loam surface layer.

This Conover soil is used for corn, beans, small grain, hay, pasture, and vegetable crops. Some small areas are idle or wooded or used for recreational purposes. A seasonal high water table, maintenance of soil structure, and poor trafficability under wet conditions are limitations. Artificial drainage is a major management requirement. A complete drainage system is difficult to design and lay out because of the undulating topography and short distances between natural drainageways. Surface drainage and interceptor tiles are used to remove excess water. Tillage under proper moisture conditions helps to maintain good soil structure. Capability unit IIw–5 (2.5b); woodland suitability group J.

Corunna Series

The Corunna series consists of nearly level or level, poorly drained, moderately coarse textured soils that are 18 to 40 inches deep to finer textured material. These soils are on lowlands throughout the county.

The surface layer of a typical Corunna soil is very dark gray sandy loam about 11 inches thick. The subsoil, about 25 inches thick, is grayish-brown and gray, friable sandy loam that is mottled with yellowish

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brown. The underlying material consists of gray, firm, calcareous silty clay loam. This material contains mottles of yellowish brown, light reddish brown, and light brown.

Corunna soils are high in organic-matter content and in natural fertility. The available moisture capacity is medium. Permeability is moderately rapid in the sandy loam layers and is moderately slow in the finer textured underlying material. Runoff is slow to ponded, and the water table is high much of the year. Consequently, workability is sometimes difficult.

The native vegetation consists of hardwood trees, chiefly elm, ash, hickory, oak, and aspen. Most areas are used for grain, hay, pasture, sod production, and vegetable crops. Small areas are wooded or are idle. Because of the high water table, artificial drainage is needed for a good growth of crops.

A typical profile of Corunna sandy loam in a cultivated field, SE¼SE¼SW¼ sec. 11, T. 3 N., R. 13 E.:

Ap—0 to 11 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, granular structure; very friable; many roots; neutral; abrupt, smooth boundary.

B21g—11 to 19 inches, grayish-brown (10YR 5/2) sandy loam; common, fine, faint mottles of gray (10YR 5/1) and common, fine, distinct mottles of yellowish brown (10YR 5/6); weak, fine, granular structure; friable; few roots; slightly acid; gradual, wavy boundary.

B22g—19 to 30 inches, gray (10YR 5/1) heavy sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/6); weak, coarse, granular structure; friable; neutral; gradual, wavy boundary.

B23g—30 to 36 inches, gray (10YR 6/1) sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/6) and few, medium, faint mottles of gray (10YR 5/1); weak, coarse, granular structure; friable; neutral; abrupt, wavy boundary.

IIC1g—36 to 46 inches, gray (5Y 6/1) silty clay loam; common, medium, prominent mottles of yellowish brown (10YR 5/8) and common, medium, distinct mottles of light reddish brown (5YR 6/4); massive; firm; mildly alkaline; gradual, wavy boundary.

IIC2g—46 to 60 inches, gray (5Y 5/1-6/1) silty clay loam; common, fine, prominent mottles of yellowish brown (10YR 5/8) and common, fine, distinct mottles of light brown (7.5YR 6/4); massive; firm; pockets and lenses of fine sand; calcareous.

The solum ranges from slightly acid to mildly alkaline in reaction. The Ap horizon ranges from very dark gray to very dark brown (10YR 2/2) in color and from sandy loam to loam or fine sandy loam in texture. The matrix color of the B21g horizon is grayish brown to gray (10YR 5/1). The texture of the B21g horizon ranges from sandy loam to fine sandy loam and loam. The B22g and B23g horizons include hues of 10YR, 2.5Y, and 5Y, a value of 5 or 6, and a chroma of 1 or 2. The texture of these horizons ranges from sandy loam to loam. In some places a 2- to 8-inch layer of heavy loamy sand occurs at a depth of 12 to 30 inches. The depth to the mildly alkaline or calcareous IIC horizon ranges from 18 to 40 inches. In many areas this horizon is calcareous directly below the B23g horizon. The IIC1g horizon ranges from loam to silty clay loam in texture. The gravel content is as much as 2 percent in some places, and there are a few cobblestones or boulders. In some areas where leaching has taken place in the finer textured IIC horizon, a moderate structure and thin clay films are in the upper few inches.

The Corunna soils have finer textured A and B horizons than the Brevort soils.

Corunna sandy loam (0 to 2 percent slopes) (Cw).—This soil occurs on lowlands and in natural drainageways throughout the county. It generally is near the Metamora, Del Rey, Conover, and Brevort soils.

In some places on the outer edge of areas mapped as this soil, small areas of Conover, Del Rey, and Brevort soils were included in mapping. Also included were small areas of Metamora soils, which are on slight rises.

This Corunna soil is used mainly for grain, hay, pasture, plants grown for sod, and vegetable crops. Small areas are wooded or are idle. Limitations are the high water table much of the year, the risk of soil blowing, and droughtiness where artificial drainage is excessive. Removal of excess water is a major management requirement for nearly all uses of this soil. If properly drained, this soil has slight limitations for farming. Cover crops and windbreaks help to reduce soil blowing. Capability unit IIw-8 (3/2c); woodland suitability group S.

Del Rey Series

In the Del Rey series are nearly level to gently sloping, somewhat poorly drained soils on lake plains. These soils formed in stratified lacustrine deposits of clay loam and silty clay loam that contain thin lenses of silt, fine sand, and clay. In this county the soils were mapped alone and in complexes with Metamora soils.

The surface layer of a typical Del Rey soil is very dark grayish-brown loam about 8 inches thick. The subsurface layer, about 3 inches thick, is grayish-brown, firm clay loam mottled with strong brown. The subsoil is about 18 inches thick. It is dark-gray silty clay mottled with brown in the upper part and gray silty clay loam mottled with yellowish brown in the lower part. The underlying material is gray, firm to friable, calcareous silty clay loam.

Del Rey soils are high in organic-matter content and in natural fertility. Infiltration is moderate, permeability is moderately slow, and the available moisture capacity is high. Runoff is slow. These soils are difficult to work because of a seasonal high water table and moderate to high shrink-swell potential, but they are easily worked when the moisture content is favorable.

The native vegetation consists of mixed hardwoods, among them beech, elm, hickory, and maple. Most areas are used for grain, hay, pasture, and vegetable crops, as well as building sites. Small areas are wooded or are idle.

A typical profile of Del Rey loam, 0 to 2 percent slopes, in a cornfield, NE¼NE¼NE¼ sec. 6, T. 2 N., R. 13 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam, light brownish gray (10YR 6/2) when dry; weak, very fine, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

A2—8 to 11 inches, grayish-brown (10YR 5/2) clay loam; common, fine, distinct mottles of strong brown (7.5YR 5/6); moderate, medium, angular blocky structure; firm; neutral; abrupt, wavy boundary.

B21tg—11 to 21 inches, dark-gray (10YR 4/1) silty clay; common, fine, distinct mottles of brown (10YR 4/3); strong, medium, angular blocky structure;

very firm; mildly alkaline; gradual, wavy boundary.

B22g—21 to 29 inches, gray (10YR 5/1) silty clay loam; common, fine, distinct mottles of yellowish brown (10YR 5/4); moderate, coarse, angular blocky structure; firm; yellowish-brown (10YR 5/6) silt coatings on ped surfaces; mildly alkaline; abrupt, wavy boundary.

C1g—29 to 38 inches, gray (5Y 5/1) silty clay loam; yellowish-brown (10YR 5/4) ped interiors; moderate, coarse, angular blocky structure; firm; calcareous; gradual, wavy boundary.

C2g—38 to 48 inches +, gray (5Y 5/1) and yellowish-brown (10YR 5/4) light silty clay loam; weak, medium, platy structure to massive; friable; calcareous.

The solum ranges from slightly acid to mildly alkaline in reaction. It ranges from 24 to 42 inches in thickness but commonly is 30 to 36 inches thick. The Ap horizon ranges from very dark grayish brown to dark gray (10YR 4/1) in color, from 7 to 10 inches in thickness, and from sandy loam to silt loam in texture. The thickness of the A2 horizon ranges from 3 to 6 inches, and the color, from grayish brown to pale brown (10YR 6/3). This layer is mottled with strong brown to yellowish brown (10YR 5/4). The B21tg horizon ranges from 10 to 14 inches in thickness, from dark gray to brown (10YR 5/3) in color, and from silty clay loam to silty clay in texture. The B22g horizon ranges from 6 to 8 inches in thickness, from gray to brown (10YR 5/3) in color, and from silty clay loam to silty clay in texture. Mottles in the B21tg horizon range from brown (10YR 4/3) to yellowish brown (10YR 5/4-5/6), and mottles in the B22g horizon range from yellowish brown (10YR 5/4) to brown (10YR 4/3). Thin varves of silt and very fine sand occur in the B22g horizon in some areas. The C horizon ranges from heavy silt loam to silty clay loam in texture and from weak, medium, angular blocky to weak, thin, platy in structure. In places, however, it is massive.

Del Rey soils formed in material similar to that giving rise to Lenawee soils, but the latter soils are poorly drained. Unlike Del Rey soils, which formed in stratified clay loam and silty clay loam, Minoa soils formed in stratified fine sand and very fine sand; Fulton and Toledo soils in lacustrine material consisting of silty clay, clay, or heavy silty clay loam; and Blount soils in unstratified glacial till consisting of clay loam to silty clay loam.

Del Rey loam, 0 to 2 percent slopes (DIA).—Areas of this soil surround or adjoin areas of Lenawee soils on nearly level lake plains. This soil has the profile described as typical of the series. Water collects on the surface after prolonged rains. Frost is a severe hazard because the soil is unstable as it thaws.

Included with this soil in mapping were sand spots generally less than one-half acre in size, small spots that have a surface layer of sandy loam or silt loam, and many areas of poorly drained Lenawee soils in shallow depressions.

Most areas of this Del Rey soil are used as cropland or are idle and covered with weeds and brush. Uncleared areas are in second-growth trees that vary in quality according to their past management. A seasonal high water table and moderately slow permeability are the major limitations. Tile drainage and shallow field ditches are needed in some places to prevent ponding. The surface layer becomes compact and cloddy if worked when too wet, and preparing a good seedbed is difficult. Capability unit IIw–2 (1.5b); woodland suitability group J.

Del Rey loam, 2 to 6 percent slopes (DIB).—This soil has a profile similar to the one described as typical of the Del Rey series. The soil is on the lake plains, generally near Lenawee soils and near soils that are sandy in the upper part and have underlying material that is not more than 27 to 37 percent clay.

***Figure 5.*—Eroded drainage ditch in an area of Del Rey loam, 2 to 6 percent slopes. Bottom of metal shaft on the spade handle shows original depth of the ditch.**

Included with this soil in mapping were small areas of Selfridge, Fulton, Minoa, and Metamora soils. Also included were areas of Lenawee, Toledo, and Corunna soils in depressions and in natural drainageways and areas that have a surface layer of silt loam or sandy loam.

Most areas of this Del Rey soil are used for corn, grain, hay, pasture, and vegetable crops and as building sites. Small areas are idle or are wooded. A seasonal high water table and moderate to high shrink-swell potential are major limitations. Working this soil is easy when the moisture content is favorable but is difficult during wet periods. Control of water erosion and maintenance of soil structure are management problems. Artificial drainage is needed for nearly all uses except woodland. If the side slopes and bottoms of roads and field ditches are left bare, erosion is a severe hazard (fig. 5). The eroded material fills culverts and tile lines and disables the drainage system. Capability unit IIw–3 (1.5b); woodland suitability group J.

Del Rey-Metamora sandy loams, 0 to 2 percent slopes (DmA).—The soils of this complex have a profile similar to the one described as typical of their respective series, except that the surface layer of each is sandy loam instead of loam, as it is in the typical Del Rey soil, or fine sandy loam, as it is in the typical Metamora soil. The Del Rey soil makes up nearly 75 percent of the mapping unit, and the Metamora soil, nearly 25 percent. These soils are on the lake plains, generally near Lenawee soils and near soils that are sandy in the upper part and have underlying material that is not more than 27 to 37 percent clay.

Included with these soils in mapping were small areas of Selfridge, Fulton, and Minoa soils. Also included were areas of Lenawee, Toledo, and Corunna soils in depressions and in natural drainageways and areas that have a surface layer of loam.

The soils are used for grain, hay, pasture, and vegetable crops and as sites for buildings and recreational areas. Small areas are idle or are wooded. A seasonal high water table and moderate to high shrink-swell potential are major limitations. Working the soils is easy when the moisture content is favorable but is difficult during wet periods. Artificial drainage is needed for nearly all uses. Control of soil blowing and maintenance of soil structure are problems. Cover crops and windbreaks help to control blowing. Plowing or cultivating when the soils are not too wet helps to maintain structure. Capability unit IIw-2 (1.5b, 3/2b); woodland suitability group J.

Del Rey-Metamora sandy loams, 2 to 6 percent slopes (DmB).—These soils have a profile similar to the one described as typical of their respective series, except that the surface layer of each is sandy loam instead of loam, as it is in the typical Del Rey soil, or fine sandy loam, as it is in the typical Metamora soil. The Del Rey soil makes up nearly 70 percent of the complex, and the Metamora soil, nearly 30 percent. These soils are on lake plains, generally near Lenawee soils and near soils that are sandy in the upper part and have underlying material that is not more than 27 to 37 percent clay.

Included with these soils in mapping were small areas of Selfridge, Fulton, and Minoa soils. Also included were areas of Lenawee, Toledo, and Corunna soils in depressions and natural drainageways.

These soils are used for grain, hay, pasture, and vegetable crops and as sites for buildings and recreational areas. Small areas are idle or are wooded. A seasonal high water table and moderate to high shrink-swell potential are major limitations. Working the soils is easy when the moisture content is favorable but is difficult during wet periods. Artificial drainage is needed for nearly all uses except woodland. Control of soil blowing and maintenance of soil structure are problems. Cover crops and windbreaks help to control blowing. Plowing or cultivating when the soils are not too wet helps to maintain structure. Capability unit IIw-3 (1.5b, 3/2b); woodland suitability group J.

Dryden Series

In the Dryden series are moderately well drained, moderately coarse textured soils on till plains and moraines, mainly in the northern part of the county. These nearly level to undulating soils developed in calcareous sandy loam glacial till.

The surface layer of a typical Dryden soil is dark grayish-brown sandy loam about 8 inches thick. The subsoil, about 22 inches thick, is yellowish-brown, friable sandy loam to brown, friable loam. Mottles in the lower part of the subsoil are faint yellowish brown and light brownish gray in color. The substratum is brown, friable, calcareous sandy loam.

Dryden soils are low in organic-matter content and medium in natural fertility. Infiltration is moderately rapid, permeability is moderate, and the available moisture capacity is medium. Runoff is medium. A seasonal high water table is infrequent.

These soils are used for grain, hay, and pasture, as building sites, and for some fruit and vegetable crops. Some small areas are idle or are wooded.

A typical profile of Dryden sandy loam on a slope of 3 percent in an idle meadow, NW¼NW¼NW¼ sec. 10, T. 4 N., R. 12 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, medium, subangular blocky structure; friable; many fine roots; slightly acid; abrupt, smooth boundary.

B1—8 to 14 inches, yellowish-brown (10YR 5/4) sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; few cobbles; slightly acid; clear, wavy boundary.

B21t—14 to 23 inches, brown (10YR 5/3) loam; weak, medium and coarse, subangular blocky structure; friable; few dark-brown (10YR 3/3) clay films; dark grayish-brown (10YR 4/2) worm casts; few fine roots; few cobbles; neutral; gradual, wavy boundary.

B22t—23 to 30 inches, brown (10YR 5/3) loam; common, fine, faint mottles of yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2); weak, coarse, subangular blocky structure; friable; few dark-brown (10YR 3/3) clay films on many ped faces; few fine roots; few cobbles; neutral; abrupt, wavy boundary.

C—30 to 60 inches, brown (10YR 5/3) sandy loam; common, fine and medium, faint mottles of yellowish brown (10YR 5/6), dark brown (10YR 4/3), and light brownish gray (10 YR 6/2); massive; friable; calcareous.

The solum ranges from medium acid to neutral in reaction. The color of the Ap horizon ranges from dark gray (10YR 4/1) to grayish brown (10YR 5/2). In some undisturbed areas, there is an A2 horizon of grayish-brown (10YR 5/2) sandy loam 1 inch to 4 inches thick. The texture of the B21t and B22t horizons ranges from light loam to light clay loam in some places. Depth to the C horizon ranges from 20 to 42 inches. In some areas the C horizon contains strata of sand and loamy sand.

The Dryden soils formed in material similar to that giving rise to the Lapeer, Locke, and Ensley soils, but the Dryden are more poorly drained and mottled than the well-drained Lapeer soils and are better drained than the somewhat poorly drained Locke and the poorly drained Ensley soils. Celina soils differ from Dryden soils in having a finer textured B horizon and a loam C horizon.

Dryden sandy loam, 0 to 2 percent slopes (DrA).—This soil is on till plains, moraines, and outwash plains in the northwestern part of the county. It is generally near the Celina, Sisson, and Locke soils. Its profile is similar to the one described as typical of the Dryden series. This soil has moderate permeability, medium runoff, moderately rapid infiltration, and medium available moisture capacity. The organic-matter content is low, and natural fertility is medium.

Included with this soil in mapping were small spots of the moderately well drained Celina soils and the well drained Sisson and Spinks soils. Also included, in small wet spots and depressions and in narrow natural drainageways, were areas of the somewhat poorly drained Locke, Minoa, and Conover soils and the poorly drained Ensley, Lamson, and Parkhill soils. Some inclusions have slopes of 2 to 6 percent, a loam surface layer, or small seep spots and springs.

Most areas of this Dryden soil are used for corn, small grain, hay, pasture, peach and apple orchards, and vegetable crops. Some small areas are idle, wooded, or used for building sites. Seasonal droughtiness and the infrequent high water table are limitations. Plowing is delayed because this soil is wet later in spring and slower to warm up than better drained soils of similar texture. Many wet spots, seep spots, and springs need random tiling to improve trafficability. Regularly supplying organic matter and maintaining fertility are management requirements. Capability unit IIs–2 (3a); woodland suitability group G.

Dryden sandy loam, 2 to 6 percent slopes (DrB).—This soil occupies areas on till plains, moraines, and outwash plains in the northwestern part of the county. It is generally near Celina, Sisson, and Locke soils. This soil has moderate permeability, medium runoff, moderately rapid infiltration, and medium available moisture capacity. The organic-matter content is low, and natural fertility is medium.

Small spots of moderately well drained Celina soils and well drained Sisson and Spinks soils were included with this soil in mapping. Also included, in wet depressions and in narrow natural drainageways, were areas of the somewhat poorly drained Locke, Minoa, and Conover soils and the poorly drained Ensley, Lamson, and Parkhill soils. Some small inclusions have slopes of 0 to 2 percent; others have slopes of 6 to 12; and still others are moderately eroded and have an exposed yellowish-brown subsoil.

This Dryden soil is used largely for corn, small grain, hay, pasture, peach and apple orchards, and vegetable crops. Some small areas are idle, wooded, or used for building sites. Limitations are the seasonal droughtiness and infrequent high water table. Plowing is delayed because this soil is wet later in spring and warms up slower than better drained soils of similar texture. Many spring areas, wet spots, seep spots, and wet depressions need random tiling. These undrained areas have poor trafficability for farm machinery and require minimum tillage to prevent surface hardening. Maintenance of the organic-matter content and fertility is a requirement. Capability unit IIe–3 (3a); woodland suitability group G.

Edwards Series

The Edwards series consists of poorly drained, shallow soils that formed in mixed woody and fibrous organic material that is from 12 to 40 inches thick over marl. These soils, which are nearly level, are in swamps, along waterways, and in depressions in the uplands.

The surface layer of a typical Edwards soil is black, friable muck about 13 inches thick. The underlying material is white, very friable marl.

Edwards soils are low in natural fertility. Permeability is rapid in the muck layers, if drained, and variable in the underlying marl. The available moisture capacity is very high. A high water table is at or near the surface most of the year. Workability is poor.

The native vegetation consists of white-cedar, elm, and maple. Most areas of this soil are wooded, are idle, or are in pasture.

A typical profile of Edwards muck in a level pasture, in the southeast corner, SW¼NW¼ sec. 22, T. 5 N., R. 12 E.:

1—0 to 13 inches, black (10YR 2/1) muck; weak, medium, granular structure; friable; calcareous; abrupt, smooth boundary.

IIC—13 to 42 inches, white (10YR 8/1) marl; massive; very friable; calcareous.

The thickness of the organic matter ranges from 12 to 40 inches but typically is 12 to 24 inches. The muck layer ranges from black to very dark brown (10YR 2/2) in color, from 12 to 18 inches in thickness, and from neutral to moderately alkaline in reaction. In some areas a layer of mucky peat, 6 to 30 inches thick, occurs under the muck. The color of the marl ranges from white to grayish brown (2.5Y 5/2).

The Edwards soils are similar to the Linwood, Tawas, and Willette soils, except that the kind of underlying material differs. The Linwood soils are underlain by loam, the Tawas soils by sand, and the Willette soils by clay. Edwards soils are thinner than Lupton soils, which consist of muck to a depth of more than 40 inches.

Edwards muck (0 to 2 percent slopes) (Ed).—This soil is in swamps, along waterways, and in depressions in the uplands. It has a profile similar to the one described as typical of the series. A high water table is at or near the surface most of the year. Runoff is very slow to ponded.

Small spots of Lupton, Tawas, and Linwood soils were included with this soil in mapping. Lupton soils have organic material greater than 40 inches thick. Tawas and Linwood soils have organic material less than 40 inches thick and are underlain by sand and loam, respectively.

Most of this Edwards soil is wooded, is in pasture, or is idle. A few areas are in general crops. The high water table, low natural fertility, and rapid oxidation of the muck if drained are major limitations. This soil has a low bearing capacity and is very unstable. Drainage outlets are difficult to obtain for many areas of this soil. Capability unit IVw–5 (M/3c); woodland suitability group U.

Ensley Series

In the Ensley series are poorly drained, moderately coarse textured soils. These soils, which are level or nearly level, occur in depressions on till plains and moraines. In Macomb County they were mapped in a complex with Parkhill soils.

The surface layer of a typical Ensley soil is very dark gray sandy loam about 9 inches thick. The subsoil is light-gray, gray, and grayish-brown, friable sandy loam and loam mottled with yellowish brown. It is about 28 inches thick. The substratum is light-gray and grayish-brown, friable sandy loam mottled with yellowish brown and strong brown. It is massive and calcareous.

Ensley soils are high in natural fertility. They have medium available moisture capacity and moderate permeability. Runoff is very slow or ponded.

The native vegetation consists of hardwood forest, including elm, ash, hickory, oak, and aspen. If adequately drained, areas of these soils are used for corn, wheat, oats, and hay. Undrained areas are generally in permanent pasture or are wooded.

A typical profile of Ensley sandy loam in a level cornfield, in the southeast corner, SE¼SE¼SW¼ sec. 26, T. 5 N., R. 13 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) sandy loam;

weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

B21g—9 to 17 inches, light-gray (10YR 6/1) sandy loam; few, fine, faint mottles of gray (10YR 5/1) and common, medium, distinct mottles of yellowish brown (10YR 5/4-5/6); weak, coarse, granular structure; friable; worm channels filled with very dark gray (10YR 3/1) sandy loam; neutral; gradual, wavy boundary.

B22g—17 to 25 inches, gray (5Y 5/1) loam; common, medium, distinct mottles of yellowish brown (10YR 5/8) and few, medium, distinct mottles of yellowish brown (10YR 5/4); weak, coarse, subangular blocky structure; friable, mildly alkaline; gradual, wavy boundary.

B3g—25 to 37 inches, grayish-brown (10YR 5/2) sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/4-5/8); weak, coarse, subangular blocky structure; friable; mildly alkaline; clear, wavy boundary.

C1g—37 to 44 inches, light-gray (5Y 6/1) sandy loam; many, coarse, prominent mottles of yellowish brown (10YR 5/6-5/8); massive; friable; calcareous; clear, wavy boundary.

C2g—44 to 60 inches, grayish-brown (10YR 5/2) sandy loam; few, medium, distinct mottles of yellowish brown (10YR 5/6) and few, medium, prominent mottles of strong brown (7.5YR 5/8); massive; friable; calcareous.

The solum ranges from slightly acid to mildly alkaline in reaction. The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color and from 6 to 9 inches in thickness. The texture of the B horizon ranges from sandy loam to loam. The depth to the calcareous sandy loam C horizon is 24 to 48 inches. The quantity of stones and cobblestones in the solum and C horizon varies greatly; it ranges from none to many. In some places thin layers or pockets of loamy sand or sand occur in the solum.

The Ensley soils differ from the Parkhill soils in that they have a coarser textured B horizon and formed in sandy loam till instead of loam or silt loam till. They are of similar texture but are more poorly drained than the somewhat poorly drained Locke soils, the moderately well drained Dryden soils, and the well drained Lapeer soils.

Ensley-Parkhill complex (0 to 2 percent slopes) (Ep).—This complex consists of level, nearly level, and depressional soils on till plains and moraines. It is made up of Ensley and Parkhill soils that occupy areas too small to be mapped separately. The Ensley soil makes up nearly 70 percent of the complex, and the Parkhill soil, nearly 30 percent. The soils of this complex have a profile similar to the one described as typical of their respective series. Runoff is very slow or ponded, and the water table is at or near the surface much of the year. Infiltration is moderate for the Ensley soil and slow for the Parkhill soil. Permeability is moderate in the Ensley soil and moderately slow in the Parkhill soil. The available moisture capacity is medium in the Ensley and high in the Parkhill.

Included with these soils in mapping were small areas of somewhat poorly drained Locke, Conover, and Metamora soils on knolls and small areas of Gilford, Lamson, and Granby soils. In some included areas, mostly in natural drainageways and in depressions, cobblestones ranging from 3 to 10 inches in diameter occupy 15 to 20 percent of the surface.

These soils are used largely for corn, small grain, soybeans, hay, and pasture. Small areas are used for vegetable crops and navy beans. Some areas are idle or are wooded. Because of the high water table, artificial drainage is needed for root development, trafficability, and good crop growth. Machinery operations involving plowing, cultivating, harvesting, and maintenance procedures are hindered by the cobbles. Management that regularly adds organic matter and maintains fertility and soil structure is helpful. Both soils in capability unit IIw-6 (2.5c, 3c); Ensley soil in woodland suitability group S; Parkhill soil in woodland suitability group P.

Fulton Series

Soils of the Fulton series are nearly level to gently sloping, somewhat poorly drained, and fine textured. These soils developed in calcareous lacustrine clay on the lake plains.

The surface layer of a typical Fulton soil is dark grayish-brown loam about 8 inches thick. The subsoil, about 28 inches thick, is partly brown, firm loam but is mostly grayish-brown, very firm silty clay. It is mottled with yellowish brown and strong brown. The underlying material is gray with grayish-brown variegations. It is firm and very firm, calcareous silty clay and clay with thin layers of silty clay loam and silt loam.

The Fulton soils are high in natural fertility. Permeability is slow, runoff is slow, and the available moisture capacity is high. A seasonal high water table limits use during wet periods.

The native vegetation consists of hardwoods, including elm, ash, hickory, soft maple, and basswood. Most areas of these soils are used for corn, wheat, oats, and hay. A few small areas are in permanent pasture or are wooded.

A typical profile of Fulton loam in a level area of bluegrass sod, NW¼NE¼NE¼NE¼ sec. 7, T. 2. N., R. 13 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, subangular blocky structure; friable; few, medium, distinct mottles of yellowish brown (10YR 5/6) on some peds; many fine roots; slightly acid; abrupt, smooth boundary.

B1—8 to 11 inches, brown (10YR 5/3) loam; common, fine, distinct mottles of yellowish brown (10YR 5/6); moderate, fine and medium, subangular blocky structure; firm; light brownish-gray (10YR 6/2) and light-gray (10YR 7/2) silt loam coatings on many peds; few fine roots; medium acid; clear, wavy boundary.

B21tg—11 to 19 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct mottles of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8); thin, patchy clay films of dark grayish brown; weak, medium, columnar structure to weak, medium, angular blocky structure; very firm; few fine roots; medium acid; gradual, wavy boundary.

B22g—19 to 30 inches, grayish-brown (10YR 5/2) silty clay; many, fine and medium, distinct mottles of yellowish brown (10YR 5/4-5/6-5/8); weak, medium, columnar structure to moderate, medium, angular blocky structure; very firm; few fine roots; neutral; gradual, wavy boundary.

B23g—30 to 36 inches, grayish-brown (10YR 5/2) silty clay; many, fine and medium, distinct mottles of yellowish brown (10YR 5/4-5/8) and many, fine and medium, faint mottles of brown (10YR 5/3); weak, medium, columnar structure to weak, medium, angular blocky structure; very firm; few fine roots; mildly alkaline; abrupt, wavy boundary.

C1g—36 to 42 inches, gray (10YR 5/1) silty clay; grayish-brown (10YR 5/2) variegations; weak, coarse, angular blocky structure; very firm; few fine roots, along structure planes; light-gray (10YR 7/2) calcium carbonate coatings on some peds; yellowish-brown (10YR 5/6) ped interiors; calcareous; abrupt, wavy boundary.

C2g—42 to 46 inches, gray (10YR 5/1), stratified silty clay, silty clay loam, and silt loam; many, medium, distinct mottles of yellowish brown (10YR 5/6); massive; firm; calcareous; abrupt, wavy boundary.

C3g—46 to 62 inches, gray (10YR 5/1) clay; grayish-brown (10YR 5/2) variegations; massive; very firm; light-gray (10YR 7/2) calcium carbonate streaks; many fine and medium mottles of yellowish brown (10YR 5/4-5/6) in interiors of stratified varves; calcareous.

The solum ranges from 24 to 48 inches in thickness and is typically from 30 to 42 inches deep. It ranges from medium acid to mildly alkaline in reaction. The Ap horizon ranges from dark gray (10YR 4/1) to very dark grayish brown in color and from 6 to 9 inches in thickness. In some undisturbed areas there is a grayish-brown (10YR 5/2) A2 horizon present. The A horizon ranges from sandy loam to loam in texture. The texture of the B2 horizon ranges from heavy silty clay loam to silty clay. In some areas thin layers of sand, silt, or light silty clay loam occur in the lower part of the B23g horizon. The texture of the C horizon ranges from heavy silty clay loam to clay.

The Fulton soils are finer textured than the Del Rey soils, which developed in lacustrine clay loam to silty clay loam. They formed in similar textured material as that giving rise to the Nappanee soils, but the Nappanee developed in glacial till and lack the stratification that is in the Fulton soils. They developed in material similar to the poorly drained Toledo soils but are better drained.

Fulton sandy loam, 0 to 2 percent slopes (FtA).—This soil has a profile similar to that described as typical of the series, but it has a sandy loam surface layer. It occupies areas on the lake plains. The available moisture capacity is high, and permeability is slow. Natural fertility is high.

Included with this soil in mapping were many small spots having a loam surface layer, a few areas with slopes of 2 to 6 percent, many small depressions containing poorly drained Toledo soils, and many shallow sand spots that are less than 18 inches thick.

Most areas of this Fulton soil are used for corn, wheat, oats, and hay. A few small areas are used for permanent pasture or are wooded. The main limitations are a seasonal high water table, slow permeability, and high shrink-swell potential. Trafficability and workability are fair. The surface layer dries out and warms up more rapidly in spring and after rains than that of the Fulton loam soil. Artificial drainage is needed for a good growth of crops. Maintaining fertility and improving drainage are the major management concerns. Capability unit IIIw–2 (1b); woodland suitability group J.

Fulton loam, 0 to 2 percent slopes (FuA).—This soil is on the lake plains. It has a high available moisture capacity and slow permeability. Natural fertility is high. This soil has the profile described as typical of the series.

Included with this soil in mapping were many small spots having a sandy loam or silt loam surface layer, small spots of the slightly coarser textured Del Rey soils, and shallow sand spots that are less than 18 inches thick. Also included were poorly drained Toledo soils in many small depressions and a few areas having slopes of 2 to 6 percent.

Most areas of this Fulton soil are used for corn, wheat, oats, and hay. A few small areas are used for permanent pasture or are wooded. The main limitations are the seasonal high water table, the slow permeability, and the high shrink-swell potential. Trafficability and workability are poor if the soil is wet. Artificial drainage is needed for good crop growth. Maintenance of fertility and improved drainage are the major needs of management. Capability unit IIIw–2 (1b); woodland suitability group J.

Gilford Series

The Gilford series consists of poorly drained, moderately coarse textured soils. These soils are nearly level and depressional; they occupy outwash plains and lake plains. Calcareous stratified sand and gravel occur at a depth ranging from 20 to 40 inches.

The surface layer of a typical Gilford soil is very dark gray sandy loam about 10 inches thick. The subsoil is gray, friable sandy loam and grayish-brown, friable gravelly sandy loam. It is about 20 inches thick and contains yellowish-brown mottles in the lower part. The substratum is light-gray, loose, calcareous gravelly sand.

The Gilford soils are moderately low in natural fertility. They have a medium available moisture capacity above a depth of 20 to 40 inches; below this depth it is very low. Permeability is moderately rapid in the upper 20 to 40 inches and rapid below this depth. Runoff is very slow or ponded.

The native vegetation consists of marsh grasses, reeds, sedges, and water-tolerant trees. Most areas of these soils are used for vegetable crops, corn, wheat, oats, and hay. A few undrained areas are in permanent pasture or second-growth forest.

A typical profile of Gilford sandy loam in a level area of an idle field, NW¼NW¼NE¼NE¼ sec. 6, T. 2 N., R. 12 E.:

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

B1g—10 to 14 inches, gray (10YR 5/1) sandy loam; common, fine, faint mottles of grayish brown (10YR 5/2); weak, medium, subangular blocky structure; friable; few roots; very dark gray (10YR 3/1) sandy loam in root channels; mildly alkaline; clear, wavy boundary.

B2g—14 to 30 inches, grayish-brown (10YR 5/2) gravelly sandy loam; many, fine and medium, distinct mottles of yellowish brown (10YR 5/6); weak, medium, subangular blocky structure; friable; few roots; mildly alkaline; abrupt, wavy boundary.

IICg—30 to 50 inches, light-gray (10YR 6/1) gravelly sand; common, coarse, faint mottles of brown (10YR 5/3); single grain; loose; calcareous.

The solum ranges from 20 to 40 inches in thickness, but it is typically 30 to 36 inches thick. The reaction of the solum ranges from slightly acid to mildly alkaline. The Ap horizon ranges from black (N 2/0) to very dark grayish brown (10YR 3/2) in color and from loamy sand to sandy loam in texture. The texture of the B2g horizon ranges from sandy loam to loam in texture. In some areas B1 and B3 horizons of loamy sand occur. The IICg horizon is light gray to gray (5Y 6/1) in color and contains thin strata of silt or silty clay loam in some places.

The Gilford and Wasepi soils developed in similar material, but the Gilford are more poorly drained than the somewhat poorly drained Wasepi. The Gilford soils are finer textured than the Granby because they formed in calcareous gravelly sand, whereas the Granby formed in deep sand.

Gilford sandy loam (0 to 2 percent slopes) (Gd).—This soil occurs on nearly level areas and in depressions on outwash plains and lake plains. Runoff is very slow or ponded. Permeability is moderately rapid in the upper 20 to 40 inches and rapid below this depth. The available moisture capacity is medium. The water table is high. Natural fertility is moderately low.

Included with this soil in mapping were many small areas of somewhat poorly drained Wasepi soils on slight rises and poorly drained Gilford soils, silty subsoil variant.

Drained areas of this soil are used for corn, wheat, oats, hay, and vegetable crops. Undrained areas are in permanent pasture or second-growth forest or are idle. The main limitation is the high water table. If drained, this soil tends to be somewhat droughty. Capability unit IIIw–6 (4c); woodland suitability group S.

Gilford Series, Silty Subsoil Variant

In the Gilford series, silty subsoil variant, are poorly drained, moderately coarse textured soils. These soils are 20 to 40 inches thick to calcareous sand and gravel material, which is underlain by sand and silt. They occupy level or nearly level to depressional areas on outwash plains and lake plains.

The surface layer of a typical Gilford soil, silty subsoil variant, is very dark gray sandy loam about 10 inches thick. The upper part of the subsoil, about 15 inches thick, is grayish-brown, friable sandy loam mottled with yellowish brown and faint gray. The lower part of the subsoil is gray, friable heavy sandy loam with yellowish-brown mottles and is about 7 inches thick. The upper part of the substratum is light-gray, loose sand and gravel about 6 inches thick. The lower part of the substratum is light-gray and gray, friable, stratified fine sand, very fine sand, and silt.

These soils are moderately low in natural fertility. They have a medium available moisture capacity. Permeability is moderately rapid in the upper layers and slow in the underlying material. Runoff is very slow or ponded, and the water table is high. Undrained areas are wet most of the year; consequently, root development of plants is limited and the operation of machinery is hindered.

The native vegetation consists chiefly of elm, black ash, aspen, marsh grasses, reeds, and sedges. Drained areas of these soils are used for vegetable crops, corn, wheat, oats, and hay. Undrained areas are in permanent pasture or are wooded.

A typical profile of Gilford sandy loam, silty subsoil variant, in a level area, SW¼NE¼NW¼ sec. 4, T. 2 N., R. 12 E.:

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

B1g—10 to 17 inches, grayish-brown (10YR 5/2) sandy loam; few, fine, faint mottles of gray (10YR 5/1) and few, fine, distinct mottles of yellowish brown (10YR 5/6); weak, medium, granular structure; friable; very dark gray (10YR 3/1) sandy loam in root channels; few roots; neutral; clear, wavy boundary.

B21g—17 to 25 inches, grayish-brown (10YR 5/2) sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/8); weak, medium, granular structure; friable; few roots; neutral; gradual, wavy boundry.

B22tg—25 to 32 inches, gray (5Y 5/1) heavy sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/6); weak, fine, subangular blocky structure; friable; few roots; mildly alkaline; abrupt, smooth boundary.

IIC1g—32 to 38 inches, light-gray (10YR 6/1) sand and gravel; single grain; loose; calcareous; abrupt, smooth boundry.

IIIC2g—38 to 42 inches, light-gray (5Y 6/1) fine sand and silt; few, medium, distinct mottles of pale brown (10YR 6/3); massive; friable; stratified; calcareous; abrupt, smooth boundary.

IIIC3—42 to 60 inches, gray (N 6/0) very fine sand and silt; massive; friable; stratified; calcareous.

The Ap horizon ranges from loamy sand to sandy loam in texture, from 10 to 14 inches in thickness, and from very dark gray to black (10YR 2/1) in color. The texture of the B horizon ranges from heavy loamy sand to clay loam. The reaction of the solum is slightly acid to mildly alkaline. The IIC horizon is at a depth ranging from 16 to 32 inches, and its thickness ranges from 2 to 20 inches. The depth to the IIIC horizon ranges from 18 to 42 inches.

These soils are underlain by silt and very fine sand at a depth of 20 to 40 inches, whereas the typical Gilford soils are underlain by stratified sand and gravel. Drainage is poorer than that of Wasepi soils, silty subsoil variant.

Gilford sandy loam, silty subsoil variant (0 to 2 percent slopes) (Gf).—This soil occupies nearly level or depressional areas on outwash plains or lake plains. It has a medium available moisture capacity. Permeability of the upper 20 to 40 inches is moderately rapid, and below this depth it is slow. Runoff is slow to ponded. The natural fertility is moderately low.

Included with this soil in mapping were areas of Wasepi soils, silty subsoil variant, on slight rises; areas of typical Gilford soils; and small areas of Lenawee and Lamson soils at the outer edge of areas mapped as this soil.

Drained areas of this Gilford soil are used for vegetable crops, corn, wheat, oats, and hay. Undrained areas are in permanent pasture or are wooded. The main limitation of this soil is a high water table. If drained, the upper 20 to 40 inches tends to be droughty. Tile lines should be blinded. Capability unit IIIw–6 (4/2c); woodland suitability group S.

Granby Series

In the Granby series are poorly drained, coarse-textured soils. These soils are nearly level, level, or in depressions. They occur throughout the county.

The surface layer of a typical Granby soil is very dark gray loamy fine sand about 9 inches thick. The upper part of the subsoil, about 7 inches thick, is light brownish-gray, loose loamy sand that contains mottles of very dark gray and yellowish brown. The lower part of the subsoil is gray, loose sand mottled with yellowish brown and is about 20 inches thick. The substratum is gray, loose sand with yellowish-brown mottles.

The Granby soils are low in natural fertility. They have a very low available moisture capacity and rapid permeability. Runoff is very slow or ponded, and the water table is high. Because undrained areas are wet most of the year, root development of plants is limited and the operation of machinery is hindered.

The native vegetation consists of marsh grasses, reeds, sedges, aspen, pin oak, red maple, black oak, and elm. Drained areas are used for vegetable crops, corn, wheat, oats, and hay. Undrained areas are in permanent pasture or second-growth forest.

A typical profile of Granby loamy fine sand in a level area of an idle field, NE¼SE¼SE¼ sec. 11, T. 3 N., R. 12 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) loamy fine sand; weak, medium, granular structure; very friable; many light-gray (10YR 6/1) sand grains; many roots; neutral; abrupt, smooth boundary.

B1g—9 to 16 inches, light brownish-gray (10YR 6/2) loamy sand; many, medium, distinct mottles of very dark gray (10YR 3/1) and common, fine, distinct mottles of yellowish brown (10YR 5/4); single grain; loose; few roots; neutral; abrupt, irregular boundary.

B2g—16 to 36 inches, gray (10YR 5/1) sand; common, medium, distinct mottles of yellowish brown (10YR 5/6); single grain; loose; few roots; neutral; gradual, wavy boundary.

Cg—36 to 54 inches. gray (10YR 5/1) sand; yellowish-brown (10YR 5/4) mottles; single grain; loose; calcareous.

The solum ranges from 24 to 42 inches in thickness and from slightly acid to mildly alkaline in reaction. The Ap horizon ranges from very dark gray to black (10YR 2/1) and very dark grayish brown (10YR 3/2) in color, from loamy fine sand to sand in texture, and from 7 to 10 inches in thickness. The C horizon is gray to light brownish gray (10YR 6/2) and is neutral to moderately alkaline.

The Granby soils are coarser textured than the Lamson soils, which have parent material of stratified very fine sand and silt. Granby soils differ from the Gilford soils in that they are coarser textured in the solum and are underlain by sand instead of gravelly sand. The Granby soils are similar in texture to the somewhat poorly drained Au Gres soils and the well-drained Oakville soils.

Granby loamy fine sand (0 to 2 percent slopes) (Gm).—This soil occurs throughout the county. Some areas are in depressions. Runoff is very slow or ponded, and the water table is at or near the surface much of the year.

Included with this soil in mapping were small areas of poorly drained Brevort and Lamson soils, areas of somewhat poorly drained Au Gres and Selfridge soils on small knolls and low ridges, and some small areas that have slopes of 2 to 6 percent.

Most areas of this soil are used for corn, small grain, hay, pasture, and vegetable crops. Some areas are wooded, are idle, or are used as habitat for wetland wildlife. The main limitation is the high water table. Artificial drainage is a major management requirement. Tile blinding to prevent soil material from entering and plugging tile systems is desirable. Drainage ditches are more easily dug when the soil is dry because this soil material flows if wet. Artificially drained areas have considerably higher crop yields than undrained ones, and cultivation and harvesting operations are hampered less. This soil is wet longer in spring and after rains than the well-drained Oakville soils. Management that provides regular additions of organic matter, maintains fertility, controls the risk of soil blowing, and reduces the hazard of droughtiness is desirable. Capability unit IIIw-11 (5c); woodland suitability group Q.

Hoytville Series

The Hoytville series consists of nearly level and depressional, poorly drained soils that developed in clayey glacial till. These soils are on glacial till plains and moraines.

The surface layer of a typical Hoytville soil is very dark gray clay loam about 9 inches thick. The upper part of the subsoil is dark-gray, firm and very firm silty clay loam and silty clay about 11 inches thick. It is mottled with dark brown and dark yellowish brown. The lower part, about 26 inches thick, is dark-gray, very firm clay mottled with dark yellowish brown. The substratum is gray, very firm clay with mottles of dark brown.

Hoytville soils are high in natural fertility. They have a high available moisture capacity and very slow permeability. Runoff is very slow or ponded, and the water table is high. Because undrained areas are wet most of the year, root development of plants is limited and machinery operations are hindered.

The native vegetation consists of deciduous swamp forest, including elm, ash, hickory, soft maple, basswood, swamp white oak, and cottonwood, with some marsh grasses. Undrained areas are in permanent pasture or are wooded. Drained areas are used mainly for corn, wheat, oats, hay, and vegetable crops.

A typical profile of Hoytville clay loam in a level area of an idle field, SE¼NE¼SW¼ sec. 6, T. 3 N., R. 14 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) clay loam; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, smooth boundary.

B1g—9 to 13 inches, dark-gray (10YR 4/1) silty clay loam; common, medium, distinct mottles of dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4); moderate, medium, subangular blocky structure; firm; organic stains on ped faces; slightly acid; clear, wavy boundary.

B21tg—13 to 20 inches, dark-gray (10YR 4/1) silty clay; common, medium, distinct mottles of dark yellowish brown (10YR 3/4); moderate, medium, angular blocky structure; very firm; thin clay films on some ped surfaces; neutral; gradual, wavy boundary.

B22tg—20 to 40 inches, dark-gray (10YR 4/1) clay; common, medium, distinct mottles of dark yellowish brown (10YR 3/4) and few, fine, faint mottles of dark grayish brown (2.5Y 4/2); moderate, coarse, angular blocky structure; very firm; thin clay films on some ped surfaces; neutral; gradual, wavy boundary.

B3g—40 to 46 inches, dark-gray (10YR 4/1) clay; many, medium, distinct mottles of dark yellowish brown (10YR 4/4); massive; very firm; neutral; clear, wavy boundary.

Cg—46 to 60 inches, gray (10YR 5/1) clay ; common, medium, distinct mottles of dark brown (10YR 4/4); massive; very firm; calcareous.

The Ap horizon ranges from very dark gray to black (10YR 2/1) and very dark brown (10YR 2/2) in color, from

6 to 9 inches in thickness, and from slightly acid to neutral in reaction. The Bg horizon ranges from silty clay loam to clay in texture and is slightly acid to neutral. The depth from the surface to the Cg horizon ranges from 28 to 55 inches and is typically at 46 inches. The Cg horizon is massive in some places and has moderate, coarse, subangular blocky structure in others. It is heavy silty clay loam to clay.

Hoytville soils have a clay content of 38 to 48 percent; the Sims soils, 27 to 37 percent; the Toledo soils, 48 to 60 percent; and the Paulding soils, 60 to 75 percent. Hoytville soils developed in glacial till, whereas the Toledo soils formed in stratified lacustrine deposits. Hoytville soils are more poorly drained and grayer than the Nappanee soils.

Hoytville clay loam (0 to 2 percent slopes) (Hy).—This soil occupies nearly level or depressional areas on till plains and moraines. It has a high available moisture capacity and very slow permeability. Runoff is very slow or ponded. Natural fertility is high.

Included with this soil in mapping were small areas of poorly drained Toledo and Sims soils and, on the slightly higher elevations, areas of Nappanee soils.

Undrained areas of this Hoytville soil are in permanent pasture or are wooded. Drained areas are used for vegetable crops, corn, wheat, oats, and hay. The main limitations are the high water table, poor workability when wet, very slow permeability, and difficulty in obtaining artificial drainage. Capability unit IIw-2 (1c); woodland suitability group P.

Lamson Series

In the Lamson series are level to nearly level, poorly drained, moderately coarse textured to medium-textured soils. These soils developed in stratified calcareous silt and very fine sand, and they occur throughout the county. In this county they were mapped alone and also in a complex with Selfridge soils.

The surface layer of a typical Lamson soil is black fine sandy loam about 10 inches thick. The subsoil, about 14 inches thick, is gray, very friable fine sandy loam that contains yellowish-brown mottles. The substratum is gray, very friable silt and very fine sand with olive and yellowish-brown mottles.

Lamson soils are high in natural fertility and organic-matter content. They have moderately slow permeability, high available moisture capacity, very slow or ponded runoff, and moderate infiltration. Because of the high water table, workability is sometimes difficult and artificial drainage is beneficial for nearly all uses.

The native vegetation consists of hardwood trees, chiefly aspen, oak, ash, and maple. Most areas are used for grain, hay, pasture, and vegetable crops. Some small areas are idle or are wooded.

A typical profile of Lamson fine sandy loam in a level brushy area, NE¼NW¼NE¼ sec. 6, T. 3 N., R. 12 E.:

Ap—0 to 10 inches, black (N 2/0) fine sandy loam; weak, medium, granular structure; very friable; yellowish-brown (10YR 5/4–5/8) stains on some peds; many roots; slightly acid; abrupt, smooth boundary.

B1g—10 to 15 inches, gray (5Y 5/1) fine sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/8); weak, fine, subangular blocky structure; very friable; few roots; neutral; gradual, wavy boundary.

B2g—15 to 24 inches, gray (5Y 5/1) fine sandy loam; many, coarse, distinct mottles of yellowish brown (10YR 5/8); weak, fine, subangular blocky structure; very friable; few roots; mildly alkaline; gradual, wavy boundary.

C1g—24 to 32 inches, gray (5Y 5/1) silt and very fine sand; common, medium, distinct mottles of olive (5Y 5/4); massive; very friable; calcareous; gradual, wavy boundary.

C2g—32 to 60 inches, gray (5Y 5/1) very fine sand; few, coarse, prominent mottles of yellowish brown (10YR 5/6); massive; very friable; stratified; calcareous.

The solum ranges from slightly acid to mildly alkaline in reaction and from 24 to 42 inches in thickness. The Ap horizon ranges from 8 to 10 inches in thickness, from fine sandy loam to very fine sandy loam in texture, and from black (N 2/0) to very dark gray (10YR 3/1) in color. The B1g horizon ranges from 4 to 10 inches in thickness and from light gray (10YR 6/1) to gray (10YR 5/1) in color, with mottles ranging from grayish brown (10YR 5/2) to yellowish brown (10YR 5/6). This horizon ranges from fine sandy loam to silt loam in texture and contains ½- to 2-inch thick bands of clay. The B2g horizon ranges from 9 to 16 inches in thickness and from fine to coarse subangular blocky in structure. This horizon ranges from fine sandy loam to silt loam in texture, with layers up to 2 inches thick of silt and very fine sand. Its color is gray (10YR 5/1) to light gray (10YR 6/1) that contains mottles ranging from light yellowish brown (10YR 6/4) to dark gray (10YR 4/1). The texture of the C horizon ranges from silt and very fine sand to stratified silt loam with thin varves of clay. In some areas there are layers of coarse sand or fine gravel 1 inch to 6 inches thick. The color of this horizon ranges from gray (N 6/0) to light gray (10 YR 6/1, 5Y 6/1), with mottles ranging from dark grayish brown (10YR 4/2) to yellowish brown and olive (5Y 5/4).

Lamson soils are more poorly drained than the somewhat poorly drained Minoa soils and the well-drained Sisson soils. They are coarser textured than the Lenawee and Parkhill soils but are finer textured than the Granby soils which formed in deep sand.

Lamson fine sandy loam (0 to 2 percent slopes) (La).—This soil occurs throughout the county. Some areas are in depressions. Runoff is very slow or ponded, permeability is moderately slow, infiltration is moderate, and the available moisture capacity is high. The water table is at or near the surface much of the year.

Included with this soil in mapping were small areas of poorly drained Granby and Brevort soils, areas of somewhat poorly drained Minoa and Selfridge soils on knolls and slightly higher elevations, and small spots of Lenawee soils in many areas mapped as this soil in Harrison Township.

This soil is used largely for corn, small grain, hay, and pasture. Some areas are idle or are wooded. Limitations are moderate to severe because of the high water table. Artificial drainage is a major management requirement for all uses of this soil. Drained areas have higher yields than undrained ones. Drainage ditches should be dug when the soil is dry because of its unstableness when wet. Tile blinding to prevent plugging by the fine soil material is often necessary because this soil flows when wet. This soil dries out later in spring and after rain than the better drained, similar-textured Sisson and Minoa soils. Management that provides a regular supply of organic matter helps to control soil blowing and to improve soil structure. If wet, this soil has poor trafficability, and the surface becomes cloddy when worked. Capability unit IIw-6 (3c); woodland suitability group S.

Lapeer Series

The Lapeer series consists of nearly level to steep, well-drained, moderately coarse textured soils. These soils formed in calcareous sandy loam glacial till on till plains and moraines.

The surface layer of a typical Lapeer soil is dark grayish-brown sandy loam about 8 inches thick. The subsoil, about 22 inches thick, is yellowish-brown, friable sandy loam to loam. The underlying material is brown, friable sandy loam.

The Lapeer soils are medium in natural fertility. They have medium available moisture capacity and moderate to moderately rapid permeability. Runoff is medium on the lesser slopes and rapid to very rapid on the steep slopes.

The native vegetation consists of hardwoods, including oak, hickory, beech, and maple. These soils are used for corn, wheat, oats, and hay.

A typical profile of Lapeer sandy loam on a slope of 4 percent, in an apple orchard, NW¼NW¼NE¼ sec. 28, T. 5 N., R. 12 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, subangular blocky structure; friable; many fine roots; neutral; abrupt, smooth boundary.

B1—8 to 11 inches, yellowish-brown (10YR 5/4) sandy loam; weak, fine and medium, subangular blocky structure; friable; few fine and coarse roots; few cobblestones; slightly acid; clear, wavy boundary.

B21t—11 to 20 inches, yellowish-brown (10YR 5/4) sandy loam; moderate, fine and medium, subangular blocky structure; friable; few dark yellowish-brown (10YR 4/4) clay films on some ped faces; few fine and coarse roots; few cobblestones; medium acid; clear, wavy boundary.

B22t—20 to 30 inches, yellowish-brown (10YR 5/4) loam; moderate, medium, subangular blocky structure; friable; common dark-brown (7.5YR 4/4) clay films on some ped faces; few fine and coarse roots; few cobblestones; medium acid; abrupt, wavy boundary.

C—30 to 60 inches, brown (10YR 5/3) sandy loam; massive; friable; few coarse roots; few cobblestones; calcareous.

The solum is typically 28 to 36 inches thick but ranges from 20 to 42 inches in thickness. The reaction of the solum ranges from medium acid to neutral. The color of the Ap horizon ranges from dark grayish brown to dark brown (10YR 4/3). In some undisturbed areas, a thin grayish-brown (10YR 5/2) A2 horizon is present. Texture of the B2 horizons ranges from sandy loam to heavy loam. The C horizon ranges from brown to yellowish brown (10YR 5/4) in color. The content of stones in the profile ranges from few to many.

The Lapeer soils are coarser textured than the Miami soils, which formed in loam or silt loam till. They are better drained than the moderately well drained Dryden soils, the somewhat poorly drained Locke, and the poorly drained Ensley, although all of these soils are similar in texture.

Lapeer sandy loam, 2 to 6 percent slopes (LeB).—This soil is on till plains and moraines in the northwestern part of the county. It is generally near Miami, Sisson, Spinks, and Dryden soils. This soil has moderate to moderately rapid permeability, medium runoff, moderately rapid infiltration, and medium available moisture capacity. The organic-matter content is low, and natural fertility is medium.

Included with this soil in mapping were small areas of the moderately well drained Dryden and Celina soils and well drained Sisson soils and, at the top of slopes and on the higher undulating areas, small spots of well drained Miami and Spinks soils. Where areas of the somewhat poorly drained Locke, Minoa, and Conover soils and the poorly drained Ensley, Lamson, and Parkhill soils were included in wet depressions and natural drainageways, the surface layer may be loam or a finer texture. Also included were small areas of Boyer soils, which are underlain by calcareous sand and gravel material that in a few places is at a depth greater than 42 inches. In a few small moderately eroded areas, plowing has mixed the thin surface layer with the subsoil, giving the present surface layer a yellowish-brown color. In many inclusions the depth to the calcareous underlying material is greater than 42 inches. Some included areas have slopes of less than 2 percent or of 6 to 12 percent.

This Lapeer soil is used largely for corn, hay, pasture, small grain, peach and apple orchards, and as building sites. Some small areas are idle or are wooded. Limitations are slight and are easily corrected. The main management requirements are supplying organic matter, maintaining fertility, and control of erosion. Capability unit IIe-3 (3a); woodland suitability group G.

Lapeer sandy loam, 6 to 12 percent slopes (LeC).—This soil occupies areas on till plains and moraines in the northwestern part of the county. It is generally near the Miami, Sisson, Spinks, and Boyer soils. This soil has moderate to moderately rapid permeability, rapid runoff, moderately rapid infiltration, and medium available moisture capacity. The organic-matter content is low, and natural fertility is medium.

Included with this soil in mapping were small spots of well drained Miami, Sisson, and Spinks soils and, on slightly lower elevations and along the upper edges of natural drainageways, small areas of moderately well drained Dryden and Celina soils. Areas of the somewhat poorly drained Locke, Minoa, and Conover soils and the poorly drained Ensley, Lamson, and Parkhill soils were included in wet depressions and in natural drainageways. The surface layer may be loam or finer textured in some inclusions. A few small spots of Linwood and Lupton muck soils were included in wet spots and depressions of this soil in Bruce and Washington Townships. Also included were small areas of Boyer soils, which are underlain by calcareous sand and gravel material that in some areas is at a depth greater than 42 inches. In some small moderately eroded inclusions, plowing has mixed the surface layer with some of the subsoil, giving the surface layer a yellowish-brown color. The depth to the calcareous underlying material is greater than 42 inches in many included areas. Some inclusions have slopes of less than 6 percent or of 12 to 18 percent.

This soil is used mainly for corn, hay, pasture, small grain, and peach and apple orchards. Some small areas are idle or are wooded, and a few areas are used for recreational purposes and as wildlife habitat. Limitations are moderate, largely because of the hazard of erosion. The main management problems are regularly adding organic matter, maintaining fertility, and control of erosion. Capability unit IIIe–6 (3a) ; woodland suitability group G.

Lapeer sandy loam, 12 to 18 percent slopes (LeD).—This soil occupies short slopes on moderately steep and hilly areas in the northwestern part of the county. It is generally near Miami, Spinks, Sisson, and Boyer soils. This soil has moderate to moderately rapid permeability, rapid runoff, medium available moisture capacity, and moderately rapid infiltration. The organic-matter content is low, and natural fertility is medium.

Included with this soil in mapping were small areas of well-drained Miami and Sisson soils and small spots of Spinks and Boyer soils along drainageways and on the outer edge of areas mapped as this soil. Small inclusions of moderately well drained Dryden and Celina soils with a loam surface layer are at the base of slopes and in natural drainageways. Some inclusions of Boyer soils are greater than 42 inches deep to the calcareous sand and gravel layer. A few eroded inclusions have the yellowish-brown subsoil exposed, and gullies that are 3 to 6 feet deep and 1 to 6 feet wide are forming in some areas. Small spots of Linwood and Lupton muck soils were included in wet spots and depressions of this soil in Bruce and Washington Townships. Small inclusions are on slopes of less than 12 percent or of 18 to 25 percent. The depth to the calcareous underlying material is greater than 42 inches in many included areas.

Most of this Lapeer soil is used for hay, permanent pasture, small grains, and apple and peach orchards. Some small areas are idle or wooded; others are used as wildlife habitat or for recreational purposes. Limitations are moderate because of the erosion hazard. Capability unit IVe–4 (3a) ; woodland suitability group G.

Lapeer sandy loam, 18 to 25 percent slopes (LeE).—This soil occurs in the northwestern part of the county. It is generally near Miami, Spinks, Sisson, and Boyer soils. This soil has moderate to moderately rapid permeability, very rapid runoff, moderately rapid infiltration, and medium available moisture capacity. The organic-matter content is very low, and natural fertility is medium. This soil is subject to gully erosion, and runoff is cutting water channels that are 3 to 12 feet deep and 1½ to 10 feet wide.

Included with this soil in mapping were small spots of well-drained Miami, Sisson, and Spinks soils and areas of well-drained Boyer soils greater than 42 inches deep to sand and gravel. Some moderately eroded included areas have the yellowish-brown subsoil exposed. A few severely eroded inclusions have the calcareous underlying material exposed; other inclusions have calcareous material at a depth greater than 42 inches. Some small included areas have slopes of less than 12 percent or of more than 25 percent.

This Lapeer soil is used largely for permanent pasture and woodland and as wildlife habitat. Some small areas are used for recreational purposes. Limitations are severe because of the erosion hazard and steepness of slope. Capability unit VIe–2 (3a) ; woodland suitability group G.

Lenawee Series

The Lenawee series consists of level and nearly level, poorly drained, moderately fine textured soils. These soils formed in calcareous clay loam and silty clay loam lacustrine material on the lake plains. In this county they were mapped alone and also in two complexes with Selfridge soils.

The surface layer of a typical Lenawee soil is very dark brown clay loam about 9 inches thick. The upper 4 inches of the subsoil is dark-gray, firm clay loam mottled with dark yellowish brown. The main part is dark grayish-brown and gray, firm, heavy silty clay loam with yellowish-brown mottles and is about 18 inches thick. The underlying material is gray, firm, calcareous clay loam.

The Lenawee soils are high in natural fertility. They have a high available moisture capacity and very slow or ponded runoff. They are easily worked at the proper moisture content. The seasonal high water table, moderately slow permeability, and moderate to high shrink-swell potential are limitations.

The native vegetation consists of mixed hardwoods, including elm, black ash, red maple, swamp oak, and white oak. Most areas of this soil are used for corn, wheat, oats, alfalfa and bromegrass for hay and pasture, and turf sod.

A typical profile of Lenawee clay loam in a level part of a wooded area, SE¼NW¼SW¼NE¼ sec. 3, T. 2 N., R. 13 E.:

Ap—0 to 9 inches, very dark brown (10YR 2/2) clay loam; moderate, fine, subangular blocky structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B1g—9 to 13 inches, dark-gray (10YR 4/1) clay loam; common, medium, distinct mottles of dark yellowish brown (10YR 4/4); moderate, medium, angular blocky structure; firm; many roots; neutral; gradual, wavy boundary.

B2g—13 to 23 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, angular blocky structure; firm; many roots; neutral; abrupt, wavy boundary.

B3g—23 to 31 inches, gray (10YR 5/1) heavy silty clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/8); moderate, coarse, angular blocky structure; firm; few roots; mildly alkaline; abrupt, wavy boundary.

C1g—31 to 39 inches, gray (10YR 5/1) clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/8); weak, coarse, subangular blocky structure; firm; calcareous; gradual, smooth boundary.

C2g—39 to 50 inches, gray (10YR 5/1) clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/8); massive; firm; calcareous.

The solum ranges from 24 to 42 inches in thickness and from slightly acid to mildly alkaline in reaction. The Ap horizon ranges from 7 to 9 inches in thickness and from black (N 2/0) to very dark brown to very dark grayish brown (10YR 3/2) in color. An A2g horizon of dark-gray (N4/0) clay loam, 4 inches thick, occurs in some places. Coatings on the ped surfaces and varves of very fine sand and silt are sometimes present in the B horizon. The C horizon ranges from light clay loam to heavy silty clay loam in texture and contains varves of silt, very fine sand, and clay in many places. In some areas lime concretions are heavily concentrated in the C horizon.

The poorly drained Lenawee soils and somewhat poorly drained Del Rey soils developed in calcareous clay loam and silty clay loam lacustrine material. The poorly drained Toledo soils developed in finer textured lacustrine material than that giving rise to the Lenawee soils. The poorly drained Sims soils formed in calcareous clay loam and silty clay loam glacial till.

Lenawee clay loam (0 to 2 percent slopes) (Lh).—This soil is on the lake plains. It surrounds and is adjacent to areas of Del Rey soils, which are somewhat poorly drained and of similar texture. Runoff is very slow and becomes ponded after prolonged rains.

Included with this soil in mapping were a few small sand spots, a few areas that have a silty clay loam surface layer, and some areas that adjoin sandy soils and have a silt loam surface layer. In many areas inclusions of low-lying sand ridges rise from a nearly level landscape.

Most of this soil is used for crops and sod production. Some idle areas are in weeds and brush. Uncleared areas are in second-growth forest. Many areas are used for growing ornamental shrubs (fig. 6). The high fertility enables good growth, and the fine-textured material restricts root growth, permitting easily balled rootstocks. A high water table is the major limitation. Surface and subsurface drainage systems remove excess water. If this soil is adequately drained, wheat, oats, corn, and hay are grown. If worked when wet, the soil becomes compacted and cloddy, and a seedbed is difficult to prepare. Capability unit IIw–2 (1.5c); woodland suitability group P.

Lenawee-Selfridge complex (0 to 2 percent slopes) (Lk).—This complex consists partly of poorly drained, moderately fine textured soils and partly of somewhat poorly drained, coarse-textured soils. Areas of this mapping unit are on the lake plains. Lenawee clay loam makes up from 65 to 90 percent of the complex, and Selfridge sand and other sands of varying depths make up 10 to 35 percent (fig. 7). These soils have a profile similar to the one described as typical of their respective series. The sandy areas range from 40 to 50 feet in diameter or from 50 to 70 feet in width and 100 to 125 feet in length. In some places the sandy soil

Figure 6.—An area of Lenawee clay loam used for ornamental shrubs.

Figure 7.—An area of Lenawee-Selfridge complex. The light-colored areas are Selfridge sand.

rises 1 to 3 feet above the surrounding soil. The thickness of sand rarely exceeds 30 inches at the center and decreases to a depth of 4 or 5 inches at the outer edge. The depth of sand commonly ranges between 18 and 30 inches.

The use and limitations of this complex are similar to those of the representative soils. The most severe limitations should be considered because of the intricate pattern of occurrence of the soils. Limitations for crops are moderate, and wheat, oats, corn, grass and legumes for hay and pasture, and vegetable crops are grown. Artificial drainage is needed for good crop growth because of the high water table. The natural fertility is high in the Lenawee soil and low in the sandy soils. Regular additions of organic matter, maintaining fertility in the sandy soils, and maintenance of soil structure in the Lenawee soil are major management problems. The control of soil blowing on exposed sandy soils is needed. Both soils in capability unit IIw–2 (1.5c, 4/2b); Lenawee soil in woodland suitability group P; Selfridge soil in woodland suitability group K.

Linwood Series

In the Linwood series are level and nearly level, poorly drained, organic soils. The organic material, 12 to 40 inches thick, is underlain by mineral material of loam texture. These soils are in swamps, along waterways, and in depressions in the uplands.

The upper part of a typical Linwood soil is very dark brown to very dark gray, friable muck about 20 inches thick. It contains undecomposed woody fragments. The underlying material is black to greenish-gray, friable loam.

The Linwood soils have a very high available moisture capacity. Permeability is rapid in the muck, if drained, and is moderate in the underlying loamy material. The water table is near the surface most of the year. Natural fertility is low, and workability is poor.

The native vegetation consists of both coniferous and deciduous trees. Most of the original forest cover remains, or remnants of it are in cutover areas.

A typical profile of Linwood muck in a nearly level idle field, SE¼NW¼NE¼NW¼ sec. 26, T. 5 N., R. 12 E.:

1—0 to 12 inches, very dark brown (10YR 2/2) muck; weak, medium, granular structure; friable; neutral; clear, smooth boundary.
2—12 to 20 inches, very dark gray (10YR 3/1) muck; weak, very coarse, granular structure; friable; neutral; clear, smooth boundary.
IIC1g—20 to 24 inches, black (10YR 2/1) loam; weak, coarse, angular blocky structure; friable; high in organic-matter content; neutral; abrupt, smooth boundary.
IIC2g—24 to 42 inches, greenish-gray (5GY 6/1) loam; common, fine, distinct mottles of olive (5Y 5/6); massive; friable; mildly alkaline.

The color of the muck ranges from very dark brown to black (N 2/0) in the upper part and from very dark gray to very dark brown (10YR 2/2) and dark brown (10YR 3/3) in the lower part. The reaction of the organic material ranges from slightly acid to neutral. The quantity of partly decomposed woody fragments is highly variable. Depth to the neutral to moderately alkaline IICg horizon ranges from 12 to 40 inches. The texture of the IICg horizon ranges from fine sandy loam to clay loam but is dominantly loam. Its color ranges from black and greenish gray to gray (5Y 5/1) and strong brown (7.5YR 5/6).

The Linwood soils are shallower than the deep Lupton soils. They are underlain by loam, whereas the Tawas and Willette soils are underlain by sand and clay, respectively.

Linwood muck (0 to 2 percent slopes) (Lm).—This soil occurs in swamps, along waterways, and in depressions in the uplands. The water table is near the surface most of the year. Runoff is very slow or ponded. In some places where this soil receives runoff from adjoining sloping soils, the surface layer is calcareous.

Included with this soil in mapping were some small spots of Lupton muck, which is organic material thicker than 40 inches, and Tawas muck, which is underlain by sand at a depth of less than 40 inches. In a few places in Shelby and Washington Townships, small areas of marl were included.

Most of this Linwood soil is wooded or is cutover and idle. The soil is best suited to use as woodland and as a wildlife habitat. The high water table, low natural fertility, and rapid oxidation of the muck, if drained, are major limitations. Drainage outlets are difficult to obtain in many areas of this soil. Capability unit IVw–5 (M/3c); woodland suitability group U.

Locke Series

In the Locke series are nearly level and gently sloping, somewhat poorly drained, moderately coarse textured soils. These soils developed in calcareous sandy loam glacial till on till plains and moraines.

The surface layer of a typical Locke soil is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, about 4 inches thick, is pale-brown, friable sandy loam that contains mottles of brownish yellow. The subsoil, about 17 inches thick, is pale-brown, friable loam mottled with grayish brown, brownish yellow, and strong brown. The underlying material is brown, friable, calcareous sandy loam mottled with yellowish brown, gray, and strong brown.

The Locke soils are medium in natural fertility. They have medium available moisture capacity. Permeability is moderate, runoff is slow or very slow, and infiltration is moderately rapid. A seasonal high water table limits the use of these soils in wet periods.

The native vegetation consists of deciduous trees, mainly elm, hickory, ash, and basswood. Most areas of these soils are used for corn, wheat, oats, and hay, but some areas are used for permanent pasture or second-growth forest.

A typical profile of Locke sandy loam, 0 to 2 percent slopes, in a cornfield, NE¼SW¼SW¼ sec. 1, T. 4 N., R. 13 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.
A2—8 to 12 inches, pale-brown (10YR 6/3) sandy loam; few, fine, distinct mottles of brownish yellow (10YR 6/8); weak, medium, granular structure; friable; slightly acid; clear, wavy boundary.
B21t—12 to 18 inches, pale-brown (10YR 6/3) light loam; common, medium, distinct mottles of brownish yellow (10YR 6/8) and common, medium, faint mottles of grayish brown (10YR 5/2); weak, medium, subangular blocky structure; friable; slightly acid; gradual, wavy boundary.
B22t—18 to 29 inches, pale brown (10YR 6/3) loam; common, medium, distinct mottles of strong brown (7.5YR 5/6) and common, fine, faint mottles of grayish brown (10YR 5/2); weak, medium, subangular blocky structure; friable; few thin clay flows; neutral; clear, wavy boundary.
C—29 to 50 inches, brown (10YR 5/3) sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/8) and gray (10YR 5/1) and common, fine, distinct mottles of strong brown (7.5YR 5/6); massive; friable; light-gray (10YR 7/1) lime concretions; calcareous.

The solum ranges from 20 to 42 inches in thickness and from medium acid to neutral in reaction. Rounded cobblestones and stones occur throughout the profile and range in abundance from none to many. In some areas numerous cobblestones are on the surface. The Ap horizon ranges from very dark grayish brown to black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The texture of the A horizon ranges from sandy loam to loam. The texture of the B horizon ranges from loam to light clay loam. Discontinuous layers and pockets of sand, loamy sand, clay loam, and gravelly sandy loam occur in the C horizon in some places.

The Locke soils differ from the Conover soils because they have coarser textured B horizons and a sandy loam C horizon. The Locke, Ensley, Dryden, and Lapeer soils developed in similar material. The Locke soils are somewhat poorly drained, the Ensley soils are poorly drained, the Dryden soils, moderately well drained, and the Lapeer soils, well drained.

Locke sandy loam, 0 to 2 percent slopes (LoA).—Areas of this soil are on level and nearly level slopes and in depressions on till plains and moraines. Runoff is very slow.

Included with this soil in mapping were small areas of moderately well drained Dryden and Celina soils on knolls and short ridges; small areas of somewhat poorly drained Conover, Minoa, and Metamora soils; and poorly drained soils in wet depressions and along natural drainageways. Some small included areas have slopes of 2 to 6 percent.

This soil is used chiefly for corn, small grain, hay,

Figure 8.—**An area of Locke sandy loam, 2 to 6 percent slopes, in the foreground and Lapeer soils in background. This Locke soil dries out slowly because of a seasonal high water table.**

pasture, and soybeans. In the north-central part of the county, large areas are used for navy beans. Small areas are idle, are wooded, or are used for vegetable crops and apple and peach orchards. Limitations are slight for farm crops because of the seasonal high water table and poor trafficability when wet. Artificial drainage, supplying organic matter, and maintaining fertility and soil structure are good management practices. Capability unit IIw–6 (3b); woodland suitability group K.

Locke sandy loam, 2 to 6 percent slopes (LoB).—This soil occurs on till plains and moraines. Runoff is slow.

Included with this soil in mapping were small areas of moderately well drained and well drained soils on the stronger slopes; small areas of somewhat poorly drained sandy soils underlain by fine-textured, generally calcareous material; and areas of poorly drained soils in wet depressions and along natural drainageways. Some small inclusions have slopes of 0 to 2 percent, and others have slopes of 6 to 12 percent.

This soil is used largely for corn, small grain, soybeans, hay, pasture, and vegetable crops. Some areas are idle, are wooded, or are used for apple orchards. In the north-central part of the county, large areas are used for navy beans. Although the seasonal water table is a slight limitation (fig. 8), it does not affect use of this soil as it does use of areas having slopes of 0 to 2 percent, mainly because runoff is greater and the surface dries out quicker after rains and in spring. The included soils in wet depressions and along drainageways are wetter and dry out slower in spring and after rains. Drainage is generally better on this soil than on level areas, but a complete drainage system is more difficult to lay out because of the undulating relief and closed depressions in many areas. Management that supplies organic matter, maintains fertility, and controls erosion is helpful. Capability unit IIw–7 (3b); woodland suitability group K.

Locke very cobbly sandy loam, 0 to 6 percent slopes (LsB).—This soil is on till plains and moraines in Armada Township. Runoff is slow. This soil has a profile similar to that described as typical of the series, but more than 50 percent of the surface is covered with cobblestones and about 30 percent of the subsoil is cobbly.

This soil is used chiefly for corn, small grain, hay, and pasture. Some areas are idle. The main limitation is the high content of cobblestones and stones, which hinders farm operations. Removal of surface stones and cobblestones, artificial drainage, additions of organic matter, and maintenance of fertility are desirable management practices. Capability unit IIw–7 (3b); woodland suitability group K.

Lupton Series

The Lupton series consists of poorly drained soils that formed in organic material that is greater than 40 inches thick. These level and nearly level soils are in swamps, along waterways, and in depressions in the uplands.

A typical Lupton soil is very dark brown muck to a depth of about 8 inches. The underlying material is black to very dark brown, friable muck, which grades to dark-brown peat.

Lupton soils are low in natural fertility. They have a very high available moisture capacity and, if artificially drained, rapid permeability. The water table is near the surface most of the year. Workability is poor on these unstable and highly compressible soils.

The native vegetation consists of hardwoods, including elm, ash, and soft maple, as well as tamarack and an understory of grasses, reeds, and sedges.

A typical profile of Lupton muck in a nearly level idle field, NW¼SW¼NW¼ sec. 3, T. 4 N., R. 12 E.:

1—0 to 8 inches, very dark brown (10YR 2/2) muck; weak, medium, granular structure; friable; neutral; clear, smooth boundry.

2—8 to 24 inches, black (10YR 2/1) muck; massive; friable; neutral; gradual, smooth boundary.

3—24 to 32 inches, very dark brown (10YR 2/2) muck; massive; friable; neutral; gradual, smooth boundary.

4—32 to 54 inches, very dark brown (10YR 2/2) peaty muck; massive; friable; mildly alkaline; clear, smooth boundary.

5—54 to 60 inches, dark-brown (10YR 4/3) fibrous peat; massive; friable; very dark grayish-brown fragments of organic material; mildly alkaline.

The uppermost layer ranges from very dark brown to black (10YR 2/1) in color and consists of well-decomposed organic material. The next layer ranges from black to very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) in color and consists of well-decomposed muck to partly decomposed peaty muck. Below a depth of about 30 inches, the organic material ranges from very dark brown to dark brown (7.5YR 4/4) and black (10YR 2/1) and from well-decomposed muck to undecomposed peat. The reaction of the soil ranges from mildly alkaline to neutral.

The Lupton soils consist of deep organic material. The Tawas, Linwood, Willette, and Edwards soils also are organic soils, but they are less than 40 inches thick to mineral material or to marl.

Lupton muck (0 to 2 percent slopes) (Lu).—This soil occurs in swamps, along waterways, and in depressions in the uplands. The water table is near the surface unless the soil is artificially drained. Runoff is very slow.

Small spots of muck, less than 40 inches thick and underlain by mineral material, were included in mapping. Some narrow inclusions along streams have slopes of 2 to 6 percent. In some included areas, especially along streams and at the base of adjoining steep slopes, much mineral material is in the surface layer of the muck.

Most of this soil is wooded or is idle. The high water table, low natural fertility, and, if drained, rapid oxidation of the organic matter are limitations for use as cropland and pasture. Frost hazard to crops is more severe than on adjacent soils. Capability unit IIIw-15 (Mc); woodland suitability group U.

Made Land

Made land (Md) consists of soil material that has been borrowed from nearby construction sites, dumped, and leveled. The areas are mostly next to buildings, pipelines, railroads, highways, and airports. The material ranges from sand to clay in texture. The only sign of soil formation is a slight darkening of the surface layer caused by grass roots.

Areas of Made land are used mainly as sites for recreation, industry, and residential development. Most areas do not contain rubbish and garbage. Nevertheless, onsite investigation is needed before any use is made of this land type. Not placed in a capability unit or woodland suitability group.

Metamora Series

In the Metamora series are somewhat poorly drained, level and gently sloping soils that occur throughout the county. These moderately coarse textured and medium-textured soils are 20 to 40 inches deep to moderately fine textured material.

The surface layer of a typical Metamora soil is very dark grayish-brown fine sandy loam about 9 inches thick. The upper part of the subsoil, about 17 inches thick, is yellowish-brown, friable fine sandy loam to brown, friable loam. It contains mottles of grayish brown, brownish yellow, and dark yellowish brown. The lower part, about 10 inches thick, is strong-brown, friable sandy loam mottled with grayish brown. The underlying material is brown, firm, calcareous silty clay loam mottled with yellowish brown and light gray.

The Metamora soils are medium in organic matter content and high in natural fertility. Permeability is moderately rapid in the moderately coarse textured and medium-textured layers and moderately slow in the underlying finer textured material. The available moisture capacity is medium. Runoff is very slow or slow. Because these soils have a seasonal high water table, workability is sometimes difficult.

These soils are used mainly for grains, hay, pasture, and vegetable crops. Some areas are wooded, are idle, or are used as building sites.

A typical profile of Metamora fine sandy loam, 0 to 2 percent slopes, in a pasture, NW¼SW¼NW¼ sec. 23, T. 3 N., R. 14 E.:

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

B21t—9 to 18 inches, yellowish-brown (10YR 5/4) heavy fine sandy loam; few fine, faint mottles of grayish brown (10YR 5/2) and few, fine, distinct mottles of brownish yellow (10YR 6/6); weak, medium, subangular blocky structure; friable; worm channels filled with dark-gray (10YR 4/1) fine sandy loam; neutral; gradual, wavy boundary.

B22t—18 to 26 inches, brown (10YR 5/3) light loam; common, fine, faint mottles of grayish brown (10YR 5/2), few, fine, faint mottles of dark yellowish brown (10YR 4/4), and common, medium, distinct mottles of brownish yellow (10YR 6/8); weak, medium, subangular blocky structure; friable; thin grayish-brown (10YR 5/2) coatings on surface of peds; neutral; gradual, wavy boundary.

B3—26 to 36 inches, strong-brown (7.5YR 5/6) sandy loam; few, medium, distinct mottles of grayish brown (10YR 5/2); weak, coarse, granular structure; friable; mildly alkaline; abrupt, smooth boundary.

IIC—36 to 60 inches, brown (10YR 5/3) silty clay loam; common, fine, distinct mottles of yellowish brown (10YR 5/8) and few, medium, distinct mottles of light gray (10YR 7/1); massive; firm; calcareous.

The Ap horizon ranges from 7 to 10 inches in thickness, from fine sandy loam to sandy loam in texture, and from weak, fine, granular to weak, fine, subangular blocky in structure. The B21t horizon ranges from 6 to 12 inches in thickness and from yellowish brown to brownish yellow (10YR 6/6) in color. Mottles in this horizon are grayish brown to strong brown (7.5 YR 5/6). The B22t horizon is 8 to 10 inches thick and is heavy sandy loam to sandy clay loam. The depth to the IIC horizon ranges from 18 to 40 inches. The IIC horizon ranges from loam to silty clay loam in texture, from mildly alkaline to moderately alkaline in reaction, and from pale brown (10YR 6/3) to brownish yellow (10YR 6/6) to strong brown (7.5YR 5/6) in color.

The Metamora soils are finer textured in the A horizon and the upper part of the B horizon than the Selfridge soils, and they are coarser textured in the B horizon than the Conover soils.

Metamora fine sandy loam, 0 to 2 percent slopes (MeA).—This soil occurs throughout the county, generally near soils having better or poorer drainage and soils having less than 27 to 37 percent clay content in the upper part of the profile. Runoff is very slow.

Included with this soil in mapping were small areas of the coarser textured, somewhat poorly drained Selfridge soils and the finer textured Conover soils on knolls, slight rises, and ridges. Also included in the wet depressions and along natural drainageways in many places were areas of the similar textured but poorly drained Corunna soils, the coarser textured Brevort and Granby soils, and the finer textured Parkhill soils. Some inclusions have a surface layer of finer or coarser texture, and some have short slopes of 2 to 6 percent.

Most of this soil is used for corn, small grain, hay, pasture, vegetable crops, and soybeans. Small areas are idle, are wooded, or, if drained, are used as building sites. The main limitation is the seasonal high water table. Artificial drainage is a major management requirement for nearly all uses of this soil. Management that supplies organic matter and maintains fertility is important. Without vegetative cover, this soil is subject to severe soil blowing (fig. 9), and therefore cover crops and tree windbreaks are helpful.

Figure 9.—**An area of Metamora fine sandy loam, 0 to 2 percent slopes. The accumulation of soil material in the fence row is the result of soil blowing.**

Capability unit IIw–8 (3/2b); woodland suitability group K.

Metamora fine sandy loam, 2 to 6 percent slopes (MeB).—This soil occurs throughout the county. Because of the steeper slopes and more rapid runoff, the surface of this soil dries out sooner in spring and after rains than that of Metamora fine sandy loam, 0 to 2 percent slopes. Trafficability and workability are therefore better on this soil. Runoff is slow.

Included with this soil on the upper slopes were small areas of moderately well drained to well drained Metea soils and Boyer soils, loamy subsoil variant. Small areas of the somewhat poorly drained, finer textured Del Rey soils and coarser textured Selfridge soils were included on the lake plains. On the till plains and moraines are inclusions of the somewhat poorly drained Conover soils.

Limitations are excess wetness and the severe risk of soil blowing on uncovered areas. Artificial drainage is a major management requirement for nearly all uses of this soil. A complete drainage system is difficult to design because of the undulating topography between the depressions and natural drainageways. Surface drainage and interceptor tiles help to remove most of the excess water. Cover crops and tree windbreaks help to control soil blowing. Capability unit IIw–8 (3/2b); woodland suitability group K.

Metea Series

The well-drained soils of the Metea series developed in 20 to 40 inches of coarse-textured material over medium-textured to moderately fine textured material. These soils are nearly level on the lake plains and are gently sloping on the outwash plains and moraines.

The surface layer of a typical Metea soil is dark-brown sand about 8 inches thick. The upper part of the subsoil is yellowish-brown and pale-brown, loose sand about 20 inches thick. The lower part, about 4 inches thick, is mainly brown, firm silty clay loam with mottles of brown and gray. The underlying material is dark grayish-brown, firm clay loam that contains mottles of gray and yellowish brown.

Natural fertility and the organic-matter content are low in the Metea soils. Permeability is rapid in the sandy layers and moderate to moderately slow in the loam to silty clay loam layers. The available moisture capacity is low in the sandy layers and medium in the finer textured layers. These soils are easily worked at any content of moisture. The shrink-swell potential is low in the coarser textured layers and moderate in the finer textured ones. Runoff is very slow.

These soils are used largely for grains, hay, pasture, and vegetable crops and as building sites. Some small areas are idle or are wooded.

A typical profile of Metea sand, 2 to 6 percent slopes, in an idle field, NE¼NW¼ sec. 17, T. 3 N., R. 13 E.:

Ap—0 to 8 inches, dark-brown (10YR 4/3) sand; very weak, fine, granular structure; very friable; many roots; slightly acid; abrupt, smooth boundary.

B2—8 to 21 inches, yellowish-brown (10YR 5/6) sand; single grain; loose; many roots; medium acid; clear, wavy boundary.

B3—21 to 28 inches, pale-brown (10YR 6/3) sand; single grain; loose; few roots; few, fine, yellowish-brown iron concretions less than 5 millimeters in diameter; medium acid; abrupt, wavy boundary.

B'21t—28 to 29 inches, strong-brown (7.5YR 5/6) light sandy loam; massive to weak, medium, subangular blocky structure; friable; few roots; neutral; abrupt, wavy boundary.

IIB'22t—29 to 32 inches, brown (7.5YR 4/2) silty clay loam; many, fine, distinct mottles of brown (7.5YR 4/4) and gray (N 5/0); weak, fine, angular blocky structure; firm; few roots; neutral; abrupt, wavy boundary.

IIC—32 to 60 inches, dark grayish-brown (10YR 4/2) clay loam; many, fine, distinct mottles of gray (10YR 5/1) and yellowish brown (10YR 5/4–5/6); massive; firm; few roots to a depth of 36 inches; very thin varves of light-gray (10YR 7/1), brownish-yellow (10YR 6/6), and yellowish-brown (10YR 5/6) silt and very fine sand are in seams between very thick varves of the matrix clay loam; calcareous.

The reaction of the solum is typically medium acid or slightly acid but ranges to neutral. The Ap horizon ranges from dark brown to very dark grayish brown (10YR 3/2) (dark grayish brown, 10YR 4/2 when rubbed) and dark grayish brown (10YR 4/2) in color and from sand to loamy sand in texture. In some places a light brownish-gray (10YR 6/2) A2 horizon that is 1 to 2 inches thick occurs below the Ap horizon. The B2 horizon ranges from yellowish brown to brownish yellow (10YR 6/6) and light yellowish brown (10YR 6/4). The B3 horizon ranges from pale brown to light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/4-5/6). Iron concretions in the B horizon are few and inconsistent, and hues range from 5YR to 7.5YR. Thickness of the B'21t and IIB'22t horizons is less than 6 inches. The B'21t horizon ranges from strong brown (7.5YR 5/6) to brown (10YR 4/3, 7.5YR 4/4) in color and from loamy sand to sandy loam in texture. The IIB'22t horizon ranges from brown (7.5YR 4/2, 10YR 5/3) to yellowish brown (10YR 5/4) in color and from loam to silty clay loam in texture but is dominantly silty clay loam. The clay content in the IIB'22t horizon is less than 18 percent. The reaction of the IIB 22t horizon ranges from neutral to mildly alkaline. The calcareous IIC horizon ranges from dominantly clay loam to loam and silty clay loam in texture and is at a depth ranging from 20 to 40 inches.

Although they formed in material similar to that giving rise to the Selfridge and Brevort soils, the Metea soils are better drained and have less mottling than those soils.

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Metea soils are shallower and better drained than the well drained or moderately well drained Oakville soils, loamy substratum, which developed in 40 to 66 inches of sand to loamy sand over loam to clay. Typical Oakville soils consist of sand more than 66 inches thick, and Spinks soils are deep sand or loamy sand containing textural bands, or B2t horizons.

Metea sand, 0 to 2 percent slopes (MnA).—This soil occurs throughout the county, generally near soils of similar texture and poorer drainage and soils that are not more than 27 to 37 percent clay in the upper part.

Included with this soil in mapping were small areas of well-drained Oakville and Spinks soils, Oakville soils, loamy substratum, and Boyer soils, loamy subsoil variant. Also included were small areas of somewhat poorly drained Selfridge, Au Gres, Metamora, and Au Gres soils, loamy substratum, in the slight depressions and on the lower edges of natural drainageways. Poorly drained soils of varying textures were included in wet depressions and along natural drainageways. Some small inclusions have slopes of 2 to 6 percent.

Most of this Metea soil is used for corn, small grain, hay, pasture, vegetable crops, and peach and apple orchards and as building sites. Some small areas are idle, are wooded, are used as a wildlife habitat, or are used for recreational purposes. Limitations are moderate and are relatively easy to overcome. The poorly drained and somewhat poorly drained included areas need artificial drainage. Because these spots have a high water table, they are slower to dry out than the better drained areas and field operations are hindered. Management practices that supply organic matter, maintain fertility, and control erosion are needed. Irrigation and growing suitable crops are helpful where droughtiness is a limitation. Capability unit IIIs–3 (4/2a); woodland suitability group G.

Metea sand, 2 to 6 percent slopes (MnB).—This soil occurs throughout the county, generally near soils of similar texture that are more poorly drained.

Included with this soil on the stronger slopes were small areas of moderately well drained to well drained Oakville and Spinks soils, Oakville soils, loamy substratum, and Boyer soils, loamy subsoil variant. Small inclusions of the somewhat poorly drained Selfridge, Au Gres, and Metamora soils, and Au Gres soils, loamy substratum, are in slight depressions and on the lower edges of deep depressions and natural drainageways. Also included were poorly drained soils of varying textures in wet depressions and along natural drainageways, areas having a loamy sand surface layer, and a few small areas with slopes of 6 to 12 percent or 0 to 2 percent.

This Metea soil is used largely for corn, small grain, hay, pasture, vegetable crops, and peach and apple orchards and as building sites. Some small areas are idle or wooded; others are used as a wildlife habitat and for recreational purposes. Limitations are moderate and are relatively easy to overcome. The poorly drained and somewhat poorly drained included areas are wet longer in spring and after rains because of the high water table. Artificial drainage is needed for good crop growth and to improve trafficability. Management that supplies organic matter, maintains fertility, controls erosion, and reduces the hazard of drought is needed. Capability unit IIIs–4 (4/2a); woodland suitability group G.

Miami Series

The Miami series consists of well-drained, medium-textured soils that formed in calcareous loam and silt loam glacial till. These soils are gently sloping to steep. They occur on the moraines, generally near the Celina, Lapeer, and Sisson soils.

The surface layer of a typical Miami soil is dark grayish-brown loam about 8 inches thick. The upper part of the subsoil is dark-brown, friable loam about 6 inches thick. The lower part, about 16 inches thick, is dark-brown, firm clay loam. The underlying material is brown, friable, calcareous loam.

Miami soils have moderate to moderately slow permeability, medium to very rapid runoff, and moderate infiltration. The organic-matter content is low, and natural fertility is moderately high. The available moisture capacity is high.

These soils are used for grains, hay, pasture, and orchards, as building sites, for recreational purposes, and as a wildlife habitat. Some small areas are idle or wooded.

A typical profile of a Miami loam having a slope of 4 percent, in a pasture in the northwest corner, NE¼SW¼ sec. 33, T. 5 N., R. 12 E.:

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

B1—8 to 14 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable; few coarse roots; few cobblestones; neutral; clear, wavy boundary.

B21t—14 to 24 inches, dark-brown (10YR 4/3) clay loam; moderate, medium and coarse, subangular blocky structure; firm; many reddish-brown (5YR 4/3) clay flows; few coarse roots; few cobblestones; neutral; gradual, wavy boundary.

B22t—24 to 30 inches, dark-brown (10YR 4/3) clay loam; moderate, medium and coarse, subangular blocky structure; firm; few reddish-brown (5YR 4/3) clay flows; few coarse roots; few cobblestones; neutral; clear, wavy boundary.

C—30 to 60 inches, brown (10YR 5/3) loam; massive; friable; a few coarse roots to a depth of 40 inches; few cobblestones; calcareous.

The quantity of stones in the A and B horizons ranges from few to many. The Ap horizon ranges from 6 to 9 inches in thickness and from dark grayish brown to very dark grayish brown (10YR 3/2) (dark grayish brown, 10YR 4/2 when rubbed). In some undisturbed areas there is an A2 horizon that ranges from light yellowish brown (10YR 6/4) to light brownish gray (10YR 6/2) in color, from loam to sandy loam in texture, and from 4 to 8 inches in thickness. The B21t horizon ranges from 6 to 10 inches in thickness and from strong brown (7.5YR 5/6) to dark yellowish brown (10YR 4/4) in color. This horizon has very dark grayish-brown (10YR 3/2) coatings on ped faces and in root channels. The B22t horizon is brown (7.5YR 5/4) to dark brown (7.5YR 4/4). The C horizon is at a depth ranging from 20 to 42 inches. It ranges from loam to silt loam in texture and commonly has a structure ranging from moderate, medium, subangular blocky to moderate, medium, platy. In places, however, it is massive.

The Miami soils developed in material similar to that giving rise to the moderately well drained Celina and the somewhat poorly drained Conover soils, but they are better drained and lack the mottling that is present in those soils.

The Miami soils are finer textured than the Lapeer soils, which formed in sandy loam till. The Sisson soils developed in stratified silt and very fine sand.

Miami loam, 2 to 6 percent slopes (MoB).—This soil is on the moraines in the northwestern part of the county. It contains few to many stones. Runoff is medium.

Included with this soil in mapping were small spots of well drained Lapeer, Sisson, and Spinks soils and, on the upper edges of natural drainageways and depressions, small spots of moderately well drained Celina and Dryden soils. Areas of the somewhat poorly drained Conover, Minoa, and Locke soils and the poorly drained Parkhill, Ensley, and Lamson soils were included in wet spots, in wet depressions, and along narrow natural drainageways. Some small inclusions have slopes of 0 to 2 percent or 6 to 12 percent, and in a few small, moderately eroded inclusions the dark-brown subsoil is exposed.

This Miami soil is used largely for corn, small grain, hay, pasture, and apple (fig. 10) and peach orchards. Some small areas are idle or in cutover woodland and brush; others are used as building sites, for recreational purposes, and as a wildlife habitat. Limitations are easily corrected. The main management requirements are additions of organic matter, maintenance of fertility, and control of erosion. Capability unit IIe–2 (2.5a); woodland suitability group B.

Miami loam, 6 to 12 percent slopes (MoC).—This soil is on the moraines in the northwestern part of the county. It contains few to many stones. Runoff is rapid. A few gullies are present, generally in plowed and cultivated fields, along drainageways, and near escarpments.

Included with this soil in mapping were small spots of well drained Lapeer, Sisson, and Spinks soils and, on the upper edges of depressions and along natural drainageways, small spots of moderately well drained Celina and Dryden soils. Some small areas of somewhat poorly drained Conover, Locke, and Minoa soils and poorly drained Parkhill, Ensley, and Lamson soils were included in wet depressions and along narrow natural drainageways. Also included were a few small areas of Linwood and Lupton mucks in the wet spots and wet depressions and small areas that have slopes of 2 to 6 percent or 12 to 18 percent. A few moderately eroded inclusions have the dark-brown subsoil exposed, and in a few small, severely eroded areas the grayish-brown, calcareous underlying material is exposed. There is a scarcity of vegetation in the severely eroded areas.

Figure 10.—**An area of Miami loam, 2 to 6 percent slopes, used for apples and other crops.**

This Miami soil is used chiefly for corn, small grain, hay, permanent pasture, and peach and apple orchards. Smaller areas are idle, are in woodland and brush, are used as building sites or as a wildlife habitat, or are used for recreational purposes. Limitations are moderate because of the slope, droughtiness, and the hazard of erosion. Supplying organic matter and maintaining fertility are major concerns of management. Capability unit IIIe–5 (2.5a); woodland suitability group B.

Miami loam, 12 to 18 percent slopes (MoD).—This soil is on moraines in the northwestern part of the county. Runoff is rapid. The quantity of stones ranges from few to many. On the moderately steep areas, some rill erosion occurs and narrow, shallow water channels have been formed. On the stronger slopes are some gullies that are 3 to 7 feet deep and 3 to 9 feet wide. Generally, these gullies are along natural drainageways and near escarpments.

Included with this soil in mapping were small spots of well drained Lapeer and Sisson soils and, along the upper edges of depressional areas and along natural drainageways, areas of moderately well drained Celina and Dryden soils. A few small inclusions of Linwood and Lupton mucks are in Bruce and Washington Townships. Some small inclusions have slopes of 6 to 12 percent or 18 to 25 percent. Some small moderately eroded inclusions have the dark-brown subsoil exposed, and a few small severely eroded areas have the brown to grayish-brown, calcareous underlying material exposed. There is little vegetation on the severely eroded areas.

This Miami soil is used for permanent pasture, hay, and peach and apple orchards. Small areas are idle, are in woodland and brush, are used for grains and for recreational purposes, or are used as a wildlife habitat. Slope is a major limitation. The chief concerns in management are control of erosion and the maintenance of organic matter and fertility. Capability unit IVe–4 (2.5a); woodland suitability group B.

Miami loam, 18 to 25 percent slopes (MoE).—This soil occupies areas on the moraines in the northwestern part of the county. The quantity of stones ranges from few to many. Runoff is very rapid. Rill and gully erosion are common on this soil, especially along drainageways, near escarpments, and near the base of the stonger slopes.

Included with this soil in mapping were small spots of well-drained Lapeer, Sisson, and Spinks soils, as well as small areas that have slopes of 12 to 18 percent or slopes greater than 25 percent. Small moderately eroded or severely eroded areas were included in some places. Moderate erosion is evident where the dark-brown subsoil is exposed, and severe erosion is evident where the brown to grayish-brown color of the calcareous underlying material is exposed and the vegetative growth is sparse.

This Miami soil is used chiefly for outdoor recreational purposes and as a wildlife habitat. Small areas are idle, in wild pasture, or wooded. Severe limitations because of the steep slopes and hazard of erosion generally make use of this soil impractical for farming. More suitable uses are for recreation, such as ski slopes and sleigh routes, and the establishment of wildlife sanctuaries. Management should include control of erosion and establishment of vegetation. Capability unit VIe–2 (2.5a); woodland suitability group B.

Minoa Series

In the Minoa series are somewhat poorly drained, moderately coarse textured to medium-textured soils. These soils formed in stratified, calcareous fine sand and very fine sand on the lake plains and moraines.

The surface layer of a typical Minoa soil is black fine sandy loam about 9 inches thick. The subsoil, about 6 inches thick, is yellowish-brown, very friable fine sandy loam mottled with faint yellowish brown and light gray. The underlying material is yellowish-brown and light-gray, stratified, very friable fine sand and very fine sand mottled with light gray, faint yellowish brown, and olive.

The Minoa soils are moderately high in natural fertility. They have a high available moisture capacity, moderate to moderately slow permeability, and slow runoff. A seasonal high water table limits the use of these soils in wet periods.

The native vegetation consists of hardwoods, including elm, beech, maple, and basswood. These soils have been largely cleared and are used for corn, wheat, oats, and hay.

A typical profile of Minoa fine sandy loam, 0 to 4 percent slopes, in a brush-covered area, NE¼NW¼NE¼ sec. 6, T. 3 N., R. 12 E.:

Ap—0 to 9 inches, black (N 2/0) fine sandy loam; weak, fine, granular structure; very friable; dark-brown (7.5YR 4/4) stains on some peds; mildly alkaline; abrupt, smooth boundary.

B2—9 to 15 inches, yellowish-brown (10YR 5/8) fine sandy loam; common, medium, faint mottles of yellowish brown (10YR 5/4) and common, medium, distinct mottles of light gray (10YR 6/1); weak, coarse, subangular blocky structure; very friable; mildly alkaline; abrupt, wavy boundary.

C1—15 to 21 inches, yellowish-brown (10YR 5/4) fine sand and very fine sand; common, medium, faint mottles of yellowish brown (10YR 5/8) and common, medium, distinct mottles of light gray (10YR 6/1); massive; very friable; stratified; calcareous; gradual, wavy boundary.

C2g—21 to 42 inches, light-gray (N 6/0) fine sand and very fine sand; few, coarse, prominent mottles of olive (5Y 4/4); massive; very friable; stratified; calcareous.

The solum ranges from 15 to 42 inches in thickness and from slightly acid to mildly alkaline in reaction. The thickness of the A horizon ranges from 6 to 9 inches. The texture of the B horizon ranges from fine sandy loam to silt loam. Thin strata of silty clay loam and silty clay occur in the C horizon in some places.

Minoa soils are finer textured than Au Gres soils, which formed in deep sand, and are coarser textured than Del Rey soils, which developed in lacustrine clay loam to silty clay loam. Minoa soils are better drained than Lamson soils and more poorly drained than Sisson soils.

Minoa fine sandy loam, 0 to 4 percent slopes (MsB).—This soil is on lake plains and moraines.

Included with this soil in mapping were some small areas of somewhat poorly drained Selfridge soils, areas of Lamson soils in small depressions, and well-drained Sisson soils on the slight rises.

Areas of this Minoa soil are used chiefly for corn, wheat, oats, and hay. Some areas are idle, are in pasture, are wooded, or are used as habitat for wetland wildlife. The main limitation is the seasonal high water table. Because this soil dries out slowly in spring and after rain, tillage is hindered. Artificial drainage is needed for good crop growth but is difficult to obtain because of the very fine sand and fine sand below a depth of 15 inches. This sand has a tendency to flow if wet, and tile lines should be blinded to prevent being plugged. Capability unit IIw–6 (3b); woodland suitability group K.

Nappanee Series

In the Nappanee series are somewhat poorly drained, level to gently sloping soils on till plains and moraines. These soils formed in calcareous, clayey glacial till. They have a fine-textured subsoil.

The surface layer of a typical Nappanee soil is dark-brown clay loam about 7 inches thick. The subsoil, about 20 inches thick, is brown, firm silty clay and clay mottled with grayish brown and yellowish brown. The underlying material is grayish-brown, firm silty clay mottled with yellowish brown.

The Nappanee soils are high in natural fertility. The available moisture capacity is high. Permeability and runoff are slow. A seasonal high water table limits use of these soils in wet periods.

The native vegetation consists of hardwoods, including elm, basswood, oak, maple, and hickory. These soils have been largely cleared and are used for corn, wheat, oats, and hay.

A typical profile of Nappanee clay loam in a nearly level idle field, NW¼NW¼NW¼ sec. 6, T. 3 N., R. 14 E.:

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

B21—7 to 13 inches, brown (10YR 5/3) silty clay; common, medium, faint mottles of grayish brown (10YR 5/2) and yellowish brown (10YR 5/8); moderate, medium, angular blocky structure; firm; slightly acid; clear, wavy boundary.

B22t—13 to 27 inches, brown (10YR 5/3) clay; many, medium, faint mottles of grayish brown (10YR 5/2) and yellowish brown (10YR 5/6); weak, medium, columnar structure breaking to moderate, medium, angular blocky; very firm; thin, dark-gray (10YR 4/1) coatings on peds and clay films on some ped faces; slightly acid; clear, wavy boundary.

Cg—27 to 60 inches, grayish-brown (10YR 5/2) silty clay; common, medium, distinct mottles of yellowish brown (10YR 5/4-5/6) and few, fine, distinct mottles of yellowish brown (10YR 5/8); weak, medium, angular blocky structure; firm; calcareous.

The solum is predominantly 24 to 36 inches thick but ranges from 18 to 42 inches in thickness. It ranges from medium acid to neutral in reaction and is 2 to 5 percent cobblestones and gravel. In some undisturbed areas, where there are A1 and A2 horizons, the A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and the A2 is pale brown (10YR 6/3). The Ap horizon ranges from sandy loam to clay loam in texture and from weak to moderate, fine to coarse, granular to weak, medium, subangular blocky in structure. The B21 horizon ranges from silty clay loam to light clay in texture and, in some places, is moderate, coarse, subangular blocky in structure. In some places the C horizon is massive in structure and is gray (5Y 5/1) and brown (10YR 4/3) in color. The clay content in the C horizon ranges from 38 to 48 percent.

The Nappanee soils differ from the Blount soils because they have a higher clay content in the C horizon. The Nappanee soils have 35 to 48 percent clay, and the Blount, 27 to 34 percent. The Nappanee and Fulton soils have similar texture, but the Nappanee developed in glacial till and the Fulton formed in stratified lacustrine deposits. The Nappanee soils are better drained than the poorly drained Hoytville soils.

Nappanee loam, 0 to 2 percent slopes (NaA).—This soil occurs on till plains and moraines. It has a profile similar to that described as typical of the series, but it has a loam surface layer.

Included with this soil in mapping were some small spots with a sandy loam or clay loam surface layer, a few areas having slopes of 2 to 6 percent along natural drainageways and in depressions, and poorly drained areas of Hoytville soils in depressions. Small areas of Blount soils were included on the outer edge of areas mapped as this soil.

This Nappanee soil is used primarily for corn, wheat, oats, and hay. The main limitations are the seasonal high water table and slow permeability. In wet periods workability and trafficability are poor for machinery. The shrink-swell potential is high. Artificial drainage is needed for good crop growth but is difficult to obtain. Capability unit IIIw–2 (1b); woodland suitability group J.

Nappanee clay loam, 0 to 2 percent slopes (NcA).—This soil has the profile described as typical of the series. It occurs on till plains and moraines.

Included with this soil in mapping were a few areas having slopes of 2 to 6 percent along natural drainageways and in depressions, some small spots that have a sandy loam or loam surface layer, and areas of poorly drained Hoytville and Sims soils in depressions.

This Nappanee soil is used mainly for corn, wheat, oats, and hay. A few areas are wooded or are in pasture. The main limitations are the seasonal high water table and slow permeability. In wet periods this soil has poor workability and poor trafficability for machinery. The shrink-swell potential is high. Artificial drainage is needed for good crop growth but is difficult to obtain. Capability unit IIIw–2 (1b); woodland suitability group J.

Nappanee clay loam, 2 to 6 percent slopes (NcB).—This soil occupies areas on till plains and moraines.

Included with this soil in mapping were areas of Hoytville soils in depressions, small areas of Blount soils on the outer edge of areas mapped as this soil, a few small areas of moderately eroded Nappanee soils, and areas having slopes of 6 to 12 percent along natural drainageways.

Areas of this Nappanee soil are used chiefly for corn, wheat, oats, and hay. A few areas are wooded or in pasture. The main limitation is the seasonal high water table. In wet periods workability and trafficability are poor for machinery. The shrink-swell potential is high. Artificial drainage is needed for good crop growth but is difficult to obtain because of the slow permeability and because the slope presents problems in tile drainage layout and installation. Capability unit IIIw–2 (1b); woodland suitability group J.

Oakville Series

The Oakville series consists of well-drained, level to undulating, sandy soils. These soils occur throughout the county on the lake plains and the outwash plains and, in the northwestern corner of the county, on the moraines.

The surface layer of a typical Oakville soil is very dark grayish-brown fine sand about 7 inches thick. The subsoil is loose fine sand about 27 inches thick. It is strong brown and yellowish brown in the upper part and brown in the lower part. The underlying material is pale-brown, loose fine sand.

The Oakville soils have a very low available moisture capacity. Permeability and infiltration are very rapid. Runoff is slow or very slow. The organic-matter content is low, and natural fertility is low.

The native vegetation is mixed hardwoods, mainly oak. Vegetable crops, small grain, and legume-grass hay are the principal crops grown. A large acreage of these soils is idle or is wooded.

A typical profile of Oakville fine sand, 0 to 6 percent slopes, in an idle field, NE¼SE¼SE¼ sec. 10, T. 3 N., R. 12 E.:

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

B21—7 to 13 inches, strong-brown (7.5YR 5/6) fine sand; single grain; loose; few roots; very dark grayish-brown (10YR 3/2) sand in root channels; slightly acid; clear, wavy boundary.

B22—13 to 22 inches, yellowish-brown (10YR 5/6) fine sand; single grain; loose; few roots; slightly acid; clear, wavy boundary.

B3—22 to 34 inches, brown (10YR 5/3) fine sand; single grain; loose; few roots; slightly acid; gradual, wavy boundary.

C—34 to 66 inches, pale-brown (10YR 6/3) fine sand; single grain; loose; neutral.

The solum has formed in medium and fine sand and is typically slightly acid to neutral but ranges to very strongly acid. In some places where the A2 and B horizons are very strongly acid, the pH is more than 5.5 in some part of the profile above a depth of 40 inches. Mottles with a chroma greater than 2 occur at a depth of 16 to 36 inches where this soil is moderately well drained. The Ap horizon is typically very dark grayish brown but ranges to dark yellowish brown (10YR 5/4) and dark grayish brown (10YR 4/2) in color and from fine sand to loamy sand in texture. In some places a brown (10YR 5/3) or dark grayish-brown (10YR 4/2) A2 horizon occurs below the Ap horizon and ranges up to 10 inches in thickness. The B21 horizon includes hues of 10YR and 7.5YR, a value of 4 or 5, and a chroma or 4, 6, or 8. The B22 horizon includes hues of

7.5YR and 10YR, a value of 4 or 5, and a chroma of 4 or 6. Where the B21 horizon is lighter in color than the B22, it is interpreted as a B1 horizon and the B21 horizon may be absent. The B3 horizon ranges from brown to light yellowish brown (10YR 6/4), brownish yellow (10YR 6/6), or yellowish brown (10YR 5/4–5/6). The C horizon is pale brown to brown (10YR 5/3) in color and may contain discontinuous strong-brown (7.5 YR 5/6) bands. The reaction of the C horizon is typically neutral to moderately alkaline, but it ranges to medium acid in some places. Discontinuous Bt horizons of loamy sand, ⅛ to ½ inch thick, occur below a depth of 60 inches in some places.

The Oakville soils are coarser textured than the Spinks soils, which have thin, finer textured Bt horizons. Oakville soils are better drained and lack the mottling and gray color of the somewhat poorly drained Au Gres soils and the poorly drained Granby soils.

Oakville fine sand, 0 to 6 percent slopes (OaB).—Areas of this soil occur throughout the county. Runoff is very slow.

Included with this soil in mapping were small spots of well-drained Spinks, Lapeer, Boyer, Oakville soils, loamy substratum, and Sisson soils. Also included were small spots of moderately well drained Dryden soils and, at lower elevations, somewhat poorly drained Wasepi, Locke, and typical Au Gres soils, and Au Gres soils, loamy substratum. Poorly drained inclusions of Granby, Gilford, Ensley, and Lamson soils are in wet spots, in wet depressions, and along natural drainageways. Some inclusions have texture ranging from sand to stratified layers of fine sand and very fine sand with some thin silt bands. Other inclusions have calcareous sand and gravel below a depth of 42 inches. Some small moderately well drained inclusions have dark yellowish-brown, yellowish-brown, and brownish-yellow streaks, spots, and splotches below a depth of 16 to 36 inches.

This Oakville soil is used mainly for vegetable crops, pasture, hay, and small grain. A large area is idle or is wooded, and smaller areas are used as building sites (fig. 11), for recreational purposes, as a wildlife habitat, and as a source of sand and fill material. Limitations are severe because of droughtiness and the hazard of soil blowing. Irrigation helps to reduce droughtiness. Management that supplies organic matter, maintains fertility, and controls soil blowing is helpful. The poorly drained and somewhat poorly drained areas included with this soil in mapping need artificial drainage to improve management and to reduce the limitations of this soil. Capability unit IVs—4 (5a); woodland suitability group E.

Figure 11.—An area of Oakville fine sand, 0 to 6 percent slopes, that is well suited to residential development. Basements generally remain dry.

Oakville fine sand, loamy substratum, 0 to 6 percent slopes (OkB).—Areas of this soil occur throughout the county. Permeability is very rapid in the sandy material and slow in the loamy substratum. Runoff is slow. The profile of this soil is similar to that described as typical of the series, except that at a depth ranging from 40 to 66 inches the underlying material ranges from loam to clay in texture.

Included with this soil in mapping were small areas of well-drained typical Oakville, Metea, and Spinks soils, which generally are on the upper slopes. Also included were many small areas of somewhat poorly drained Au Gres soils, loamy substratum, typical Au Gres soils, and Selfridge soils on the lower slopes and adjacent to drainageways and in depressions. Inclusions of the poorly drained Granby, Brevort, Lamson, and Gilford soils are in wet depressions and along narrow natural drainageways. Some small inclusions are underlain by silt and very fine sand at a depth of less than 40 inches. A few small moderately eroded inclusions have the light yellowish-brown and strong-brown subsoil exposed. In these eroded areas, the depth to the loam substratum is about 40 inches.

This Oakville soil is used largely for corn, small grain, hay, pasture, and peach and apple orchards. Some areas are idle or wooded. Other uses are as building sites, as a wildlife habitat, for recreational purposes, and as a source of sandy material. Limitations are severe because of the sandy texture, droughtiness, low fertility, low organic-matter content, and the hazard of soil blowing. Because of the high and seasonal high water table in the poorly drained and somewhat poorly drained included areas, artificial drainage is needed for good crop growth. Management that regularly adds organic matter, maintains fertility, and controls soil blowing is helpful. Capability unit IVs–4 (5/2a); woodland suitability group E.

Parkhill Series

In the Parkhill series are poorly drained, level and nearly level, medium-textured soils. These soils developed in calcareous loam and silt loam glacial till. They are on the glacial till plains in the northern part of the county and in the depressions on the moraines in the northwestern corner of the county. They are mapped alone and in a complex with Ensley soils.

The surface layer of a typical Parkhill soil is very dark gray loam about 8 inches thick. The subsurface layer, about 4 inches thick, is dark-gray, friable loam mottled with light gray and yellowish brown. The upper part of the subsoil is gray, friable loam mottled with light gray and yellowish brown; it is about 4 inches thick. The lower part, about 20 inches thick, is grayish-brown, firm clay loam that contains yellowish-brown mottles. The underlying material is gray, firm loam mottled with light gray, brown, dark grayish brown, and yellowish brown.

Parkhill soils are low to high in organic-matter content and high in natural fertility. If these soils are not artificially drained, the water table is near the surface much of the year. Infiltration is slow, permeability is moderately slow, the available moisture capacity is high, and runoff is slow or ponded.

The native vegetation consists of elm, maple, ash, hickory, and oak. Most of the original forest cover has been cut over, and the land cleared. Crops grown are corn, wheat, oats, navy beans, soybeans, and alfalfa-brome for hay and pasture. The few small woodlots that remain contain low-quality timber.

A typical profile of Parkhill loam in a nearly level hayfield, SE¼SW¼SW¼ sec. 16, T. 5 N., R. 14 E.:

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

A3g—8 to 12 inches, dark-gray (10YR 4/1) loam; common, medium, distinct mottles of light gray (10YR 6/1) and yellowish brown (10YR 5/8); moderate, medium, subangular blocky structure; friable; many roots; slightly acid; clear, wavy boundary.

B21tg—12 to 16 inches, gray (10YR 5/1) heavy loam; common, medium, faint mottles of light gray (10YR 6/1) and common, medium, distinct mottles of yellowish brown (10YR 5/6); weak, medium, subangular blocky structure; friable; many roots; slightly acid; clear, wavy boundary.

B22tg—16 to 36 inches, grayish-brown (10YR 5/2) heavy clay loam; common, medium, distinct mottles of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/8); moderate, coarse, subangular blocky structure; firm; many roots to a depth of 26 inches and few roots below that depth; slightly acid; abrupt, wavy boundary.

Cg—36 to 60 inches, gray (10YR 5/1) loam; common, medium, faint mottles of light gray (10YR 6/1) and common, medium, distinct mottles of brown (10YR 5/3), dark grayish brown (10YR 4/2), and yellowish brown (10YR 5/6); massive; firm; calcareous.

The thickness of the solum ranges from 24 to 42 inches. The Ap horizon ranges from 7 to 9 inches in thickness, from black (10YR 2/1) to very dark gray to very dark grayish brown (10YR 3/2) in color, from slightly acid to mildly alkaline in reaction, and from low to high in organic-matter content. The B2g horizon is loam to silty clay loam, neutral to slightly acid, and grayish brown to gray (N 6/0, 5Y 5/1). The C horizon ranges from dark grayish brown (10YR 4/2) to dark yellowish brown (10YR 4/4) and gray (N 6/0) and contains mottles ranging from brown to yellowish brown and light gray. In some places the C horizon has a weak, coarse or medium, subangular blocky structure. Cobblestones and stones occur throughout the profile in a few areas.

The poorly drained Parkhill soils developed in material similar to that giving rise to the somewhat poorly drained Conover, moderately well drained Celina, and well drained Miami soils. Parkhill soils have finer textured B and C horizons than Ensley soils and are coarser textured throughout than Sims soils.

Parkhill loam (0 to 2 percent slopes) (Pa).—This soil occurs on level till plains and in depressions on the morainic uplands.

Included with this soil in mapping were small spots of somewhat poorly drained Conover soils at the slightly higher elevations, sand spots that are less than 18 inches thick on the level till plains, and small areas of shallow Linwood soils on the morainic uplands. Also included were small spots of Blount, Nappanee, Sims, Hoytville, and Lamson soils.

This Parkhill soil is used largely for corn, small grain, hay, pasture, navy beans, and soybeans. It is wet longer in spring and after rain than better drained soils of similar texture. The high water table and poor bearing capacity are slight limitations for growing farm crops. Drained areas are more easily tilled than undrained ones. If worked when wet, this soil becomes hard and cloddy. Management that includes artificial drainage, supplies organic matter, and maintains soil structure is important. Capability unit IIw-4 (2.5c); woodland suitability group P.

Paulding Series

In the Paulding series are poorly drained, fine-textured soils that developed in calcareous lacustrine clay. These are level and nearly level or depressional soils on lake plains in the central and eastern parts of the county.

The surface layer of a typical Paulding soil is dark-gray, firm clay about 7 inches thick. The subsoil, about 18 inches thick, is gray, firm to very firm clay mottled with yellowish brown. The underlying material is gray, very firm, calcareous clay mottled with light olive brown.

Paulding soils are high in natural fertility. They have a high available moisture capacity, very slow permeability, and very slow or ponded runoff. Undrained areas are wet most of the year because of the high water table.

The native vegetation consists of deciduous swamp forest, including elm, ash, hickory, soft maple, and basswood, as well as some marsh grasses. Undrained areas are in permanent pasture, are idle, or are in second-growth forest. Drained areas are used for corn, wheat, oats, and hay.

A typical profile of Paulding clay in a nearly level idle field in the northeast corner, SW¼SW¼ sec. 20, T. 3 N., R. 14 E.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) clay; moderate, fine, angular blocky structure; firm; neutral; abrupt, smooth boundary.

B21g—7 to 10 inches, gray (5Y 5/1) clay; common, fine, distinct mottles of yellowish brown (10YR 5/4–5/6); moderate, fine, angular blocky structure breaking to moderate, very fine, angular blocky; firm; neutral; clear, wavy boundary.

B22g—10 to 20 inches, gray (5Y 5/1) clay; many, fine, distinct mottles of yellowish brown (10YR 5/6); moderate, coarse, angular blocky structure; very firm; mildly alkaline; gradual, wavy boundary.

B23g—20 to 25 inches, gray (5Y 5/1) clay; many, fine, distinct mottles of yellowish brown (10YR 5/6); moderate, coarse, angular blocky structure; very firm; mildly alkaline; clear, wavy boundary.

C1g—25 to 28 inches, gray (N 5/0) clay; many, medium, distinct mottles of light olive brown (2.5Y 5/6); moderate, coarse, angular blocky structure breaking to weak, medium and fine, angular blocky; very firm; slight effervescence; calcareous; abrupt, wavy boundary.

C2g—28 to 42 inches, gray (N 5/0) clay; many, medium, distinct mottles of light olive brown (2.5Y 5/6); moderate, coarse, angular blocky structure breaking to moderate, medium and fine, angular blocky;

very firm; common, fine, light-gray (2.5Y 7/2) lime concretions; calcareous.

The thickness of the solum ranges from 24 to 42 inches. The Ap horizon ranges from 5 to 9 inches in thickness, from firm to very firm in consistence, and from slightly acid to neutral in reaction. Its color is typically dark gray (5Y 4/1, 10YR 4/1), and its structure is moderate, fine, subangular blocky to strong, coarse, angular blocky. The total thickness of the B horizons ranges from 18 to 36 inches; the structure ranges from weak to strong, fine to coarse, angular blocky; the consistence is firm to extremely firm; and the reaction is slightly acid to mildly alkaline. The B horizons range from dark gray (5Y 4/1) to light brownish gray (10YR 6/2) and contain common to many, medium to coarse, distinct to prominent mottles that range from strong brown (7.5YR 5/6) to yellowish brown. The C horizons range from light brownish gray (10YR 6/2) to gray (5Y 5/1) and contain common to many, medium to coarse, distinct to prominent mottles that are light olive brown to yellowish brown (10YR 5/4) to dark grayish brown (10YR 4/2). The C horizons are moderate, coarse, angular blocky in structure or are massive.

Paulding soils have a clay content of 60 to 75 percent, whereas Toledo soils have a clay content of 40 to 60 percent.

Paulding clay (0 to 2 percent slopes) (Pc).—This soil is on the lake plains. Some areas are in depressions.

Included with this soil in mapping were small spots of Toledo soils and a few small spots of Selfridge soils.

Limitations for farming are moderate. The shrink-swell potential is high. The high water table limits root development and tillage operations. Wet areas become plastic and sticky, and trafficability is difficult. This soil is difficult to drain because of its very slow permeability. Open ditch drainage is the most practical method. Capability unit IIIw-1 (Oc); woodland suitability group P.

Sanitary Land Fill

Sanitary land fill (Sa) consists of areas, generally at the outskirts of cities, where municipal and industrial wastes have been dumped. These wastes are made up of garbage, noncombustible rubbish, or both. Thin layers of earthy material, commonly less than 8 inches thick, are mixed with the rubbish.

Areas no longer used as dumping grounds for wastes have been leveled and are now idle. They have potential as recreation sites, such as golf courses, play areas, and picnic areas. Because each area differs in composition, onsite investigation is needed before the area is developed for any use. Not placed in a capability unit or woodland suitability group.

Saranac Series

In the Saranac series are poorly drained, level and nearly level, moderately fine textured soils. These are alluvial soils on flood plains of rivers and streams and are subject to flooding one or more times each year. The quantity of deposition is highly variable.

The surface layer of a typical Saranac soil is very dark gray clay loam about 11 inches thick. The subsoil is dark-gray and gray silty clay and silty clay loam about 18 inches thick. It is mottled with dark yellowish brown, yellowish brown, and light gray. The underlying material consists of layers of dark-gray silty clay loam, gray and yellowish-brown clay loam, light-gray sandy clay loam, and gray sand. This material contains mottles of dark brown, olive, dark yellowish brown, and yellowish brown.

The surface layer of these soils is medium in organic-matter content. Natural fertility is moderately high. The water table is seasonally high. Infiltration is moderate, permeability is moderately slow, and the available moisture capacity is high. Runoff is very slow or ponded.

The native vegetation consists of elm, oak, maple, and various kinds of grasses. Because of the high water table and periodic flooding, the use of these soils is restricted to wildlife habitat and intermittent pasture.

A typical profile of Saranac clay loam in a nearly level pasture, NE¼NW¼SE¼ sec. 36, T. 4 N., R. 13 E.:

A1—0 to 11 inches, very dark gray (10YR 3/1) clay loam; weak, medium, subangular blocky structure; friable; high in organic-matter content; mildly alkaline; clear, smooth boundary.

B21g—11 to 18 inches, dark-gray (10YR 4/1) silty clay; common, medium, distinct mottles of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4); moderate, coarse, angular blocky structure; firm; mildly alkaline; clear, smooth boundary.

B22g—18 to 29 inches, gray (10YR 5/1) silty clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/6) and few, fine, faint mottles of light gray (10YR 6/1); moderate, coarse, angular blocky structure; firm; mildly alkaline; clear, smooth boundary.

C1g—29 to 40 inches, dark-gray (10YR 4/1) silty clay loam; common, medium, distinct mottles of dark brown (10YR 4/3); massive; firm; gray (10YR 5/1) 1/16-inch sand lenses throughout the horizon; mildly alkaline; clear, smooth boundary.

C2g—40 to 46 inches, gray (10YR 5/1) and yellowish-brown (10YR 5/6) clay loam; few, medium, distinct mottles of dark brown (7.5YR 4/4); massive; firm; gray (10YR 5/1) 1/8-inch sand lenses throughout the horizon; mildly alkaline; clear, smooth boundary.

C3g—46 to 50 inches, light-gray (5Y 6/1) sandy clay loam; common, medium, distinct mottles of olive (5Y 5/6); common, medium, prominent mottles of yellowish brown (10YR 5/4), and few, medium, prominent mottles of dark yellowish brown (10YR 4/4); massive; mildly alkaline; abrupt, smooth boundary.

C4g—50 to 60 inches, gray (5Y 5/1) sand; single grain; loose; clay varves of light gray (5Y 6/1) and olive (5Y 5/6) throughout; mildly alkaline.

The A1 horizon ranges from 10 to 20 inches in thickness, from light clay loam to light silty clay loam in texture, and from weak, medium, granular to weak, coarse, angular blocky in structure. The upper 1 to 2 inches of the A1 horizon is calcareous in some places. Reaction of the B and C horizons ranges from neutral to moderately alkaline. The texture of the upper part of the C horizon ranges from clay loam to silty clay, and that of the lower part ranges from sandy clay loam to sand. In the C horizons are 1/2- to 6-inch bands of coarser and finer textured alluvial sediments ranging from sand to clay. These bands vary from none to 6 or more in number.

The Saranac soils are finer textured than the medium-textured, poorly drained Sloan soils.

Saranac clay loam (0 to 2 percent slopes) (Sc).—This soil is on the flood plains of rivers and streams in the central and eastern parts of the county. Flooding from stream overflow occurs one or more times each year.

Where the stream channel has been deepened and straightened, the material from the new channel has been spread over the original surface of the soil.

Included with this soil in mapping were small spots of other alluvial soils that are coarser in texture and a few small spots of muck soils.

Nearly all of this soil is wooded, is in pasture, or is idle. A few areas are used for small grain or meadow. Pit-type ponds for wildlife and irrigation are in a few places. The high water table and frequent flooding are major limitations. Capability unit Vw-3 (L-2c); woodland suitability group O.

Selfridge Series

The Selfridge series consists of nearly level to gently sloping, somewhat poorly drained soils. These soils are made up of sand or loamy sand 20 to 40 inches deep over calcareous loam to silty clay loam. They occur on lake plains, till plains, outwash plains, and moraines but are most common on the lake plains. They are mapped alone and also in complexes with the Lamson, the Brevort, and the Lenawee soils.

The surface layer of a typical Selfridge soil (fig. 12) is very dark grayish-brown fine sand about 9 inches thick. The main part of the subsoil, about 20 inches thick, is brown and yellowish-brown, loose fine sand with mottles of yellowish brown, grayish brown, and brown. The lower part of the subsoil is reddish-brown clay loam about 3 inches thick. The underlying material is reddish-brown, friable, calcareous clay loam containing mottles of greenish gray and strong brown.

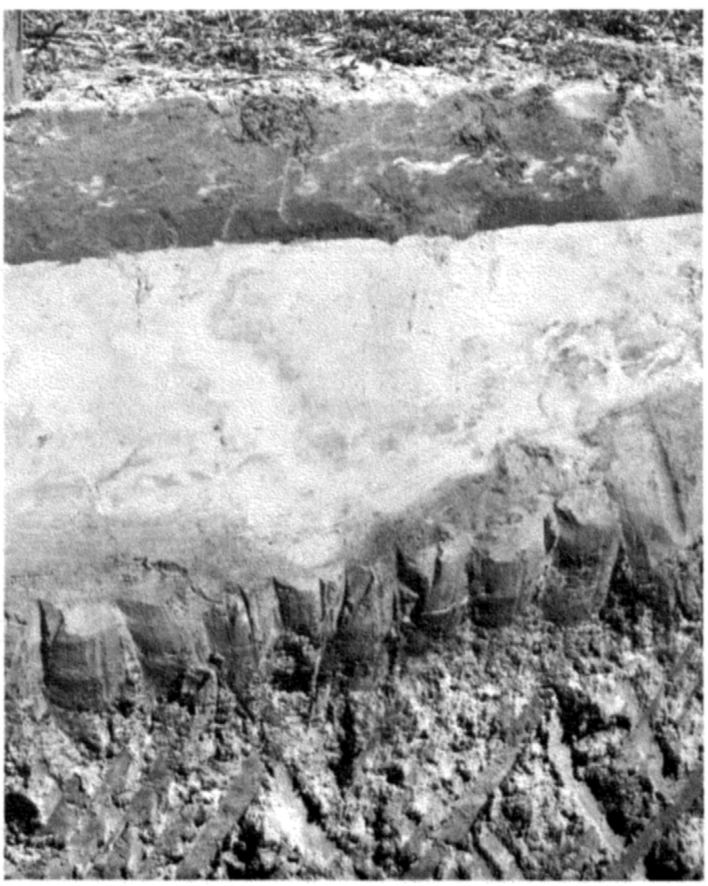

Figure 12.—**Profile of Selfridge fine sand showing highly contrasting horizons.**

The Selfridge soils are low in natural fertility. Above a depth of 20 to 40 inches, the available moisture capacity is low and permeability is rapid. Below this depth, the soils have a medium available moisture capacity and moderately slow permeability. Runoff is very slow or slow.

The native vegetation consists of hardwoods, mainly elm, ash, and basswood. Most areas are cultivated and used for vegetable crops, corn, wheat, oats, and hay. A few areas are idle or are in second-growth forest. In a few areas close to the cities, the uppermost 20 to 40 inches of sandy material have been excavated.

A typical profile of Selfridge fine sand, 0 to 2 percent slopes, in a cultivated field in the northeast corner, NW¼NW¼ sec. 18, T. 2 N., R. 13 E.:

Ap—0 to 9 inches, very dark grayish brown (10YR 3/2) fine sand; weak, fine, granular structure; very friable; few roots; slightly acid; abrupt, smooth boundary.

B1—9 to 24 inches, brown (10YR 5/3) fine sand; common, fine, faint mottles of yellowish brown (10YR 5/6) and grayish brown (10YR 5/2); single grain; loose; few roots; discontinuous streaks of strong-brown (7.5YR 5/8) sand; medium acid; clear, wavy boundary.

B21—24 to 29 inches, yellowish-brown (10YR 5/6) fine sand; common, fine, faint mottles of yellowish brown (10YR 5/8) and brown (10YR 5/3); single grain; loose; neutral; abrupt, wavy boundary.

IIB22t—29 to 32 inches, reddish-brown (5YR 5/3) clay loam; many, fine, distinct mottles of strong brown (7.5YR 5/6) and greenish gray (5GY 6/1); weak, fine, angular blocky structure; friable; few thin grayish-brown (10YR 5/2) clay films on ped faces; mildly alkaline; clear, wavy boundary.

IIC—32 to 42 inches, reddish-brown (5YR 5/3) clay loam; many, fine, distinct mottles of strong brown (7.5YR 5/6) and greenish gray (5GY 6/1); massive; friable; thin varves of silt; many lime concretions; sand on structural planes; calcareous.

The depth to calcareous loam to silty clay loam ranges from 24 to 40 inches, but typically it is 24 to 36 inches. The solum ranges from medium acid to mildly alkaline in reaction. The Ap horizon ranges from very dark grayish brown to very dark gray (10YR 3/1) and very dark brown (10YR 2/2) in color and from fine sand to loamy sand in texture. In some places there is a 2- to 4-inch A2 horizon of grayish-brown (10YR 5/2) sand or loamy sand below the Ap horizon. The matrix color of the B1 horizon ranges from brown to yellowish brown (10YR 5/6) and dark brown (10YR 4/3). The texture of the B1 horizon ranges from fine sand to loamy sand. The matrix color of the B21 horizon ranges from yellowish brown to pale brown (10YR 6/3), and the color of the mottles ranges from yellowish brown and brown to light gray (10YR 7/2). The texture of the B21 horizon is loamy sand in some places. In some areas a B22t horizon, 1 to 3 inches thick, of dark-brown (10YR 4/3) heavy loamy sand or sandy loam is above the IIBt horizon. The IIC horizon has a matrix hue of 5YR to 10YR and a texture ranging from loam to silty clay loam. Thin varves of silt and very fine sand in the IIC horizon range from none to many.

The Selfridge soils developed in material similar to that giving rise to the poorly drained Brevort soils, but they are better drained than those soils. They differ from typical Au Gres soils in being underlain at a depth of 24 to 40 inches by loam to silty clay loam; the typical Au Gres soils formed in deep sand. The Au Gres soils, loamy substratum, developed in 40 to 66 inches of sand to loamy sand over calcareous loam to silty clay. The Selfridge soils are coarser textured than the Metamora soils, which formed in 20 to 40 inches of fine sandy loam underlain by calcareous loam to silty clay loam.

Selfridge fine sand, 0 to 2 percent slopes (SdA).—This soil occupies areas throughout the county. Runoff is very slow.

Included with this soil in mapping were small areas of better drained soils on knolls and slight rises, small areas having slopes of 2 to 6 percent, and small areas of other somewhat poorly drained soils. Also included were poorly drained soils of varying textures that occur in wet depressions and along natural drainageways. The surface layer of some inclusions is sand or sandy loam.

This Selfridge soil is used mainly for corn, small grain, hay, pasture, and vegetable crops. Some small areas are idle or wooded. Some areas are drained and used as building sites. Because of the seasonal high water table, limitations are moderate. Artificial drainage is a major management requirement. This soil is slower to warm up and is wet longer in spring and after rain than better drained soils of similar texture. This wetness hinders early plowing and planting. Management practices that supply organic matter, maintain fertility, and control soil blowing are helpful. Capability unit IIIw–9 (4/2b); woodland suitability group K.

Selfridge fine sand, 2 to 6 percent slopes (SdB).—This soil occurs throughout the county. Runoff is slow.

Included with this soil in mapping were small areas of well drained to moderately well drained soils having stronger slopes, small areas of Metamora and Minoa soils, and areas of poorly drained soils of varying textures in the wet depressions and along natural drainageways. Some inclusions of Selfridge fine sand have slopes of 6 to 12 percent, and others have slopes of 0 to 2 percent. Inclusions of the somewhat poorly drained Conover soils of the till plains and the Del Rey soils of the lake plains are on the lower edges of slopes and along the natural drainageways. The surface layer is sand in some included areas and ranges to sandy loam in others.

Most areas of this Selfridge soil are used for corn, small grain, hay, pasture, and vegetables. Some small areas are idle or are wooded. Some areas have been drained and are used as building sites. Limitations are moderate because of the seasonal high water table. Artificial drainage is a major management requirement, but a complete drainage system is difficult to design and lay out because of the undulating slopes and the short distances between drainageways. Surface drainage and interceptor tiles are useful in removing excess water. Management that supplies organic matter, maintains fertility, and controls erosion is helpful. Capability unit IIIw–9 (4/2b); woodland suitability group K.

Selfridge-Lamson complex, 0 to 2 percent slopes (SeA).—This complex consists of level, nearly level, and depressional soils on till plains and lake plains. The Selfridge soil makes up 60 percent of this complex, and the Lamson soil, 40 percent. The somewhat poorly drained Selfridge soil occurs at slightly higher elevations than the poorly drained Lamson soil. The Lamson soil is in small channels and depressions that are too small and in too intricate patterns to be mapped separately. The soils of this complex have a profile similar to the one described as typical of their respective series.

The use and limitations of this complex are similar to those for the Selfridge and Lamson soils. A seasonal high water table is the major limitation, and artificial drainage is helpful. The organic-matter content is low in the Selfridge soils and high in the Lamson soils. The available moisture capacity is low in the Selfridge soils and high in the Lamson soils. Management practices that maintain the soil structure of the Lamson soils and control soil blowing on both soils of this complex are helpful. Because drained areas dry out more quickly in spring and after rain, their workability is better than that of undrained areas. Both soils in capability unit IIIw–9 (4/2b, 3c); Selfridge soil in woodland suitability group K; Lamson soil in woodland suitability group S.

Selfridge-Lenawee complex, 0 to 4 percent slopes (SfB).—This complex consists partly of a somewhat poorly drained, coarse-textured Selfridge soil that is 20 to 40 inches thick over poorly drained, finer textured soil material. Also in the complex is a poorly drained, moderately fine textured Lenawee soil. Both soils are level to gently sloping and lie on the lake plains. Selfridge sand makes up nearly 70 percent of the complex, and Lenawee clay loam, nearly 30 percent. The Lenawee soil occupies positions that are 6 inches to about 3 feet lower than the Selfridge soil, and it generally occurs in oblong depressions. Permeability is rapid in the sandy material of the Selfridge soil and moderately slow in the finer textured material of the Lenawee soil. Natural fertility is low in the Selfridge soil but is high in the Lenawee soil. The soils of this complex have a profile similar to the one described as typical of their respective series.

Included with this complex in mapping were small areas of soils consisting of sand to a variable depth.

The use and limitations of this complex are similar to those for the Selfridge and Lenawee soils. Use for farm crops is moderately limited. Wheat, oats, corn, grasses and legumes for hay and pasture, and truck crops are grown. Artificial drainage will lower the high water table. Maintenance of organic matter and fertility and the control of soil blowing on the sandy Selfridge soil and maintenance of soil structure on the Lenawee soil are major concerns of management. Both soils in capability unit IIIw–9 (4/2b, 1.5c); Selfridge soil in woodland suitability group K; Lenawee soil in woodland suitability group P.

Shoals Series

Soils of the Shoals series are somewhat poorly drained, level to nearly level, and medium textured. These are alluvial soils that formed on flood plains or rivers and streams and are subject to flooding one or more times each year. The quantity of deposition is highly variable.

The surface layer of a typical Shoals soil is dark grayish-brown loam about 10 inches thick. The subsurface layer, about 5 inches thick, is dark grayish-brown, friable silt loam with grayish-brown mottles. The underlying material is dark-brown and yellowish-brown, friable silt loam that contains yellowish-brown and grayish-brown mottles.

The surface layer of these soils is moderate in organic-matter content. Natural fertility is medium. The water table is seasonally high. Infiltration is moderately rapid, permeability is moderate, and the available moisture capacity is high. Runoff is very slow or ponded.

The native vegetation consists of elm, oak, maple, ash, hickory, and various kinds of grasses. These soils are better suited to use as a wildlife habitat and intermittent pasture than to use as cropland.

A typical profile of Shoals loam in a nearly level idle field, SW¼SW¼SW¼ sec. 16, T. 2 N., R. 13 E.:

A11—0 to 10 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A12—10 to 15 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint mottles of grayish brown (10YR 5/2); weak, medium, subangular blocky structure; friable; many roots; mildly alkaline; gradual, wavy boundary.

C1—15 to 36 inches, dark-brown (10YR 4/3) silt loam; common, fine, faint mottles of yellowish brown (10YR 5/4); weak, coarse, subangular blocky structure; friable; many roots are present to a depth of 30 inches and few roots are below that depth; mildly alkaline; gradual, wavy boundary.

C2—36 to 54 inches, yellowish-brown (10YR 5/4) silt loam; few, medium, distinct mottles of grayish brown (10YR 5/2) and few, medium, faint mottles of yellowish brown (10YR 5/6); weak, coarse, subangular blocky structure; friable; mildly alkaline.

The A1 horizon ranges from 8 to 20 inches in thickness and from loam to silt loam in texture. It is typically dark grayish brown in color. Reaction of the soil is neutral to mildly alkaline above a depth of 20 inches and is mildly alkaline to moderately alkaline below 20 inches. The C horizons range from loam to silt loam in texture and have 1/2- to 6-inch bands of coarser and finer textured alluvial sediments ranging from sand to clay. These bands range from none to 6 or more in number.

The Shoals soils are finer textured than the somewhat poorly drained, moderately coarse textured Ceresco soils. They have a texture similar to that of the poorly drained Sloan soils but are better drained.

Shoals loam (0 to 2 percent slopes) (Sh).—This soil occupies flood plains of rivers and streams throughout the county. Flooding occurs one or more times each year. Where the stream channel has been deepened and straightened in some areas, material from the new channel has been spread over the original surface layer.

Included with this soil in mapping were large spots of other alluvial soils and a few small areas of muck.

Nearly all of this soil is wooded, is in pasture, or is idle. A few areas are used for small grain or meadow. Pit-type ponds for wildlife and irrigation are in a few places. The seasonal high water table and frequent flooding are limitations to the use of this soil. Capability unit Vw-3 (L-2c); woodland suitability group O.

Sims Series

In the Sims series are poorly drained, moderately fine textured soils on till plains. These are level or nearly level soils that formed in calcareous silty clay loam and clay loam glacial till. They occur along natural drainageways.

The surface layer of a typical Sims soil is very dark gray, friable clay loam about 8 inches thick. The upper part of the subsoil, about 9 inches thick, is dark-gray, firm silty clay loam mottled with dark yellowish brown. The lower part, about 13 inches thick, is dark-brown, firm heavy silty clay loam containing gray mottles. The underlying material is dark yellowish-brown, calcareous, firm silty clay loam mottled with gray.

Sims soils are high in organic-matter content and natural fertility. The available moisture capacity is high, and shrink-swell potential is moderate to high. Permeability is moderately slow, drainage is poor, and runoff is slow or ponded. The water table is high much of the year, and workability is somewhat difficult.

Most areas are used for grains, hay, and pasture. Small areas are wooded or are idle.

A typical profile of Sims clay loam in a nearly level wheatfield, NE¼NE¼SW¼ sec. 28, T. 5 N., R. 14 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) clay loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

B21g—8 to 17 inches, dark-gray (10YR 4/1) silty clay loam; common, medium, distinct mottles of dark yellowish brown (10YR 4/4); moderate, medium, subangular blocky structure; firm; old root channels that are 1 to 2 inches in diameter contain very dark gray (10YR 3/1) clay loam; dark-gray (10YR 4/1) clay skins on ped faces; slightly acid; clear, wavy boundary.

B22—17 to 30 inches, dark-brown (10YR 4/3) heavy silty clay loam; common, fine, distinct mottles of gray (10YR 5/1); moderate, medium, angular blocky structure; firm; old root channels that are 1 to 2 inches in diameter contain very dark gray (10YR 3/1) clay loam; dark-gray (10YR 4/1) patchy clay skins on ped faces; neutral; clear, wavy boundary.

C—30 to 54 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, fine, distinct mottles of gray (10YR 5/1); weak, coarse, angular blocky structure; firm; dark gray (10YR 4/1) on some ped faces; calcareous.

The Ap horizon ranges from 7 to 9 inches in thickness and from very dark gray to very dark brown (10YR 2/2) in color. The B21g horizon ranges from 8 to 10 inches in thickness, from dark gray to grayish brown (10YR 5/2) in color, and from clay loam to silty clay loam in texture. The B22 horizon ranges from 10 to 20 inches in thickness, from silty clay to heavy silty clay loam in texture, and from slightly acid to mildly alkaline in reaction. The C horizon ranges from light clay loam to silty clay loam in texture and has weak, coarse, angular blocky structure or is massive. In some places the C horizon is 10 to 15 percent fine gravel.

The Sims soils differ from the Parkhill soils because they have finer textured B and C horizons. The Sims soils contain less clay in the B horizons than the Hoytville soils, which also formed in glacial till. Sims soils and Lenawee soils have similar texture, but the latter developed in lacustrine material.

Sims clay loam (0 to 2 percent slopes) (Sl).—This soil occurs along natural drainageways and on the till plains and moraines. It formed in calcareous clay loam or silty clay loam glacial till, generally near Parkhill, Hoytville, Blount, and Conover soils.

Included with this soil in mapping were small areas of the poorly drained Hoytville and Parkhill soils and, on slight rises, small areas of the somewhat poorly drained Blount, Conover, and Nappanee soils.

This Sims soil is used primarily for small grain, pasture, and hay. Small areas are wooded or are idle. Limitations are the high water table much of the year, moderate to high shrink-swell potential, and moderately slow permeability. Artificial drainage is a major management requirement. Drainage lowers the water table and makes the soil more suitable for cultivation. Capability unit IIw–2 (1.5c); woodland suitability group P.

Sisson Series

The Sisson series consists of well-drained, gently sloping and sloping soils that occur mainly in the western part of the county. These soils developed in lacustrine and alluvial deposits consisting of calcareous silt and very fine sand.

The surface layer of a typical Sisson soil is very dark grayish-brown fine sandy loam about 7 inches thick. The subsurface layer is pale-brown, very friable silt loam about 2 inches thick. The subsoil, about 20 inches thick, is yellow and strong-brown, very friable and friable silt loam. The underlying material is light yellowish-brown, very friable silt and very fine sand that are calcareous and massive.

Sisson soils have moderate to moderately slow permeability, medium or rapid runoff, and high available moisture capacity. Their organic-matter content is low, and natural fertility is medium.

These soils are used for grains, hay, pasture, and orchards, for recreational purposes, and as building sites. Some small areas are idle or wooded.

A typical profile of Sisson fine sandy loam on a slope of 4 percent, SE¼SE¼SE¼SE¼ sec. 6, T. 3 N., R. 12 E.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) when dry; weak, fine, granular structure; very friable; many roots; mildly alkaline; abrupt, smooth boundary.

A2—7 to 9 inches, pale-brown (10YR 6/3) silt loam; weak fine, granular structure; very friable; few roots; neutral; clear, wavy boundary.

B21—9 to 15 inches, yellow (10YR 7/6) silt loam; weak, coarse, granular structure; very friable; few roots; mildly alkaline; clear, wavy boundary.

B22t—15 to 29 inches, strong-brown (7.5YR 5/6) silt loam; weak, medium, subangular blocky structure; friable; dark-brown (7.5YR 4/4) clay skins on some ped faces; mildly alkaline; clear, wavy boundary.

C—29 to 60 inches, light yellowish-brown (10YR 6/4) silt and very fine sand; massive; very friable; very dark grayish-brown (10YR 3/2) coatings in old root channels; light-gray (10YR 7/2) lime concretions; calcareous.

The solum ranges from 24 to 42 inches in thickness and from slightly acid to mildly alkaline in reaction. The Ap horizon ranges from 6 to 8 inches in thickness and from dark grayish brown to very dark grayish brown in color. The B21 horizon ranges from 5 to 12 inches in thickness and from yellowish brown (10YR 5/6) or brownish yellow (10YR 6/6) to yellow in color. The texture of the B21 horizon is heavy fine sandy loam to silt loam and the structure is weak, fine to coarse, granular to weak, medium, subangular blocky. The B22t horizon ranges from 12 to 20 inches in thickness, from strong brown to yellowish brown (10YR 5/8) or brownish yellow (10YR 6/6) in color, and from light silt loam to heavy silt loam in texture. In some areas, where the Sisson soils border the Spinks soils, there is a B23 horizon of yellowish-brown (10YR 5/6) light sandy loam. The C horizon is at a depth ranging from 24 to 42 inches, and its color ranges from light yellowish brown to very pale brown (10YR 7/4) to light brownish gray (10YR 6/2).

Sisson soils have coarser textured B horizons than the Miami soils and are finer textured than the Spinks soils.

Sisson fine sandy loam, 2 to 6 percent slopes (SmB).—This soil occurs in the northwestern and west-central parts of the county. Runoff is medium.

Included with this soil in mapping were small areas of well-drained Miami and Spinks soils, small areas of somewhat poorly drained Minoa and Conover soils on the foot slopes and in depressions, and poorly drained soils of varying textures in wet depressions and along narrow natural drainageways. Some small inclusions have slopes of 0 to 2 percent or 6 to 12 percent, and some moderately eroded areas on the steeper slopes have brownish-yellow and yellowish-brown colors of the subsoil exposed.

This Sisson soil is used mainly for corn, small grain, hay, and pasture, and for peach, pear, and apple orchards. Small areas are wooded or idle, are used as a wildlife habitat or as building sites, or are used for recreational purposes. Limitations are slight and are relatively easy to overcome. Artificial drainage by interceptor tiles and open ditches removes excess water in the natural drainageways and in wet depressions. This soil dries out rapidly in spring and after rain. If worked when wet, it has poor trafficability and hardens. Management that supplies organic matter, maintains fertility, controls water erosion and soil blowing, and maintains soil structure is helpful. Capability unit IIe–2 (3a); woodland suitability group G.

Sisson fine sandy loam, 6 to 12 percent slopes (SmC).—This soil is in the western part of the county in areas with long uniform slopes and in rolling areas with short complex slopes. Runoff is rapid. Where intensive row cropping is practiced, some rill and gully erosion occurs.

Included with this soil in mapping were small areas of well drained Miami and Spinks soils, small areas of moderately well drained Celina soils on the lower slopes and side slopes of natural drainageways, and somewhat poorly drained and poorly drained soils in most of the wet depressions and along natural drainageways. Also included were a few small areas of Linwood and Lupton mucks in wet depressions and small areas that have slopes of 2 to 6 percent or 12 to 18 percent. On some of the steeper slopes, moderately eroded inclusions have the brownish-yellow and yellowish-brown subsoil exposed.

Most of this Sisson soil is used for corn, small grain, hay, and pasture, and for peach, pear, and apple orchards. Some small areas are idle, are wooded, are used as wildlife habitat, or are used for recreational purposes. Some small areas having slopes greater than 10 percent have been leveled for building sites. Limitations are moderate because of excess runoff and the hazard of water erosion and soil blowing. This soil is not so well suited to field crops as the less sloping Sisson soil. For peach, pear, and apple orchards the suitability of the two soils is about the same. Management that supplies organic matter, maintains fertility, and controls soil blowing and water erosion is helpful. This soil dries out quickly in spring and after rain. Trafficability is poor in wet periods, and if worked when wet, the soil becomes slightly hard and crusted on drying. Management is needed to prevent plugging of tiles and filter beds because the soil material liquifies readily and flows when wet. Capability unit IIIe-5 (3a); woodland suitability group G.

Sloan Series

Soils of the Sloan series are poorly drained, level to nearly level, and medium textured. They formed on flood plains of rivers and streams. They are subject to flooding one or more times each year. The quantity of deposition is highly variable.

The surface layer of a typical Sloan soil is very dark gray loam about 11 inches thick. The subsurface layer, about 13 inches thick, is very dark gray, friable silt loam mottled with dark grayish brown and brown. The upper part of the underlying material is gray, friable loam mottled with brown, yellowish brown, and light gray and is about 16 inches thick. The lower part of the underlying material is gray and light-gray, friable, stratified silt loam mottled with brown. Gray and dark-gray, loose, stratified, calcareous sand occurs at a depth of about 55 inches.

The surface layer of these soils is high in organic-matter content. Natural fertility is medium. The water table is seasonally high. Infiltration is moderately rapid, and permeability is moderate. The available moisture capacity is high. Runoff is very slow or ponded.

The native vegetation consists of elm, oak, maple, and various kinds of grasses. The high water table and periodic flooding restrict use of these soils to wildlife habitat and intermittent pasture.

A typical profile of Sloan loam in a nearly level idle field, SE¼SW¼SE¼ sec. 17, T. 2 N., R. 13 E.:

A11—0 to 11 inches, very dark gray (10YR 3/1) loam; moderate, medium, subangular blocky structure; friable; many roots; mildly alkaline; clear, wavy boundary.

A12—11 to 24 inches, very dark gray (10YR 3/1) silt loam; common, medium, distinct mottles of dark grayish brown (10YR 4/2) and common, medium, prominent mottles of brown (7.5YR 4/4); moderate, medium, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

C1g—24 to 40 inches, gray (5Y 5/1) loam; common, medium, prominent mottles of brown (7.5YR 4/4), common, medium, distinct mottles of yellowish brown (10YR 5/4), and common, fine, faint mottles of light gray (5Y 6/1); weak, coarse, subangular blocky structure; friable; few roots; mildly alkaline; abrupt, smooth boundary.

C2g—40 to 55 inches, gray (5Y 5/1) and light-gray (5Y 6/1), stratified silt loam containing common, medium, prominent, brown (7.5YR 5/4) mottles; massive; friable; mildly alkaline; abrupt, smooth boundary.

C3g—55 to 60 inches, gray (5Y 5/1) and dark-gray (5Y 4/1), stratified sand; single grain; loose; calcareous.

The A1 horizon ranges from 6 to 24 inches in thickness, from very dark gray and gray to very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) in color, and from heavy fine sandy loam to silt loam in texture. In some places the A1 horizon is calcareous. Reaction of the C horizon ranges from neutral to moderately alkaline. The texture of the C1 and C2 horizons is loam or silt loam. In some places there are ½- to 6-inch bands of coarser and finer textured alluvial sediments ranging from sand to clay. These bands range from none to 6 or more in number.

The Sloan soils are coarser textured than the fine-textured, poorly drained Saranac soils and are finer textured than the poorly drained Cohoctah soils.

Sloan loam (0 to 2 percent slopes) (Sn).—This soil occupies flood plains of rivers and streams throughout the county. Flooding occurs one or more times each year. In some areas where the stream channel has been deepened and straightened, the material from the new channel has been spread over the original soil.

Included with this soil in mapping were large spots of other alluvial soils and a few small spots of muck soils.

Nearly all the acreage of this soil is wooded, is in pasture, or is idle. A few areas are in small grain or meadow. The high water table and frequent flooding are major limitations. Pit-type ponds for wildlife and irrigation are in a few places. Capability unit Vw-3 (L-2c); woodland suitability group O.

Spinks Series

In the Spinks series are level to hilly soils on outwash plains and moraines. These well-drained, coarse-textured soils contain thin bands of finer textured material.

The surface layer of a typical Spinks soil is dark grayish-brown loamy sand about 8 inches thick. The upper part of the subsoil is yellowish-brown, very friable loamy sand and light yellowish-brown, loose sand about 15 inches thick. The lower part of the subsoil, about 25 inches thick, is yellowish-brown, loose sand alternating with ¼- to 2-inch layers of reddish-brown, friable loamy sand and sandy loam. The underlying material is pale-brown, loose sand.

The Spinks soils are moderately low in natural fertility. The available moisture capacity is low. Permeability is rapid, and runoff is slow or medium.

The native vegetation consists of hardwoods, mainly oak. Most areas of these soils have been cleared and are used for vegetable crops, peach and apple orchards, corn, wheat, oats, and hay. Some areas are wooded, and others are used as a source of sandy material.

A typical profile of a Spinks loamy sand in a nearly level abandoned cherry orchard, NE¼SE¼NE¼SE¼ sec. 32, T. 4 N., R. 12 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; many roots; slightly acid; abrupt, smooth boundary.

B1—8 to 16 inches, yellowish-brown (10YR 5/4) loamy sand; weak, fine, granular structure; very friable; few roots; slightly acid; clear, wavy boundary.

A'21—16 to 23 inches, light yellowish-brown (10 YR 6/4) sand; single grain; loose; few roots; neutral; gradual, irregular boundary.

A'22 and Bt—23 to 48 inches, 2- to 8-inch layers of yellowish-brown (10YR 5/4) sand (A'22 horizon) alternating with ¼- to 2-inch, wavy and discontinuous bands of reddish-brown (5YR 4/4) loamy sand and sandy loam (Bt horizon); the A'22 material is single grain and loose; the Bt material is massive and friable; few roots; neutral; abrupt, wavy boundary.

C—48 to 60 inches, pale-brown (10YR 6/3) sand; single grain; loose; few roots; calcareous.

The solum ranges from 42 to 60 inches in thickness but is typically 48 inches thick. It is medium acid to neutral in reaction. The Ap horizon ranges from dark grayish brown to very dark grayish brown (10YR 3/2) to brown (10YR 5/3) in color and from loamy sand to sand in texture. The depth to the first Bt horizon ranges from 20 to 30 inches. The number of Bt horizons alternating with the A'22 horizons ranges from 5 to 10. The thickness of the Bt horizons is ¼ inch to 2 inches, and their combined thickness is 6 to 10 inches. The reaction of the C horizon is neutral to moderately alkaline.

The Spinks soils have thin and discontinuous Bt horizons, which are missing in the Oakville and Metea soils. Metea soils are underlain by loam to silty clay loam at a depth of 20 to 40 inches, and Oakville soils, loamy substratum, are underlain by loam to clay at a depth of 40 to 66 inches. The Spinks soils have thinner Bt horizons than the Boyer soils and are underlain by sand instead of stratified sand and gravel.

Spinks loamy sand, 0 to 2 percent slopes (SpA).—This soil is on till plains and moraines. It has the profile described as typical of the series. Runoff is slow, and infiltration is very rapid.

Included with this soil in mapping were small spots of well-drained Lapeer, Sisson, Metea, typical Oakville soils, and Oakville soils, loamy substratum. In addition, there are small inclusions of moderately well drained areas of Dryden soils. The somewhat poorly drained Locke, Minoa, Au Gres, and Selfridge soils and the poorly drained Ensley, Granby, Lamson, and Brevort soils were included in natural depressions, in wet spots, and along drainageways. Some small inclusions have slopes of 2 to 6 percent.

This Spinks soil is used largely for corn, small grain, hay, and pasture; for apple and peach orchards; and as building sites. Some small areas are idle, are wooded, are used for recreational purposes, or are used as borrow pits for highway fills. Limitations are moderate because of droughtiness and the risk of soil blowing. Additions of organic matter, maintenance of fertility, and the control of soil blowing are beneficial management practices. Capability unit IIIs–3 (4a); woodland suitability group E.

Spinks loamy sand, 2 to 6 percent slopes (SpB).—This soil occupies areas on till plains and moraines. Runoff is slow, and infiltration is very rapid.

Included with this soil in mapping were small spots of well-drained typical Oakville soils, Oakville soils, loamy substratum, and Lapeer, Sisson, and Miami soils on the stronger slopes. Also included were small spots of the moderately well drained Dryden and Celina soils. Inclusions of the somewhat poorly drained Locke soils, typical Au Gres soils, Au Gres soils, loamy substratum, and Minoa and Conover soils and the poorly drained Granby, Lamson, Ensley, and Parkhill soils are in wet spots, in wet depressions, and along natural drainageways. In a few places inclusions have slopes of 0 to 2 percent or 6 to 12 percent. In a few, small, moderately eroded inclusions, the yellowish-brown subsoil is exposed because the surface layer has been removed through water erosion and soil blowing.

This Spinks soil is used largely for corn, small grain, hay, pasture, and peach and apple orchards. Some areas are idle, are wooded, or are used as building sites or as a source of sandy material. Limitations are moderate because of droughtiness and the hazard of erosion. The poorly drained and somewhat poorly drained areas included with this soil need artificial drainage for good crop growth. Additions of organic matter, maintenance of fertility, and control of erosion are beneficial management practices. Capability unit IIIs–4 (4a); woodland suitability group E.

Spinks loamy sand, 6 to 12 percent slopes (SpC).—This sloping and rolling soil is in the western and northwestern parts of the county. Runoff is medium, and infiltration is rapid.

Included with this soil in mapping were small spots of well-drained Sisson, Lapeer, Miami, and typical Oakville soils and Oakville soils, loamy substratum, on the stronger slopes and small areas of moderately well drained Dryden, Celina, and Oakville soils, loamy substratum, on the lower slopes. The somewhat poorly drained typical Au Gres and Au Gres soils, loamy substratum, were included on the upper edges of the lower slopes and adjacent to depressions and along natural drainageways. Small areas of poorly drained Granby, Lamson, Ensley, and Parkhill soils were included in wet spots, in wet depressions, and along natural drainageways. Some inclusions are moderately eroded and have the yellowish-brown subsoil exposed; some have slopes of 2 to 6 percent or 12 to 18 percent; and a few are spots of Linwood and Lupton mucks in some wet depressions in Bruce and Washington Townships.

This Spinks soil is used mainly for corn, small grain, hay, pasture, and peach and apple orchards. Some small areas are idle, are wooded, are used for recreational sites, and are used as a wildlife habitat. Limitations are moderate because of droughtiness and the hazard of erosion. Management that supplies organic matter, maintains fertility, and controls erosion is beneficial. Capability unit IIIe–9 (4a); woodland suitability group E.

Tawas Series

The Tawas series consists of poorly drained, organic soils that are 12 to 40 inches thick over sandy mineral material. These are level and nearly level soils in swamps, along waterways, and in depressions in the uplands.

The upper part of a typical Tawas soil is black muck about 18 inches thick. The underlying material is gray, loose sand.

The available moisture capacity in the Tawas soils is very high in the muck layers and very low in the sandy underlying material. Permeability is rapid in areas where the muck is artificially drained, and it is very rapid in the underlying material. In undrained areas the water table is near the surface most of the year. Natural fertility is low, and workability is poor.

The native vegetation consists of coniferous and deciduous trees, including soft maple, elm, ash, and white-cedar. Most areas are wooded or are idle, and a few areas are in cropland.

A typical profile of Tawas muck in a nearly level cultivated field, NW¼NE¼SE¼ sec. 16, T. 3 N., R. 12 E.:

1—0 to 12 inches, black (10YR 2/1) muck; weak, medium, granular structure; friable; neutral; clear, smooth boundary.

2—12 to 18 inches, black (10YR 2/1) muck; massive; friable; neutral; abrupt, smooth boundary.

IICg—18 to 60 inches, gray (10YR 5/1) sand; many, medium, distinct mottles of yellowish brown (10YR 5/4); single grain; loose; calcareous.

Reaction ranges from slightly acid to neutral in the organic horizons and from neutral to moderately alkaline in the IICg horizon. In some areas the upper part of the muck is very dark brown (10YR 2/2). The lower part of the muck is dark brown (7.5YR 3/2) and is only partly decomposed in some places. The depth to the IICg horizon ranges from 12 to 40 inches.

The Tawas soils are similar to the Edwards, Linwood, and Willette soils, but they are underlain by coarser textured mineral material. The Edwards soils are underlain by marl; the Linwood soils, by loam; and the Willette soils, by clay.

Tawas muck (0 to 2 percent slopes) (Ta).—This soil occurs in swamps, along waterways, and in depressions in the uplands. It generally is in areas that are dominantly sandy but sometimes is in areas that are finer textured. The water table is high most of the year; it is near the surface unless the soil is artificially drained. Runoff is very slow.

Included with this soil in mapping were small spots of Lupton muck, which is greater than 40 inches thick. Some narrow inclusions along streams have slopes of 4 to 5 percent. In some inclusions in finer textured soil areas, the sandy material is underlain by clay loam at a depth of 3 to 4 feet.

This soil is wooded or is idle. Frost hazard to crops is more severe than on adjacent soils. The high water table, low natural fertility, shallowness of the muck, and rapid oxidation of the organic matter if the soil is drained are limitations. Capability unit IVw-5 (M/4c); woodland suitability group U.

Toledo Series

In the Toledo series are poorly drained, nearly level and depressional soils on lake plains throughout the county. These soils developed in lacustrine clay, silty clay, and heavy silty clay loam and have thin seams and layers of silt and very fine sand.

The surface layer of a typical Toledo soil is very dark gray, firm silty clay loam about 7 inches thick. The subsoil is gray, very firm and firm silty clay mottled with olive brown and yellowish brown. The subsoil is mildly alkaline and about 23 inches thick. The underlying material is brown silty clay mottled with strong brown and light gray to gray in the upper part and is yellowish-brown heavy silty clay loam in the lower part. This material is firm and calcareous.

Toledo soils are high in organic-matter content and natural fertility. The water table is near the surface much of the year unless the soils are artificially drained. Infiltration is slow, and permeability is very slow. Water movement generally occurs along horizontal cracks or structure planes. The available moisture capacity is high. Runoff is slow or ponded, and ponding lasts for extended periods in spring.

The native vegetation consists of elm, hickory, ash, and oak. Most of the original forest cover has been cut over, and the few small woodlots that remain contain low-quality timber. Crops grown are wheat, oats, corn, legume-grass hay, and pasture. Many areas are idle, and a few areas have been developed for urban use.

A typical profile of Toledo silty clay loam in a nearly level idle area, SE¼SE¼SE¼ sec. 6, T. 2 N., R. 13 E.:

Ap—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam; moderate, very fine, angular blocky structure; firm; mildly alkaline; abrupt, smooth boundary.

B21g—7 to 13 inches, gray (5Y 5/1) silty clay; many, fine, prominent mottles of olive (5Y 4/4); moderate, fine, angular blocky structure; firm; thin coatings and stains of very dark gray (10YR 3/1) on numerous ped faces; mildly alkaline; clear, wavy boundary.

B22g—13 to 24 inches, gray (5Y 5/1) silty clay; many, medium, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, angular blocky structure; very firm; mildly alkaline; gradual, wavy boundary.

B23g—24 to 30 inches, gray (5Y 5/1) silty clay; many, fine, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, angular blocky structure; firm; worm and root channels of very dark gray (10YR 3/1); mildly alkaline; clear, wavy boundary.

C1g—30 to 48 inches, brown (7.5YR 5/2) silty clay; many fine and medium, distinct mottles of strong brown (7.5YR 5/6) and light gray (5Y 6/1); moderate, very coarse, angular blocky structure; firm; light-gray (5Y 6/1) clay coatings on ped surfaces; calcareous; gradual, wavy boundary.

C2g—48 to 60 inches, gray (5Y 5/1) and yellowish-brown (10YR 5/6) heavy silty clay loam; massive; firm; calcareous.

The thickness of the solum ranges from 30 to 55 inches. The Ap layer ranges from 6 to 9 inches in thickness, from very dark gray to very dark brown (10YR 2/2) in color, from clay loam to clay in texture, and from slightly acid to mildly alkaline in reaction. The texture of the B horizons ranges from clay to silty clay; these horizons include thin varves and pockets of silt and fine sand in some areas. The B horizons range from 10YR to 5Y in color, from faint to prominent in mottling contrast, from weak to strong in structure, from firm to very firm in consistence, and from slightly acid to mildly alkaline in reaction. The texture of the C horizons is light clay to heavy silty clay loam. This horizon contains thin varves of silt and fine sand in some areas. Depth to free carbonates ranges from 2 feet to more than 7 feet but is typically between 30 and 48 inches.

The poorly drained Toledo soils developed in material similar to that giving rise to the somewhat poorly drained Fulton soils. The Toledo soils have a finer textured B horizon and developed in finer textured lacustrine material than the Lenawee soils, which developed in clay loam and silty clay loam. The Toledo and Hoytville soils formed in material of similar texture, but the material giving rise to the Hoytville soils is nonstratified glacial till. Toledo soils have a clay content of 40 to 60 percent; Paulding soils have a clay content of 60 to 75 percent.

Toledo silty clay loam (0 to 2 percent slopes) (Ts).—This soil occurs on lake plains throughout the county. Some areas are in depressions. Areas generally are near the Lenawee, Paulding, Fulton, Del Rey, and other Toledo soils. The shrink-swell potential is high. Surface cracks that are 1 to 2 inches wide and 10 to 15 inches deep are evident in dry periods and are closed by swelling in wet periods.

Small areas of Paulding and other Toledo soils are included with this soil in mapping. Many large areas of Lenawee soils were included, especially where those soils adjoin this Toledo soil. Also included were many small spots of shallow sand (fig. 13) less than 20

***Figure 13.*—An area of Toledo silty clay loam in which beech trees are a plant indicator of sand spots.**

inches thick, spots of Fulton soils, and a few small spots of somewhat poorly drained Del Rey soils in the eastern part of the county.

The high water table, very slow permeability, and high shrink-swell potential are moderate limitations for crops. Maintenance of soil structure is a major management requirement. Capability unit IIIw-1 (1c); woodland suitability group P.

Toledo clay (0 to 2 percent slopes) (Tt).—This soil occurs on lake plains in the central and eastern parts of the county, generally near Paulding soils. Some areas are in depressions. The shrink-swell potential is high. Surface cracks that are 1 to 2 inches wide and 12 to 18 inches deep are evident in dry periods and are closed by swelling in wet periods.

In some places small spots of Paulding and Lenawee soils were included with this soil in mapping. Also included were small spots of sand less than 20 inches thick and spots of Fulton soils.

This Toledo soil has moderate limitations, which include the high water table, very slow permeability, high shrink-swell potential, and poor trafficability when wet. Maintenance of soil structure is a major management requirement. Capability unit IIIw-1 (1c); woodland suitability group P.

Urban Land

Urban land (Ur) consists of areas so altered or obscured by urban works and structures that identification of soils is not feasible.

Onsite investigation is needed before any management practices can be recommended. Not placed in a capability unit or woodland suitability group.

Wasepi Series

In the Wasepi series are somewhat poorly drained, level to gently sloping, moderately coarse textured soils that occur mainly in the western part of the county. These soils developed in loamy sand and sandy loam glacial outwash that is 24 to 40 inches thick over calcareous, stratified sand and gravel. In Macomb County the Wasepi soils were mapped alone and in a complex with Au Gres soils.

The surface layer of a typical Wasepi soil is very dark grayish-brown sandy loam about 9 inches thick. The subsurface layer, about 2 inches thick, is pale-brown, very friable sandy loam. The subsoil is brown and dark-brown, friable sandy loam about 17 inches thick. It contains brownish-gray, grayish-brown, and yellowish-brown mottles. The underlying material is light brownish-gray, loose, calcareous, stratified sand and gravel.

The Wasepi soils have a medium organic-matter content and moderately low natural fertility. They have medium available moisture capacity, rapid infiltration, and moderately rapid to rapid permeability. The water table is seasonally high.

The native vegetation is deciduous forest; elm, ash, swamp white oak, white oak, and hickory are the prominent species. The Wasepi soils are used mainly for vegetable crops, corn, wheat, soybeans, and hay.

A typical profile of Wasepi sandy loam in a nearly level idle field, SW¼NE¼NE¼ sec. 35, T. 5 N., R. 12 E.:

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

A2—9 to 11 inches, pale-brown (10YR 6/3) sandy loam; few, fine, faint mottles of brownish yellow (10YR 6/6); weak, medium, granular structure; very friable; neutral; clear, wavy boundary.

B21—11 to 20 inches, brown (10YR 5/3) heavy sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/6) and few, fine, faint mottles of light brownish gray (10YR 6/2); weak, coarse, granular structure; friable; neutral; gradual, wavy boundary.

B22t—20 to 28 inches, dark-brown (7.5YR 4/4) heavy sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/6) and few, medium, distinct mottles of grayish brown (10YR 5/2); weak, coarse, granular structure; friable; clay bridging between sand grains; mildly alkaline; abrupt, wavy boundary.

IIC—28 to 60 inches, light brownish-gray (10YR 6/2) sand and gravel; single grain; loose; calcareous.

The solum ranges from slightly acid to mildly alkaline in reaction. Its gravel content ranges from 0 to 20 percent. The Ap horizon ranges from 7 to 10 inches in thickness, from loamy sand to sandy loam in texture, and from very dark brown (10YR 2/2) to very dark grayish brown in color. The abundance of mottling in the A2 horizon ranges from none to common. The B horizons range from 17 to 30 inches in thickness, from loamy sand to heavy sandy loam in texture, and from dark brown and grayish brown (10YR 5/2) to light yellowish brown (10YR 6/4) in color. Common, fine and medium, faint and distinct mottles of strong brown (7.5YR 5/8) to yellowish brown to grayish brown are present in the B horizons. The IIC horizon consists of thin stratified layers to thick deposits of sand and gravel. It is light brownish gray to gray (10YR 5/1) and contains common, fine to medium, faint mottles of light yellowish brown (10YR 6/4) to grayish brown to brown (10YR 5/3).

The somewhat poorly drained Wasepi soils and poorly drained Gilford soils formed in similar material, but the Gilford are darker in color. The Wasepi soils are more poorly drained than the well-drained Boyer soils. The calcareous sand and gravel underlying material in the typical Wasepi soils extends to a depth of several feet, whereas in Wasepi soils, silty subsoil variant, this material is about 10 inches thick over stratified silt and very fine sand.

Wasepi loamy sand, 0 to 2 percent slopes (WsA).—This soil is on glacial outwash plains and moraines. It has a profile similar to that described as typical of the series, but it has a coarser texture and contains more gravel. The available moisture capacity is medium but is slightly lower than in the Wasepi sandy loams. Runoff is slow or very slow.

Included with this soil in mapping were many small spots of Gilford soils in depressions; Boyer soils having slopes of 2 to 6 percent on low ridges; small spots of Wasepi sandy loam; and a few areas of Wasepi soils, silty subsoil variant, and Gilford soils, silty subsoil variant.

This Wasepi soil has moderate limitations because of its seasonal high water table and the risk of soil blowing. Artificial drainage and control of soil blowing are management requirements. Capability unit IIIw–5 (4b); woodland suitability group K.

Wasepi loamy sand, 2 to 6 percent slopes (WsB).—This soil is on glacial outwash plains and moraines. It has a profile similar to that described as typical of the series, but it is coarser textured and contains more gravel. The available moisture capacity is medium, but it is slightly lower than in the Wasepi sandy loam soils. Runoff is slow.

Included with this soil in mapping were many small spots of Gilford soils in depressions; Boyer soils on low ridges; small spots of Wasepi sandy loam; and small spots of Wasepi soils, silty subsoil variant, and Gilford soils, silty subsoil variant.

Limitations for crops are moderate because of the seasonal high water table and hazard of soil blowing. Artificial drainage and control of soil blowing are management requirements. Capability unit IIIw–5 (4b); woodland suitability group K.

Wasepi sandy loam, 0 to 2 percent slopes (WtA).—This soil occupies glacial outwash plains and moraines. It has the profile described as typical of the series. The available moisture capacity is medium, and runoff is slow.

Included with this soil in mapping were small spots of Gilford soils in depressions; small areas of Boyer sandy loam, 2 to 6 percent slopes, on low ridges; and some spots of Wasepi loamy sand; small areas of Wasepi soils, silty subsoil variant; and spots of Gilford soils, silty subsoil variant.

This Wasepi soil has moderate limitations for crops. It has a seasonal high water table and requires artificial drainage. Capability unit IIIw–5 (4b); woodland suitability group K.

Wasepi-Au Gres complex, 0 to 4 percent slopes (WvB).—This complex consists of level to gently sloping soils on glacial outwash plains, till plains, and moraines. The Wasepi soils are dominant in the complex but are in areas too small in size and in too closely intermingled intricate patterns with areas of Au Gres soils to be mapped separately. The Wasepi soil makes up 60 percent of this complex, and the Au Gres soil, 40 percent. The soils of this complex have a profile similar to the one described as typical of their respective series. Runoff is slow on the Wasepi soils and very slow on the Au Gres soils. The available moisture capacity is medium in the Wasepi soils and very low in the Au Gres soils. Permeability is moderately rapid to very rapid in both soils. Natural fertility is moderately low and low.

The use and limitations of this complex are similar to those for the Wasepi and Au Gres soils, but they vary somewhat from one area to another. A seasonal high water table is the major limitation. Artificial drainage is helpful in removing excess water. Both soils in capability unit IIIw–5 (4b, 5b); Wasepi soil in woodland suitability group K; Au Gres soil in woodland suitability group L.

Wasepi Series, Silty Subsoil Variant

The Wasepi series, silty subsoil variant, consists of somewhat poorly drained, nearly level to gently sloping soils on glacial outwash and lake plains. These soils have a sandy loam surface layer and subsoil over calcareous sand and gravel, which, in turn, is underlain at a depth of 20 to 40 inches by calcareous silt and very fine sand.

The surface layer of a typical Wasepi soil, silty subsoil variant, is very dark gray sandy loam about 9 inches thick. The subsoil, about 16 inches thick, is yellowish-brown to brown, very friable, mildly alkaline sandy loam. The underlying material is light brownish-gray, calcareous, loose sand and gravel over stratified, very friable, calcareous very fine sand and silt that contain mottles of brownish yellow.

The Wasepi soils, silty subsoil variant, are moderately low in natural fertility. Except for the high available moisture capacity in the underlying silt and very fine sand material, these soils have a medium available moisture capacity. Permeability is moderately rapid in the upper layers and moderately slow in the underlying silt and very fine sand. Runoff is slow. A seasonal high water table limits use of machinery in wet periods.

The native vegetation consists chiefly of ash, elm, swamp white oak, and hickory. Areas of this soil are used for vegetable crops, wheat, corn, oats, and hay.

A typical profile of Wasepi sandy loam, silty subsoil variant, in a nearly level cultivated field, NW¼SE¼SW¼SE¼NW¼ sec. 9, T. 2 N., R. 12 E.:

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Ap—0 to 9 inches, very dark gray (10YR 3/1) sandy loam; weak, coarse, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

B21—9 to 16 inches, yellowish-brown (10YR 5/4) sandy loam; common, medium, distinct mottles of strong brown (7.5YR 5/6) and common, fine, faint mottles of grayish brown (10YR 5/2); weak, coarse and fine, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

B22t—16 to 25 inches, brown (10YR 5/3) heavy sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/6) and grayish brown (10YR 5/2); weak, fine, granular structure; very friable; mildly alkaline; abrupt, wavy boundary.

IIC1—25 to 35 inches, light brownish-gray (10YR 6/2) sand and gravel; single grain; loose; calcareous; clear, wavy boundary.

IIIC2—35 to 60 inches, light brownish-gray (10YR 6/2) stratified silt and very fine sand; many, medium, distinct mottles of brownish yellow (10YR 6/6); massive; very friable; calcareous.

The solum ranges from slightly acid to mildly alkaline in reaction. It ranges from 16 to 30 inches in thickness but is dominantly 20 to 26 inches thick. The Ap horizon ranges from very dark gray to very dark brown (10YR 2/2) in color and from loamy sand to sandy loam in texture. The texture of the B horizon ranges from loamy sand to heavy sandy loam. The IIC1 horizon ranges from 6 to 20 inches in thickness and is 5 to 35 percent gravel. The IIIC2 horizon is at a depth ranging from 24 to 42 inches and is brownish yellow (10YR 6/6) to light brownish gray to light gray (10YR 6/1).

The Wasepi soils, silty subsoil variant, differ from the typical Wasepi soils in being underlain by silt and very fine sand at a depth of 20 to 40 inches. The typical Wasepi soils are underlain by thicker deposits of stratified sand and gravel. These variant Wasepi soils are better drained than the poorly drained Gilford soils, silty subsoil variant.

Wasepi sandy loam, silty subsoil variant, 0 to 4 percent slopes (WuB).—This soil is on outwash plains and lake plains. It has a medium available moisture capacity in the upper 20 to 40 inches and a high available moisture capacity below that depth. Permeability of the upper 20 to 40 inches is moderately rapid; below that depth it is moderately slow.

Included with this soil in mapping were many areas of typical Wasepi soils; Minoa soils on the outer edges of areas mapped as this soil; and Gilford soils, silty subsoil variant, in the depressions.

Areas of this Wasepi soil are used for vegetable crops, corn, wheat, oats, and hay. The main limitations are the seasonal high water table and the risk of soil blowing. Although artificial drainage is needed, the upper 20 to 40 inches tends to be droughty if drained. Capability unit IIIw-5 (4/2b); woodland suitability group K.

Willette Series

The Willette series consists of poorly drained, shallow, organic soils that are 12 to 40 inches thick over mineral material of clay texture. These soils are in swamps, along waterways, and in depressions in the uplands.

The upper part of the muck in a typical Willette soil is very dark brown in color and about 12 inches thick. Below this is very dark grayish-brown, friable muck about 6 inches thick. The underlying material is black to gray, firm to very firm clay.

Natural fertility is low in the Willette soils. The available moisture capacity is very high in the muck layers and medium in the clayey underlying material. Permeability is rapid in the muck layers if they are drained, but it is slow in the clay material. In undrained areas the water table is near the surface most of the year. Workability is poor.

The native vegetation consists of mixed coniferous and deciduous trees, as well as reeds and sedges. Very few areas of this soil have been cleared and used for crops.

A typical profile of Willette muck in a nearly level area covered with reeds, NW¼SE¼SE¼ sec. 22, T. 3 N., R. 14 E.:

1—0 to 12 inches, very dark brown (10YR 2/2) muck; weak, medium, granular structure; friable; slightly acid; clear, smooth boundary.

2—12 to 18 inches, very dark grayish-brown (10YR 3/2) muck; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

IIC1g—18 to 22 inches, black (N2/0) clay; weak, very fine, angular blocky structure; firm; high in organic-matter content; neutral; clear, smooth boundary.

IIC2g—22 to 30 inches, black (10YR 2/1) clay; common, fine, distinct mottles of gray (10YR 5/1); massive; very firm; many fine yellowish-red (5YR 5/6) root fragments; neutral; clear, smooth boundary.

IIC3g—30 to 42 inches, gray (10YR 5/1) clay; common, fine, distinct mottles of yellowish brown (10YR 5/6); massive; very firm; mildly alkaline.

The upper part of the muck ranges from very dark gray (10YR 3/1) to very dark brown in color and from 6 to 15 inches in thickness. The lower part ranges from black (N 2/0) to very dark grayish brown in color and from 6 to 36 inches in thickness. The organic matter ranges from well-decomposed muck at the surface to partly decomposed peat just above the IIC1g horizon in some areas. The muck layers have weak, medium, granular structure or are structureless. The consistence ranges from friable to loose. Reaction of the muck is medium acid to neutral. Boundaries between the muck and underlying material range from abrupt and smooth to gradual and wavy. The texture of the IIC1g and IIC2g horizons ranges from silty clay loam to clay; the color, from black to dark yellowish brown (10YR 3/4). The horizons have weak, very fine to coarse, angular blocky structure or are massive. Reaction of the upper 2 inches of the IIC1g horizon is slightly acid in some areas, but typically the IIC1g and IIC2g horizons are neutral to moderately alkaline. Depth to the IIC1g horizon ranges from 12 to 40 inches but is typically 15 to 30 inches.

The Willette soils are shallower than the deep Lupton soils. They are underlain by finer textured material than the Tawas or Linwood soils, which are underlain by sand and loam, respectively.

Willette muck (0 to 2 percent slopes) (Wx).—This soil occurs in swamps, along waterways, and in depressions in the uplands. The water table is near the surface most of the year, and runoff is very slow or ponded. In some places where this soil receives runoff from adjoining soils, the surface layer is calcareous.

Included with this soil in mapping were some small spots of Lupton muck, which is deeper than 40 inches, and a few spots of muck less than 12 inches thick.

Most of this Willette soil is wooded or is idle, cutover or marshy land. It is best suited to woodland and as a habitat for wildlife. The high water table, low natural fertility, and rapid oxidation of the shallow muck, if drained, are major limitations. The muck is very unstable, and the underlying clayey material has a high shrink-swell potential. Drainage outlets are difficult to obtain for many areas of this soil. Capability unit IVw–5 (M/lc) ; woodland suitability group U.

Use and Management of the Soils

This section gives an explanation of the nationwide capability classification system used by the Soil Conservation Service and discusses use and management of the soils for crops. It also includes a table showing predicted yields of the principal crops under two levels of management and discusses use and management of the soils for woodland, wildlife, engineering purposes, and community development.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife. (No soils in Macomb County are in class VII.)

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (No soils in Macomb County are in class VIII.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–3 or IIIw–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

In this survey the Arabic numerals are not consecutive, because not all the capability units used in Michigan are represented in Macomb County.

In parentheses following the symbol of each capability unit are symbols made up of Arabic numerals and small or capital letters. These symbols in parentheses identify the management group or groups, all or parts of which are represented by the soils in that capability unit. These management groups are part of a Statewide system used in Michigan for making recommendations on application of fertilizer, drainage, and other practices. For an explanation of this classification, refer to "Fertilizer Recommendations for Michigan Vegetables and Field Crops" (*4*).

Management by capability units

In this section each capability unit in Macomb County is described and use and management are discussed. The names of the soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. The unit designation for each soil in the county can be found in the "Guide to Mapping Units" at the back of this publication. Made land, Sanitary land fill, and Urban land have not been placed in a capability unit.

CAPABILITY UNIT I-1 (2.5a)

Celina loam, 0 to 2 percent slopes, the only soil in this unit, is moderately well drained. It has a moderately fine textured subsoil and medium-textured underlying material.

The available moisture capacity is high, and crops normally have an adequate supply of moisture. Permeability is moderate or moderately slow. Wet spots occur in a few places. This soil is fertile and easy to manage. Erosion is only a slight hazard.

All the common crops are well suited to this soil. Suitable grasses and legumes can be grown for forage. The major management needs are renewal of organic matter and maintenance of good tilth.

Suitable management consists of minimum tillage and the use of crops that return large amounts of organic matter. Restricted grazing of forage during wet periods helps to prevent soil compaction and to maintain structure and tilth.

CAPABILITY UNIT IIe-2 (2.5a, 3a)

In this unit are soils of the Celina, Miami, and Sisson series. These are gently sloping, moderately well drained or well drained soils. They have a moderately fine textured or medium-textured subsoil. The underlying material consists of stratified silt and very fine sand to loam or silt loam. Most areas are slightly eroded, but a few are moderately eroded. Small seep areas and wet depressions occur in some places.

The available moisture capacity is high, and crops normally have an adequate supply of moisture. Runoff is medium. Permeability is moderate or moderately slow. These soils are moderate to moderately high in natural fertility and low in organic-matter content. The moderately eroded areas have a lighter colored surface layer than the slightly eroded ones and are in slightly poorer tilth.

Crops commonly grown on these soils are corn, small grain, hay, and pasture. The major management needs are control of erosion and maintenance of tilth and fertility.

Minimum tillage, terraces, and stripcropping help to control erosion. In many areas, however, terracing and stripcropping are not feasible, because the slopes are short and complex. Seeding natural waterways helps to control gullying and to reduce loss of soil. Shallow surface drains help to dry up the wet depressions and permit early tillage. Plowing under of crop residue and green-manure crops reduces surface crusting and slows runoff. Adding manure to the moderately eroded areas improves tilth and productivity and hastens germination of seeds.

CAPABILITY UNIT IIe-3 (3a)

In this unit are soils of the Dryden and Lapeer series. These soils are mainly gently sloping and are moderately well drained or well drained. A few areas are sloping. The subsoil is medium textured, and the underlying material is moderately coarse textured.

The available moisture capacity is medium, and crops lack moisture during extremely dry periods. Runoff is medium. Permeability is moderate or moderately rapid, and wetness is not a hazard. Natural fertility is medium.

These soils are easy to till throughout a wide range of moisture content. They warm up and are ready for tillage early in spring and dry out quickly after rains. Erosion has washed away part of the original surface layer in some moderately eroded spots and consequently has reduced the organic-matter content and fertility and has impaired tilth.

Most crops grown in the county are suited to these soils. Examples are corn, oats, wheat, tree fruits, potatoes, and hay crops. All legumes and grasses suited to the soils can be grown for forage. The major management needs are control of erosion, maintenance of fertility and organic-matter content, conservation of moisture, and preservation of tilth.

Where terraces, stripcropping, and contour tillage are feasible, these measures help to control erosion. Plowing under of green-manure crops and crop residue increases water absorption, improves tilth, and keeps the surface layer from crusting. Minimum tillage also is beneficial. Winter cover crops help to control soil blowing and water erosion. They provide organic matter as well.

CAPABILITY UNIT IIw-2 (1c, 1.5b, 1.5c, 3/2b, 4/2b)

In this unit are soils of the Blount, Del Rey, Hoytville, Lenawee, Metamora, Selfridge, and Sims series. These are mainly level or nearly level, somewhat poorly drained and poorly drained soils. Some are in shallow depressions. The subsoil and underlying material are moderately fine textured or fine textured. In areas where the Lenawee and Selfridge soils are mapped together, 20 to 35 percent of the acreage has varying amounts of sand on the surface.

The available moisture capacity is high in most places. Runoff is slow to ponded. Permeability is moderately slow or very slow. Natural fertility is high except in sandy areas of Lenawee and Selfridge soils, where fertility is low and the available moisture capacity is low. The poorly drained soils have a slightly higher content of organic matter than the somewhat poorly drained soils and are darker colored.

The water table is near the surface in undrained areas, and the soils are saturated during wet periods. Wet depressions are common. Undrained areas are slow to dry out and warm up in spring. They puddle readily if tilled when wet and dry out cloddy and hard. Farm machinery bogs down easily, and planting, weed control, and harvesting are difficult. Frost damage is a hazard in some years because of the low-lying position of the soils.

Drained areas of these soils are well suited to the crops commonly grown in the county. Forage crops that are tolerant of wetness do well. The choice of crops for planting depends on how wet the soils are and how much drainage is provided. The major management needs are control of wetness and maintenance of good tilth. Unless planted in drained areas, small grain either drowns out or grows rank and lodges before it can be harvested. Corn also is damaged by wetness. The Hoytville soil is finer textured than the others and is harder to manage.

Drainage is not practical in some areas, because outlets are lacking and the soils have little slope. Tile drains are easy to install, and the trenches are stable in areas that are not sandy. The tile should be more closely spaced than in less clayey soils. Backfilling the trenches with porous material, such as straw, grass, or topsoil, helps to keep the drains free. Diversion terraces constructed upslope from these soils help to divert runoff. Plowing under of crop residue and green-manure crops reduces crusting and improves tilth and workability. Fall plowing permits early planting in spring and helps to maintain soil structure. Delayed grazing of forage crops helps to prevent puddling during wet periods.

CAPABILITY UNIT IIw-3 (1.5b, 3/2b)

In this unit are soils of the Blount, Del Rey, and Metamora series. These are gently sloping or undulating soils. Both the subsoil and underlying material are moderately fine textured. There are numerous depressions.

The available moisture capacity is high. Runoff is slow, and permeability is moderately slow. Natural fertility is high.

The water table fluctuates but is at or near the surface in spring. Many areas are so wet in spring and after rains that farm machinery bogs down. Planting and tillage must be delayed in the wet depressions. If these soils are worked when wet, they become puddled and they dry out cloddy, hard, and crusty. The crust hinders the emergence of seedlings.

Drained areas of these soils are well suited to small grain, row crops, and hay crops. The major management needs are control of wetness and preservation of tilth.

A complete drainage system is not practical where the soils are undulating, because installation is difficult and there are not enough outlets. Only random tile and surface drains can be used in many places. Once established, however, ditchbanks and tile trenches require little maintenance because the soils are stable. Plowing under of large amounts of crop residue and green-manure crops improves tilth and reduces surface crusting. Minimum tillage is beneficial.

CAPABILITY UNIT IIw-4 (2.5b, 2.5c)

In this unit are soils of the Conover and Parkhill series. These are mainly nearly level, somewhat poorly drained and poorly drained soils. They have a moderately fine textured subsoil and medium-textured underlying material.

The available moisture capacity is high, and crops normally have enough moisture. Runoff is slow, and water ponds in depressions. Permeability is moderately slow. Natural fertility is moderately high or high. The surface layer of the poorly drained soil is slightly thicker than that of the somewhat poorly drained soil and contains more organic matter.

The water table fluctuates but normally is high. The soils receive runoff from higher areas and are excessively wet in spring and after rains. Farm machinery readily bogs down. Once these soils are drained, however, they are easy to work and to keep in good tilth.

Drained areas of these soils are suited to corn, wheat, oats, navy beans, soybeans, and a mixture of alfalfa and bromegrass. The choice of forage crops depends on how wet the soils are and the amount of drainage provided. Control of wetness is the chief management need.

Installing a complete drainage system is difficult because some places are undulating. Where outlets are available, the best system consists of a combination of random tile and open ditches. Additions of lime and fertilizer benefit most cropped areas. Plowing under of green-manure crops and crop residue improves the content of organic matter. Minimum tillage is beneficial.

CAPABILITY UNIT IIw-5 (2.5b)

Conover loam, 2 to 6 percent slopes, is the only soil in this unit. It is a gently sloping or undulating, somewhat poorly drained soil. The subsoil is moderately fine textured, and the underlying material is medium textured.

The available moisture capacity is high. Runoff is medium, and water ponds in the numerous depressions. Infiltration is moderate, and permeability is moderately slow. Natural fertility is moderately high.

The water table fluctuates but is at or near the surface in spring. Many areas are so wet in spring and after rains that machinery bogs down. Planting and tillage must be delayed in the wet depressions. If this soil is worked when wet, it becomes puddled and dries out cloddy, hard, and crusty. The crust hinders the emergence of seedlings.

Drained areas of this soil are well suited to corn, wheat, oats, beans, and hay crops. Control of wetness is the chief management need.

Installing a complete drainage system is difficult in some places because of the undulating relief and lack of outlets. Only random tile and surface drains are feasible in many areas. Once installed, however, ditchbanks and tile trenches require little maintenance because this soil is stable. Plowing under of large amounts of crop residue and green-manure crops improves tilth and reduces surface crusting. Minimum tillage also is beneficial.

CAPABILITY UNIT IIw-6 (2.5c, 3b, 3c)

In this unit are soils of the Ensley, Lamson, Locke, Minoa, and Parkhill series. These are level or nearly level, poorly drained and somewhat poorly drained soils. They have a medium-textured subsoil and moderately coarse textured to medium-textured underlying material. The Minoa and Lamson soils are underlain by layers of very fine sand and silt.

The available moisture capacity is medium to high, and crops generally have an adequate supply of moisture. Runoff is slow, and water ponds in depressions. Permeability is moderate or moderately slow. Natural fertility is moderate to high.

The water table fluctuates but is high in spring and after rains. Once the soils are drained, however, they dry out readily and are easy to work and to keep in good tilth. Cobblestones hinder tillage of the Locke soil.

Most crops commonly grown in the county are suited to these soils, but drainage is needed. The choice of forage crops depends on how wet the soils are and the amount of drainage provided. Small grain planted on the poorly drained soils either drowns out or grows rank and lodges before it can be harvested. In some years the soils are so wet that machinery bogs down and planting, weed control, and harvesting are delayed. Control of wetness is the chief management need.

A drainage system consisting of tile drains and surface drains is suitable if outlets are available. Installing the system is difficult in some areas because silty and sandy material readily fills tile trenches. Minoa and Lamson soils are especially unstable when wet. Backfilling the trenches with organic material or suitable surface soil helps to keep the drains free. Additions of fertilizer benefit most cropped areas. Plowing under of green-manure crops and crop residue improves the content of organic matter. Minimum tillage also is beneficial.

CAPABILITY UNIT IIw-7 (3b)

In this unit are soils of the Locke series. These are chiefly gently sloping, somewhat poorly drained soils. They have a medium-textured subsoil and moderately coarse textured underlying material.

The available moisture capacity is medium, and crops normally have an adequate supply of moisture. Runoff is slow, and water ponds in depressions. Infiltration is moderately rapid, and permeability is moderate. Natural fertility is moderate.

The water table fluctuates but is high in spring and after rains. The soils are excessively wet at these times, but once drained, they dry out and are easy to work and to keep in good tilth.

Corn, wheat, oats, beans, and hay are suited to these soils. The choice of forage crops depends on how wet the soils are and the amount of drainage provided. Control of wetness is the chief management need.

A complete drainage system is difficult to install because of the undulating relief. Random tile and surface drains are suitable where outlets are available. Additions of lime and fertilizer benefit most cropped areas. Plowing under of green-manure crops and crop residue improves the organic-matter content.

CAPABILITY UNIT IIw-8 (3/2b, 3/2c)

In this unit are soils of the Corunna and Metamora series. These are mainly level or nearly level, poorly drained and somewhat poorly drained soils. Some of the poorly drained areas are in depressions. The subsoil is medium textured or moderately coarse textured, and the underlying material is medium textured to moderately fine textured.

The available moisture capacity is medium. Runoff is slow or very slow, and water ponds in the depressions. Permeability is moderately rapid in the upper part of the soils and is moderately slow in the substratum. Natural fertility is high.

The water table is seasonally high and is at or near the surface in spring. The surface layer of the poorly drained Corunna soil is thicker than that of the somewhat poorly drained Metamora soils and has a higher content of organic matter.

Most crops grown in the county are suited to these soils once they are drained. Truck crops are well suited. Control of wetness is the chief management need, but soil blowing also is a hazard when the soils are dry. Frost damage is a hazard in some years because of the low-lying position of the soils.

Tile drains and surface drains can be used to remove excess water and thus permit earlier tillage. The depth and spacing depend on the depth to fine-textured material; sandy material tends to fill the trenches in some areas. Uneven areas are harder to drain than the nearly level areas. Random tile and surface drains are satisfactory for the gently sloping soils. Mulches, cover crops, crops planted in strips, and windbreaks help to protect the soils from blowing. Tillage should be kept to a minimum.

CAPABILITY UNIT IIs-2 (3a)

Dryden sandy loam, 0 to 2 percent slopes, the only soil in this unit, is moderately well drained. It has a medium-textured subsoil and moderately coarse textured underlying material.

The available moisture capacity is medium, and the supply of moisture is not adequate during extremely dry periods. Runoff is medium. Permeability is moderate, and excess wetness is seldom a hazard. Natural fertility is moderate.

This soil is easy to till within a wide range of moisture content. It warms up and is ready for tillage early in spring and dries out quickly after rains.

Most crops grown in the county are suited to this soil. Examples are corn, oats, wheat, and hay. All legumes and grasses suited to the soil can be grown for forage. The major management needs are conservation of moisture, maintenance of fertility and organic-matter content, and control of erosion.

Stripcropping and contour tillage help to conserve moisture and control erosion. Plowing under of green-manure crops and crop residue increases water absorption and improves tilth. Minimum tillage and additions of organic matter keep the surface layer from crusting. Winter cover crops help to control soil blowing and provide organic matter.

CAPABILITY UNIT IIIe-5 (2.5a, 3a)

In this unit are soils of the Miami and Sisson series. These are sloping, well-drained soils that are slightly eroded or moderately eroded. They have a medium-textured subsoil and moderately coarse textured or medium-textured underlying material.

The available moisture capacity is high. Tilth and the condition of the plant cover affect the rate of runoff, which is rapid on the moderately eroded soil and medium on the slightly eroded soil. Permeability is moderate to moderately slow. Natural fertility is moderate to moderately high. Erosion is a serious hazard. The moderately eroded spots are in poorer tilth and crust more readily than the slightly eroded spots.

The crops commonly grown in this county are suited to these soils, but protection from erosion is needed. All suitable legumes and grasses can be grown for forage. The major problems are control of runoff and erosion, maintenance of tilth and fertility, and conservation of moisture.

Close-growing crops help to slow runoff and thereby control erosion. Plowing under of large amounts of crop residue and green-manure crops improves tilth and fertility, especially of the moderately eroded soils where crusting is a severe hazard. Terraces and stripcropping are beneficial but are hard to lay out because the slopes are short and complex. Minimum tillage helps to maintain tilth and to conserve moisture.

CAPABILITY UNIT IIIe-6 (3a)

Lapeer sandy loam, 6 to 12 percent slopes, is the only soil in this unit. It is a well-drained, mainly slightly eroded soil. The subsoil is medium textured, and the underlying material is moderately coarse textured.

The available moisture capacity is medium. Runoff is rapid, especially where crops are planted up and down the slope. Although infiltration is rapid and permeability is moderate to moderately rapid, most of the water runs off because of the slope. Natural fertility is medium to low. Some spots are moderately eroded, and as a result runoff has increased and the fertility and organic-matter content have been reduced.

The crops commonly grown in this county are suited to this soil, but protection from erosion is needed. The chief management problems are control of erosion and the conservation of moisture, especially during dry months in summer.

Minimum tillage, plowing under of crop residue, and the use of cover crops all help to reduce runoff and the risk of further erosion. Seeding natural waterways helps to dispose of runoff safely without gullying. Terraces and stripcropping are beneficial where the slopes are continuous, but they are hard to lay out where the slopes are short and complex. Close-growing crops help to control runoff and erosion on the short slopes.

CAPABILITY UNIT IIIe-9 (4a)

In this unit are soils of the Boyer and Spinks series. These are sloping, well-drained soils that are mainly slightly eroded. Most areas are moderately coarse textured throughout. Boyer soils are underlain by stratified sand and gravel, and the Spinks soil by sand.

The available moisture capacity is medium to low. Runoff is rapid, especially where crops are planted up and down the slope. Because of runoff and the sandy nature of the soils, moisture is in short supply during dry months in summer. Permeability is rapid or moderately rapid in most areas. Fertility is moderately low.

These soils warm up early in spring and are ready for planting earlier than are finer textured soils. They are easy to till, but they erode readily where cultivated intensively. The Boyer sandy loam resists erosion better than the other soils. Soil blowing is a hazard in large areas exposed by tillage. Eroded spots are lower in organic-matter content than the other areas and tend to be more droughty.

The crops commonly grown in the county are suited to these soils. Corn, small grain, and alfalfa are the main crops. The chief management needs are control of erosion and conservation of moisture. During dry years deep-rooted crops, such as alfalfa, are better suited than shallow-rooted crops. Small grain normally matures before the drier part of summer.

Minimum tillage, stubble mulching, and stripcropping help to control erosion and permit intensive use, but stripcropping is difficult to lay out or is not practical in areas that lack continuous slopes. Seeding natural waterways helps to dispose of surplus water safely, but maintaining the grass is difficult on the loamy sands in this unit. Plowing under of crop residue, green-manure crops, and barnyard manure improves the content of organic matter and reduces droughtiness and the risk of further erosion. Heavy fertilization may not be beneficial in dry years, because soil moisture is not sufficient to make the plant nutrients available to crops.

CAPABILITY UNIT IIIw-1 (Oc, 1c)

In this unit are soils of the Paulding and Toledo series. These are nearly level, poorly drained soils that are dominantly fine textured throughout.

The available moisture capacity is high. Runoff is slow to very slow or ponded. Permeability is very slow. Natural fertility is high, and the organic-matter content also is high.

The water table is at or near the surface part of the year, and as a result, the soils are wet. They warm up slowly in spring and cannot be tilled early. Also, they shrink when dry and swell when wet.

Drained areas of these soils are suited to most crops commonly grown in the county. Their suitability for forage crops depends on the degree of wetness. The chief management needs are control of wetness and maintenance of structure in the plow layer.

Tile drainage alone does not drain these soils sufficiently; both surface drainage and subsurface drainage are needed. Special blinding material helps to increase the flow of water into the drains. Minimum tillage and frequent additions of large amounts of organic material help to maintain soil structure. In some places fall plowing permits earlier planting of crops. Delayed grazing of forage crops helps to prevent puddling in wet periods.

CAPABILITY UNIT IIIw-2 (1b)

In this unit are soils of the Fulton and Nappanee series. Most areas are level, but some are gently sloping. All are somewhat poorly drained. They are dominantly fine textured throughout.

The available moisture capacity is high. Runoff is slow, and permeability is slow. Natural fertility is high.

The water table is at or near the surface in undrained areas, and water stands in depressions and nearly level areas for long periods. The gently sloping areas have somewhat better surface drainage. Farm machinery bogs down readily, and weed control, planting, and harvesting are difficult during wet periods. Frost damage is a hazard, especially in the lowest areas. Growth of plant roots is hindered by the clayey subsoil and high water table. Tilling these soils in wet periods tends to damage soil structure and to impair tilth.

Drained areas of these soils are well suited to the crops commonly grown in the county. The major problems are control of wetness and preservation of tilth.

Tile drains, surface drains, and bedding systems help to remove excess water and to permit earlier tillage. Fall plowing at the right moisture content reduces damage to soil structure and also permits earlier tillage the following spring. Plowing under of organic matter helps to increase permeability and thereby the flow of water into tile drains.

CAPABILITY UNIT IIIw-5 (4b, 4/2b, 5b)

In this unit are soils of the Wasepi and Au Gres series. These are level or gently sloping, somewhat poorly drained soils. They are coarse textured and moderately coarse textured. The silty subsoil variant of the Wasepi soils is underlain by stratified silt and very fine sand. The other Wasepi soils are underlain by stratified sand and gravel.

The available moisture capacity is medium for the Wasepi soils and very low for the Au Gres soils. Because of their sandy nature, both soils tend to be droughty during dry periods. Runoff is slow or very slow. Permeability is moderately rapid to rapid except in areas that are saturated. Natural fertility is moderately low, and the content of organic matter is moderate.

The water table is high in undrained areas, but once it is lowered, the soils dry out quickly. Soil blowing is a hazard in large areas exposed by tillage.

Drained areas of these soils are suited to vegetables, truck crops, and other crops commonly grown in the county. The major problems are control of wetness, maintenance of fertility, and conservation of moisture during dry periods. Small grain is better suited than corn because it normally matures before the drier part of summer. Installing tile drains or surface drains permits earlier tillage of the soils in spring and after rains and improves productivity. The loamy sands are slightly less productive than the others.

A complete drainage system is not practical in some areas, because the relief is uneven or outlets are lacking. Random surface drains or tile drains can be used in undulating areas. These sandy soils tend to cave into tile trenches, but they support farm machinery better than clayey soils. Tile is laid most easily during dry periods. Windbreaks, mulches, cover crops, and stripcropping help to reduce soil blowing. Minimum tillage also is beneficial. Frequent, light applications of fertilizer are better than heavy applications because these soils lose nutrients through leaching.

CAPABILITY UNIT IIIw-6 (4c, 4/2c)

In this unit are soils of the Gilford series. These are level or depressional, poorly drained soils. They have a moderately coarse textured subsoil and coarse textured underlying material. A few areas are underlain by stratified silt and very fine sand.

The available moisture capacity is medium. Runoff is very slow, and water ponds in the depressions. Permeability is rapid to moderately rapid except in areas that are saturated. Natural fertility is moderately low.

The water table is high in spring, but once it is lowered by drainage, the soils tend to be droughty. Soil blowing is a hazard.

Corn, small grain, and hay commonly are grown on these soils. The choice of crops depends on the amount of drainage provided. Vegetables and truck crops do well in drained areas, and pasture or water-tolerant forage crops in undrained areas. The major problems are control of wetness and conservation of moisture during dry periods.

Tile drains and open ditches help to remove excess water. These are installed most easily when the soils are dry because ditchbanks and trenches cave in readily when the soils are wet. Windbreaks, mulches, cover crops, and stripcropping help to control soil blowing. Minimum tillage also is beneficial. Additions of fertilizer and of organic matter improve productivity.

CAPABILITY UNIT IIIw-9 (4/2b, 1.5c, 3c)

In this unit are soils of the Lamson, Lenawee, and Selfridge series. These are mainly nearly level, poorly drained and somewhat poorly drained soils. The uppermost 20 to 40 inches of the Selfridge soils consists of sandy (coarse-textured) material, and the underlying material is moderately fine textured. The Lenawee soils are moderately fine textured, and the Lamson soils are mainly medium textured. In areas where Selfridge and Lenawee soils are mapped together, 30 percent of the acreage has no coarse-textured material in the surface layer and the soils are gently rolling in some places.

Where mapped together, Selfridge and Lenawee soils have spots of clay loam that are high in available moisture capacity and high in natural fertility. In other places the soils are low in available moisture capacity and low in natural fertility. All the soils have slow or very slow runoff, and water ponds in the depressions. Permeability is rapid in the sandy layers and moderately slow in the finer textured underlying material.

The water table is high in spring and after rains, and the soils are saturated. Once the water table is lowered by drainage, the sandy soils dry out quickly and become droughty. The spots of clay loam are less droughty than the sandy soils. Soil blowing is a hazard in large areas that are exposed by tillage.

The crops commonly grown in the county are suited to these soils. Vegetables and truck crops are well suited. The major problems are control of wetness and conservation of moisture during dry periods. Small grain does better than corn because it matures before the drier part of summer. Crops mature faster on the sandy soils than on the clayey soils, but the sandy soils are harder to manage because tillage implements bog down in wet periods.

Drainage is not practical in some areas, because outlets are not available. Diversion terraces constructed upslope help to divert runoff and permit the soils to dry out more rapidly. Tile drains and open ditches provide ample drainage in some areas. They are best installed during dry periods because ditchbanks and trenches cave in readily when the sandy soils are wet. Stripcropping, mulches, cover crops, and windbreaks help to control soil blowing. Minimum tillage also is beneficial. Plowing under of large amounts of organic matter, such as crop residue and green-manure crops, improves tilth and helps to conserve moisture. Heavy applications of fertilizer may not be beneficial in dry years, because soil moisture is not sufficient to make the plant nutrients available to crops.

CAPABILITY UNIT IIIw-10 (4/2c)

This unit consists of Brevort-Selfridge complex. These soils are nearly level or depressional and poorly drained or somewhat poorly drained. The uppermost 20 to 40 inches is sandy (coarse textured), and the underlying material is medium textured to moderately fine textured.

The available moisture capacity is low. Runoff is very slow or ponded. Permeability is rapid in the sandy layer and slow in the underlying finer textured material. Natural fertility is moderately low or low.

The water table is high, and the soils dry out slowly. Tillage must be delayed in spring, and harvesting is delayed in years of excessive rainfall. Once the water table is lowered by drainage, the soils dry out quickly and then become droughty during extremely dry periods. Soil blowing is a hazard. Frost damage is a hazard in some years because of the low-lying position of the soils.

Drained areas of these soils are used for crops and pasture. Vegetables and truck crops do well. The major problems are control of wetness and conservation of moisture during dry periods. Small grain is a dependable crop because it matures before the drier part of summer.

Drainage is not practical in some areas, because outlets are not available. Many areas are not used for farming. Some remain wooded, and some are idle. Tile drains and open ditches provide ample drainage in some places, but they are best installed during dry periods because ditchbanks and trenches cave in readily when these sandy soils are wet. The depth and spacing of tile drains depend on the depth to the underlying finer textured material. Additions of organic matter and fertilizer improve productivity and help to conserve moisture. Minimum tillage also is beneficial. Windbreaks, stripcropping, cover crops, and mulches help to control soil blowing.

CAPABILITY UNIT IIIw-11 (5c)

Granby loamy fine sand is the only soil in this unit. This is a nearly level, poorly drained soil. It is coarse textured in most places, but in a few places it is finer textured at a depth of more than 40 inches.

The available moisture capacity is very low. Runoff is very slow, and water ponds in depressions. Permeability is rapid. Natural fertility is low.

The water table is high, and the soil is saturated all or part of each year. Once the water table is lowered by drainage, the soil dries out quickly and then becomes droughty. Soil blowing is a hazard in large areas exposed by tillage.

The crops commonly grown in the county are suited to this soil. Vegetables and truck crops do well. Among the major problems are control of wetness and conservation of moisture during dry periods. Small grain does better than corn because it matures before the drier part of summer.

Tile drains and open ditches provide ample drainage. They are best installed during dry periods, since the sandy material tends to cave in when it is wet. Windbreaks, stripcropping, cover crops, and mulches help to control soil blowing. Minimum tillage also is beneficial. Heavy applications of fertilizer generally are not practical, because crops may not have enough moisture to mature in dry years.

CAPABILITY UNIT IIIw-15 (Mc)

Lupton muck, the only soil in this unit, is nearly level and very poorly drained. The topmost 40 inches or more consists of woody and fibrous plant material.

The available moisture capacity is very high. Runoff is very slow to ponded, and permeability is rapid. The organic-matter content is very high, and natural fertility is low.

The water table is high, and drainage is needed before crops can be grown. When the soil is wet farm machinery bogs down readily and planting and harvesting are hampered. Nevertheless, care must be taken in lowering the water table. If it is lowered too much, subsidence occurs and some areas dry out to a point where soil blowing and fire are hazards. Wind blows out newly seeded crops, decreases the thickness of the organic material, and causes drifting soil material to fill drainage ditches. Frost damage also is a hazard. Weeds, pests, and diseases are hard to control.

Drained areas of this soil are used for specialty crops, small grain, and grasses. Less drainage is needed in areas used for water-tolerant plants and grassland. The major problems are control of wetness, reduction of soil blowing, and improvement of fertility.

Drainage is not practical in some areas, because outlets are not available. Where it is practical, maintaining the water table at a suitable level helps to control droughtiness and to reduce soil blowing. Subsidence can be reduced by permitting the water to rise closer to the surface in areas not used for crops. Compaction of the surface layer, sprinkler irrigation, and the use of stripcropping, buffer strips, and windbreaks help to control blowing. Grain planted in rows 2 to 3 feet apart also helps. Besides protecting the soil, windbreaks provide nesting areas and cover for wildlife. Selecting frost-hardy plants and providing good air drainage help to reduce the risk of frost damage. Cultural and chemical means can be used to control weeds, insects, and diseases.

CAPABILITY UNIT IIIs-3 (4a, 4/2a)

In this unit are soils of the Boyer, Metea, and Spinks series. These are nearly level, well-drained soils. They have a moderately coarse textured subsoil and coarse textured or moderately fine textured underlying material.

The available moisture capacity is medium or low, and crops generally lack moisture during dry months in summer. Runoff is slow or very slow. Infiltration is rapid, and permeability is moderately rapid or rapid. The organic-matter content is low, and natural fertility is low or moderately low. Tillage is easy because the surface layer is friable.

Most crops commonly grown in the county are suited to these soils. Examples are corn, potatoes, beans, small grain, and hay. Crops that resist drought and mature early do best. Deep-rooted forage plants are more productive than other plants. The major problems are control of soil blowing and conservation of moisture. Wind damage is serious if the soils are farmed intensively. Water erosion generally is not a hazard.

Windbreaks, stripcropping, and minimum tillage help to control soil blowing. Organic matter added to the soils helps to conserve moisture and to preserve tilth. Fertilization improves productivity, but heavy additions of fertilizer are not beneficial in dry years, because crops lack moisture and do not mature. Metea and Spinks soils are somewhat more droughty than Boyer soils.

CAPABILITY UNIT IIIs-4 (4a, 4/2a)

In this unit are Boyer, Metea, and Spinks soils. These are gently sloping, well drained or moderately well drained soils. The loamy subsoil variant of the Boyer soils has coarse-textured material in the uppermost 20 to 40 inches and is underlain by moderately fine textured to medium-textured material. The other soils have moderately coarse textured and coarse textured material to a depth of 5 feet or more.

All the soils have medium or low available moisture capacity. Normally, they are filled with moisture almost to capacity at the beginning of the growing season but become progressively droughty as the season goes on. Moisture is not adequate during dry periods. Runoff is slow. Permeability is rapid or moderately rapid. Natural fertility is moderately low or low.

These soils are easy to work throughout a wide range of moisture content without clodding or crusting. Excessive tillage, however, increases the hazard of soil blowing. Spinks soils are more droughty and more susceptible to soil blowing than the other soils in this unit.

Most crops commonly grown in the county are suited to these soils. Examples are corn, beans, small grain, and hay. The major problems are control of soil blowing and conservation of moisture. Crops that resist drought and mature early do best.

Windbreaks, stripcropping, and minimum tillage help to control soil blowing. Plowing under of large amounts of crop residue, green-manure crops, and barnyard manure increases fertility, maintains the organic-matter content, and conserves moisture. Fertilization improves productivity, but heavy additions of fertilizer are not profitable in dry years, because crops lack moisture and do not mature.

CAPABILITY UNIT IVe-4 (2.5a, 3a)

In this unit are soils of the Lapeer and Miami series. These are moderately steep or hilly, well-drained soils. Some areas are slightly eroded, and some are moderately eroded. The subsoil is medium textured or moderately fine textured, and the underlying material is medium textured or moderately coarse textured.

The available moisture capacity is medium to high. Runoff is rapid, and erosion is a severe hazard. Permeability is moderately rapid to moderately slow. Natural fertility is moderately high or medium. The moderately eroded spots are low in organic-matter content and are more susceptible to runoff and further erosion than the other areas. Also, they tend to crust readily.

These soils are too steep for intensive cultivation. They are used mainly for small grain and hay. Severe erosion results if row crops are grown up and down the slopes in successive years. The major problems are control of erosion and conservation of moisture.

Minimum tillage, stripcropping, and hay crops in long rotations help to slow runoff and control erosion. Close-growing crops can be used where the slopes are too complex or too short for stripcropping. Plowing under of large amounts of organic matter conserves moisture by helping the soils to absorb rainwater, which otherwise runs off. Grassed waterways can be used to carry away runoff safely.

CAPABILITY UNIT IVe-9 (4a)

Boyer sandy loam, 12 to 18 percent slopes, is the only soil in this unit. It is a well-drained soil and is slightly eroded in most places. It is moderately coarse textured to coarse textured to a depth of at least 5 feet. The underlying material consists of stratified sand and gravel.

The available moisture capacity is moderately low. Runoff is medium, and permeability is moderately rapid or rapid. Natural fertility is moderately low.

This soil is easy to till, but the slope limits use of farm machinery in some places and causes a serious erosion hazard. Also, moisture is likely to be inadequate in summer because of the sandy nature of the soil. Soil blowing is a hazard if large areas are exposed by tillage.

The use of this soil for crops is severely limited because of the hazards of erosion and droughtiness. The major problems, therefore, are control of erosion and conservation of moisture. Shallow-rooted crops do not have enough moisture in dry years. Small grain is better suited because it matures before the drier part of summer.

Minimum tillage, stubble mulching, and stripcropping help to slow runoff and control erosion, but stripcropping and tillage are difficult where the slopes are not continuous. Maintaining a grass cover helps to control erosion on uneven and short slopes. Uncontrolled grazing, however, leads to gullying. Additions of organic matter and fertilizer improve the stand of plants and promote a thicker cover. Heavy additions of fertilizer are not beneficial in dry years, because crops lack moisture and do not mature.

CAPABILITY UNIT IVw-2 (5b, 5/2b)

In this unit are soils of the Au Gres series. These are nearly level to gently sloping, somewhat poorly drained soils. The loamy substratum phase of the Au Gres soil is underlain by medium-textured to fine-textured material at a depth of 40 to 66 inches. The other soil is coarse textured throughout.

The available moisture capacity is very low. Runoff is very slow, and water ponds in depressions. Permeability is very rapid where the material is sand; it is slow in the finer textured material that occurs in the loamy substratum phase. Natural fertility is low.

The water table is high in spring and restricts permeability. Drained areas are easy to till, but if the water table is lowered too much, the soils become droughty. Soil blowing is a hazard in large areas exposed by tillage.

These soils are severely limited for use as cropland. The major problems are control of wetness, conservation of moisture in dry periods, and improvement of fertility.

Installing a drainage system is difficult because of the sandy nature of the soils. Tile is easiest to install when the soils are dry. Otherwise, ditchbanks and tile trenches cave in readily, and soil material fills the drains. Backfilling with such porous material as straw, topsoil, or grass clippings helps to keep the drains free. Stripcropping, windbreaks, cover crops, mulches, and minimum tillage help to conserve moisture and to control soil blowing. Fertilization improves fertility and productivity, but heavy additions of fertilizer are not beneficial in dry years, because crops lack moisture and do not mature.

CAPABILITY UNIT IVw-5 (M/1c, M/3c, M/4c)

In this unit are soils of the Edwards, Linwood, Tawas, and Willette series. These are level and nearly level, poorly drained soils. The uppermost 12 to 40 inches is organic material. The underlying material is sand in most places, but it is loam in some, and it consists of clay and marl in others.

The available moisture capacity is very high. Runoff is very slow or ponded. Permeability is rapid in the organic layer and ranges from very rapid to slow in the underlying material. The organic-matter content is high, but natural fertility is low.

The water table is high, and the soils are saturated. Farm machinery bogs down readily when the soils are wet, and planting and harvesting are hampered. Nevertheless, care must be taken in lowering the water table. If it is lowered too much, subsidence occurs and some areas dry out to a point where soil blowing and fire are hazards. Wind blows out newly seeded crops, decreases the thickness of the organic material, and causes drifting soil material to fill drainage ditches. Frost damage also is a hazard. Weeds, pests, and diseases are hard to control.

Drained areas of these soils are used for specialty crops, small grain, and grasses. Less drainage is needed in areas used for water-tolerant plants and grassland. The major problems are control of wetness, reduction of soil blowing, and improvement of fertility.

Maintaining the water table at a suitable level helps to control droughtiness and to reduce soil blowing. Among the effective measures are dams, dikes, pumps, and irrigation wells. Also effective are subirrigation by means of tile lines and surface drainage by means of tile and open ditches. Subsidence can be reduced by permitting the water table to rise nearer the surface in areas not used for crops. Compaction of the surface layer, sprinkler irrigation, and the use of stripcropping, buffer strips, and windbreaks help to control soil blowing. Grain planted in rows 2 to 3 feet apart also helps. Selecting frost-hardy plants and providing good air drainage help to reduce the risk of frost damage. Cultural and chemical means can be used to control weeds, insects, and diseases. These soils generally are low in phosphorus and potassium and in micronutrients, such as manganese, boron, copper, molybdenum, and zinc. These elements should be applied in amounts determined by soil tests and according to the needs of the crop to be grown.

Areas of these soils that cannot be drained can be used for wildlife habitat or forage crops. Grazing should be restricted during wet periods.

CAPABILITY UNIT IVs-4 (5a, 5/2a)

In this unit are soils of the Oakville series. These are nearly level to gently sloping, well-drained soils. The loamy substratum phase is underlain by medium-textured to fine-textured material at a depth of 40 to 66 inches. The other soil is coarse textured throughout.

The available moisture capacity is very low, and crops lack moisture during dry months in summer. Little water runs off these sandy soils, and permeability is very rapid. Natural fertility is low. Soil blowing is a hazard in areas exposed by tillage.

These soils have severe limitations for use as cropland. They show the effects of droughtiness sooner than most of the other soils. In extremely dry years, such shallow-rooted crops as corn do not mature, because they lack moisture. Forage crops are productive early in the growing season, and so are crops that mature before the drier part of summer. The major problems are conservation of moisture, control of soil blowing, and improvement of fertility.

Minimum tillage helps to reduce loss of moisture through evaporation. Windbreaks, cover crops, stripcropping, and mulches, as well as minimum tillage, can be used to control soil blowing. Fertilization improves fertility, but heavy additions of fertilizer are not beneficial in dry years, because crops lack moisture and do not mature.

CAPABILITY UNIT Vw-3 (L-2c)

In this unit are soils of the Ceresco, Cohoctah, Saranac, Shoals, and Sloan series. These are level or nearly level, somewhat poorly drained and poorly drained soils. They are on bottom lands and are subject to deposition. They consist of stratified, moderately coarse textured to moderately fine textured material.

The available moisture capacity is medium or high. Runoff is very slow, and water ponds in depressions. Infiltration is moderately rapid to rapid, and permeability is moderately slow to moderately rapid. Natural fertility is moderate to moderately high.

The use of these soils for crops is limited mainly by frequent flooding and a seasonal high water table. Farming is not practical in many areas, because meandering streams cut the soils into small tracts. Wildlife habitat and intermittent pasture are least affected by these limitations and are better uses than cropland.

CAPABILITY UNIT VIe-2 (2.5a, 3a, 4a)

In this unit are soils of the Boyer, Lapeer, and Miami series. These are steep, well-drained soils that chiefly are slightly eroded to moderately eroded. They are coarse textured to medium textured.

The available moisture capacity is medium to high. Runoff is medium for the Boyer soil and very rapid for the others. Erosion is a more serious hazard on the Lapeer and Miami soils, in which gullies form readily. Permeability is moderately slow to rapid. Natural fertility ranges from low to moderately high.

The use of these soils for row crops and small grain is limited mainly by the slope and the risk of further erosion. Pasture and forage crops are suited, but productivity is reduced where the coarser textured soils are short of moisture during the dry months of summer. Maintaining a cover of vegetation is most important. Severely eroded spots are in poor tilth and crust readily when they are dry. The use of planting and harvesting equipment is difficult because of the slope. Overgrazing leads to sheet erosion and gullying. Recreation, wildlife habitat, and woodland are least affected by the limitations of these soils and are better uses than cropland.

Predicted Yields

The soils of Macomb County vary considerably in their suitability for crops. Some can be used consistently for cultivated crops. Others are better suited to less intensive uses because of limitations of the soils or the hazard of erosion.

Predictions of average yields per acre of the principal crops grown in the county are given in table 2. The predictions are given for each soil at two levels of management.

In columns A are average yields obtained under the management common in the county at the time the soil survey was made. The following measures are applied.

1. Some farmers use a crop rotation that includes grasses and legumes but generally give little consideration to how well suited the rotation is to the soil.
2. Barnyard manure produced on the farms is returned to the soil, and some commercial fertilizer is applied.
3. Lime also is applied, but generally not in amounts soil tests would indicate necessary.
4. Poorly drained areas are worked at times when they are wet. In many places excess water results in only a partial crop.
5. Not enough attention is given to erosion control and proper soil management.

The yields in columns B are obtained if management is improved. Under such management, most of the following practices are applied.

1. The crop rotation used is suited to the soil and has the proper proportion of row crops and legume-grass crops.
2. Control of water erosion and soil blowing, where needed, is supplied by such measures as contour tillage, stripcropping, minimum tillage, and the return of crop residue.
3. Soil tests are used to determine the amount of lime and the amount and kind of fertilizer needed for a specific crop.
4. Where needed, an adequate system of artificial drainage is installed.
5. Improved varieties of plants and seeds of high quality are used.
6. Weeds, diseases, and insects are controlled.
7. Methods and timing of tillage and harvesting are suited to the soils.
8. Cover crops, crop residue, and manure are returned to improve soil structure, to supply organic matter, and to control erosion.

The crop yields listed are those to be expected over a period of several years. Those listed under improved management are not necessarily the best obtainable. A favorable combination of soil, plants, and weather conditions could make yields somewhat higher. Irrigation is not considered a part of improved management, since this practice is limited mainly to areas used for truck and fruit crops.

Woodland

Forest originally covered most of Macomb County. Now, scattered areas of woodland make up only about 8.4 percent of the total acreage. The largest areas occur in soil associations 1 and 6, which are shown on the general soil map at the back of this survey.

Wood products are not a major source of income in the county. The 1964 Census of Agriculture shows that during that year sales amounted to 367 cords of firewood and fuelwood, 75,000 board feet of saw logs and veneer logs, and 4,100 Christmas trees. The county is in the metropolitan area of Detroit, and the potential market for Christmas trees is high.

Woodland suitability groups

The soils of Macomb County have been placed in woodland suitability groups to assist farmers and others in planning the use of their soils for woodland. Each group consists of soils that are similar in potential productivity and in their requirements for and response to management. The groups are identified by

TABLE 2.—*Predicted average yields per acre of crops under two levels of management*

[Yields in columns A are those to be expected under common management; yields in columns B are those 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 For grain A	Corn For grain B	Corn For silage A	Corn For silage B	Oats A	Oats B	Wheat A	Wheat B	Alfalfa A	Alfalfa B	Mixed hay A	Mixed hay B	Field beans A	Field beans B	Soybeans A	Soybeans B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Au Gres sand, 0 to 6 percent slopes	25	45	4	8	20	40	16	25	1.3	2.1	0.7	1.6	--	--	--	--
Au Gres sand, loamy substratum, 0 to 6 percent slopes	25	45	4	8	20	40	16	25	1.3	2.1	.8	1.7	--	--	--	--
Blount loam, 0 to 2 percent slopes	65	90	12	15	40	80	35	45	2.2	4.2	2.0	2.8	20	30	25	35
Blount loam, 2 to 6 percent slopes	65	90	12	15	40	80	35	45	2.2	4.2	2.0	2.8	20	30	25	35
Boyer loamy sand, 0 to 2 percent slopes	35	65	6	11	30	50	25	40	2.0	3.0	1.0	1.8	--	--	--	--
Boyer loamy sand, 2 to 6 percent slopes	35	65	6	11	30	50	25	40	2.0	3.0	1.0	1.8	--	--	--	--
Boyer loamy sand, 6 to 12 percent slopes	32	60	5	10	27	45	20	35	2.0	3.0	1.0	1.8	--	--	--	--
Boyer sandy loam, 0 to 2 percent slopes	40	70	7	12	32	60	25	40	2.0	3.0	1.2	2.0	--	--	--	--
Boyer sandy loam, 2 to 6 percent slopes	40	70	7	12	32	60	25	40	2.0	3.0	1.2	2.0	--	--	--	--
Boyer sandy loam, 6 to 12 percent slopes	35	65	6	11	25	55	20	35	2.0	3.0	1.2	2.0	--	--	--	--
Boyer sandy loam, 12 to 18 percent slopes	32	60	5	10	25	50	19	30	2.0	3.0	1.2	2.0	--	--	--	--
Boyer sandy loam, 18 to 25 percent slopes	--	--	--	--	--	--	--	--	--	--	.6	1.2	--	--	--	--
Boyer gravelly loamy sand, loamy subsoil variant, 2 to 6 percent slopes	35	65	6	11	30	50	25	40	2.0	3.0	1.2	2.0	--	--	--	--
Brevort-Selfridge complex	30	65	5	11	30	50	17	35	1.4	2.5	--	--	--	--	--	--
Celina loam, 0 to 2 percent slopes	55	95	10	16	55	75	35	45	3.5	4.5	2.0	3.5	14	25	20	30
Celina loam, 2 to 6 percent slopes	55	95	10	16	55	75	35	45	3.5	4.5	2.0	3.5	14	25	20	30
Ceresco fine sandy loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cohoctah fine sandy loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Conover loam, 0 to 2 percent slopes	60	100	11	17	55	80	35	55	2.7	5.0	2.0	3.5	20	35	23	35
Conover loam, 2 to 6 percent slopes	60	100	11	17	55	80	35	55	2.7	5.0	2.0	3.5	20	35	23	35
Corunna sandy loam	50	80	9	14	45	70	25	45	2.0	3.5	1.7	2.5	18	27	22	32
Del Rey loam, 0 to 2 percent slopes	55	90	10	15	50	80	35	45	2.5	4.2	2.0	2.8	20	35	20	35
Del Rey loam, 2 to 6 percent slopes	55	90	10	15	50	80	35	45	2.5	4.2	2.0	2.8	20	35	20	35
Del Rey-Metamora sandy loams, 0 to 2 percent slopes	50	85	9	14	45	75	30	45	2.3	4.0	1.8	2.5	18	30	20	32
Del Rey-Metamora sandy loams, 2 to 6 percent slopes	50	85	9	14	45	75	30	45	2.3	4.0	1.8	2.5	18	30	20	32
Dryden sandy loam, 0 to 2 percent slopes	45	85	8	14	45	65	35	50	2.5	4.0	1.5	2.5	15	25	25	35
Dryden sandy loam, 2 to 6 percent slopes	45	85	8	14	45	65	35	50	2.5	4.0	1.5	2.5	15	25	25	35
Edwards muck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ensley-Parkhill complex	55	100	10	17	50	80	25	50	2.0	4.5	1.8	3.0	--	--	--	--
Fulton sandy loam, 0 to 2 percent slopes	35	80	6	13	40	65	25	40	1.5	3.0	1.2	2.8	--	--	20	32
Fulton loam, 0 to 2 percent slopes	35	80	6	13	40	65	25	40	1.5	3.0	1.2	2.8	--	--	20	32
Gilford sandy loam	40	75	7	12	35	60	25	35	1.8	3.0	1.5	2.5	--	--	20	30
Gilford sandy loam, silty subsoil variant	40	80	7	13	35	65	25	40	1.8	3.0	1.7	2.7	--	--	22	33
Granby loamy fine sand	20	65	3	11	20	45	15	30	1.2	2.2	.8	1.7	--	--	14	22
Hoytville clay loam	35	90	6	15	40	70	25	45	1.5	3.5	1.5	3.0	--	--	20	35
Lamson fine sandy loam	45	95	8	16	40	70	25	45	2.3	3.5	1.8	2.5	15	25	20	30
Lapeer sandy loam, 2 to 6 percent slopes	45	85	8	14	45	65	30	40	2.5	4.0	1.3	2.8	12	22	20	30
Lapeer sandy loam, 6 to 12 percent slopes	40	80	7	14	40	60	25	35	2.2	3.5	1.3	2.8	8	16	20	30
Lapeer sandy loam, 12 to 18 percent slopes	35	70	6	12	35	55	20	30	1.8	3.0	1.0	1.8	--	--	--	--
Lapeer sandy loam, 18 to 25 percent slopes	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lenawee clay loam	50	100	9	17	45	80	30	55	2.0	5.0	2.0	3.0	15	35	25	38
Lenawee-Selfridge complex	45	70	8	12	35	60	25	50	2.0	4.0	--	--	--	--	--	--
Linwood muck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Locke sandy loam, 0 to 2 percent slopes	55	90	10	15	50	70	30	50	2.2	4.0	1.5	3.0	16	25	20	30
Locke sandy loam, 2 to 6 percent slopes	55	90	10	15	50	70	30	50	2.2	4.0	1.5	3.0	16	25	20	30
Locke very cobbly sandy loam, 0 to 6 percent slopes	40	60	7	10	30	55	20	35	1.4	2.0	1.0	1.7	--	--	--	--
Lupton muck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Made land	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Metamora fine sandy loam, 0 to 2 percent slopes	50	85	9	14	45	70	30	50	2.2	4.0	1.7	2.8	15	25	25	35

TABLE 2.—*Predicted average yields per acre of crops under two levels of management*—Continued

Soil	Corn: For grain A	Corn: For grain B	Corn: For silage A	Corn: For silage B	Oats A	Oats B	Wheat A	Wheat B	Alfalfa A	Alfalfa B	Mixed hay A	Mixed hay B	Field beans A	Field beans B	Soybeans A	Soybeans B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Metamora fine sandy loam, 2 to 6 percent slopes	50	85	9	14	45	70	30	50	2.2	4.0	1.7	2.8	15	25	25	35
Metea sand, 0 to 2 percent slopes	30	60	5	10	30	50	20	30	1.5	2.5	1.5	2.3	--	--	--	--
Metea sand, 2 to 6 percent slopes	30	60	5	10	30	50	20	30	1.5	2.5	1.5	2.3	--	--	--	--
Miami loam, 2 to 6 percent slopes	55	95	10	16	55	75	35	45	3.0	4.5	1.3	3.0	14	25	18	27
Miami loam, 6 to 12 percent slopes	40	75	7	13	40	65	25	35	2.3	3.5	1.3	3.0	10	20	14	24
Miami loam, 12 to 18 percent slopes	35	70	6	12	35	60	22	33	2.3	3.5	1.0	2.2	--	--	--	--
Miami loam, 18 to 25 percent slopes	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Minoa fine sandy loam, 0 to 4 percent slopes	50	85	9	13	40	75	25	45	2.0	3.5	1.5	2.6	16	25	20	30
Nappanee loam, 0 to 2 percent slopes	35	80	6	13	40	65	25	40	1.5	3.0	1.2	2.8	--	--	20	32
Nappanee clay loam, 0 to 2 percent slopes	35	80	6	13	40	65	25	40	1.5	3.0	1.2	2.8	--	--	20	32
Nappanee clay loam, 2 to 6 percent slopes	35	80	6	13	40	65	25	40	1.5	3.0	1.2	2.8	--	--	20	32
Oakville fine sand, 0 to 6 percent slopes	20	40	3	7	17	33	12	23	1.2	2.0	.9	1.5	--	--	--	--
Oakville fine sand, loamy substratum, 0 to 6 percent slopes	25	45	4	8	20	35	15	25	1.4	2.2	1.0	1.7	--	--	--	--
Parkhill loam	60	110	11	18	50	80	30	55	2.5	5.0	2.2	3.2	20	40	25	40
Paulding clay	25	60	4	10	30	50	20	35	1.2	2.8	1.0	2.0	--	--	--	--
Sanitary land fill	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saranac clay loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selfridge fine sand, 0 to 2 percent slopes	40	65	7	11	35	60	25	40	2.0	3.0	1.0	2.0	13	20	18	26
Selfridge fine sand, 2 to 6 percent slopes	40	65	7	11	35	60	25	40	2.0	3.0	1.0	2.0	13	20	18	26
Selfridge-Lamson complex, 0 to 2 percent slopes	45	70	8	12	40	65	25	40	1.7	3.0	1.2	2.8	15	25	20	30
Selfridge-Lenawee complex, 0 to 4 percent slopes	45	75	8	12	40	65	25	50	2.0	3.5	1.2	2.8	15	25	20	30
Shoals loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sims clay loam	50	100	9	17	45	80	30	50	2.0	3.8	1.5	2.8	15	30	25	38
Sisson fine sandy loam, 2 to 6 percent slopes	55	95	10	16	55	75	35	45	3.0	4.5	1.3	3.0	12	22	23	35
Sisson fine sandy loam, 6 to 12 percent slopes	45	85	8	14	45	70	30	40	3.0	4.0	1.3	3.0	10	20	20	32
Sloan loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spinks loamy sand, 0 to 2 percent slopes	30	55	5	9	30	50	20	30	1.5	2.5	1.0	1.8	--	--	--	--
Spinks loamy sand, 2 to 6 percent slopes	30	55	5	9	30	50	20	30	1.5	2.5	1.0	1.8	--	--	--	--
Spinks loamy sand, 6 to 12 percent slopes	27	50	4	8	25	45	18	25	1.0	2.0	.9	1.4	--	--	--	--
Tawas muck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toledo silty clay loam	35	90	6	15	40	70	25	45	1.5	3.5	1.5	3.0	--	--	20	30
Toledo clay	35	90	6	15	40	70	25	45	1.5	3.5	1.5	3.0	--	--	20	30
Urban land	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Wasepi loamy sand, 0 to 2 percent slopes	50	80	9	13	45	60	25	40	2.0	3.0	1.2	2.0	--	--	18	26
Wasepi loamy sand, 2 to 6 percent slopes	50	80	9	13	45	60	25	40	2.0	3.0	1.2	2.0	--	--	18	26
Wasepi sandy loam, 0 to 2 percent slopes	50	80	9	13	45	60	25	40	2.0	3.0	1.5	2.3	--	--	18	26
Wasepi sandy loam, silty subsoil variant, 0 to 4 percent slopes	55	90	10	15	50	70	30	50	2.2	4.0	1.6	2.5	--	--	20	30
Wasepi-Au Gres complex, 0 to 4 percent slopes	35	60	6	10	30	50	20	32	1.6	2.5	1.2	2.0	--	--	18	25
Willette muck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

letters assigned on a Statewide basis. Since not all the groups in Michigan are represented in Macomb County, the letters are not in consecutive alphabetic order. To find the group number for a specific soil mapped in this county, turn to the "Guide to Mapping Units."

Made land, Sanitary land fill, and Urban land have not been assigned to a group. Information about woodland in these small areas can be obtained from the local office of the Soil Conservation Service or from forestry specialists in the area.

The description of each woodland suitability group contains brief information about the soils, tells about their limitations for use as woodland, and gives potential productivity, or estimates of yields to be expected. It also names the trees suitable for management in natural stands and for planting. The most suitable is named first.

Following are explanations of the terms used in the descriptions of the groups. Then the woodland suitability groups are described. Unless a group contains only one soil, the soils are identified only by the name of the series. Listing of the series does not mean that all of the soils of that series are in the particular group. To find the classification of the individual soils, refer to the "Guide to Mapping Units" at the back of this soil survey.

Potential productivity.—Soils that are best suited to trees have an annual yield per acre of 325 board feet of saw logs and veneer logs or 1.5 cords of firewood and fuelwood. The next best suited soils produce 300 to 325 board feet or 1.0 to 1.5 cords. Soils that are moderately well suited produce between 240 and 300 board feet or 0.8 to 1.0 cord. Those that are poorly suited produce 160 to 240 board feet or 0.3 to 0.8 cord. Very poorly suited soils produce less than 125 board feet or 0.1 cord.

Species priority.—The choice of trees for managing in existing stands and for planting is based on the suitability of the soils and the productivity and commercial value of the dominant trees that grow on a particular site. The first species listed should be given the most consideration when making new plantings or improvement cuttings. Not considered were diseases or insect infestations that plague certain localities.

Plant competition.—Undesirable species of brush, trees, grasses, or other plants invade a site that has been disturbed by fire, logging, or other factors. They compete with the wanted trees and hinder or prevent their establishment. A rating of *slight* indicates that competition does not prevent the natural regeneration of a stand. Nor does it interfere with the growth of planted seedlings. A rating of *moderate* indicates that competition delays the natural regeneration of a stand of desirable trees or the growth of planted trees. It does not prevent the eventual development of a fully stocked stand. A rating of *severe* indicates that competition prevents the establishment of both natural and planted stands without intensive site preparation and effective control practices.

Seedling mortality.—A high water table, extreme acidity, droughtiness, and high soil temperature are among the unfavorable soil properties that kill some seedlings. A rating of *slight* indicates that ordinarily not more than 25 percent of the seedlings die. A rating of *moderate* indicates a mortality of 25 to 50 percent, and a rating of *severe* indicates mortality of more than 50 percent.

Erosion hazard.—Soils differ in their susceptibility to erosion because of differences in slope, permeability, available moisture capacity, and other characteristics. Erosion can be controlled by using special techniques in woodland management and by careful construction and maintenance of roads, trails, and landings. Erosion is only a *slight* hazard where the soils are level or nearly level. All operations can be carried out with a minimum loss of soil. A rating of *moderate* indicates that a moderate loss of soil is likely where the soils are sloping enough to require some limitations on the use of equipment. Operations on the contour are beneficial. The soils in this county are not susceptible to a severe loss of soil material.

Windthrow hazard.—Soil characteristics affect the development of tree roots and thus determine how well the trees can withstand the force of wind. Susceptibility to windthrow affects the choice of species to favor in existing stands and for planting. It also affects the choice of management practices. A rating of *slight* indicates that normal woodland management or operations do not result in windthrow. A rating of *moderate* indicates that some trees can be expected to blow down during extremely wet periods or periods of high winds. A rating of *severe* indicates that root development is not adequate, because of a high water table, a hardpan, or other adverse soil characteristics. Many trees can be expected to blow down.

Equipment limitation.—Poor drainage, slope, or soil texture can restrict or prohibit the use of equipment commonly used in woodland management or harvesting. Soils differ in their suitability for different kinds of equipment, methods of operation, or season of use. A rating of *slight* indicates that all equipment normally can be used without restriction. A rating of *moderate* indicates that there are some restrictions for some types of equipment. For example, the restriction on wet soils lasts 1 to 3 months each year. A rating of *severe* indicates that special equipment is needed or that the use of equipment is restricted for more than 3 months each year. Otherwise, soil structure and stability can be severely damaged. If tree roots are exposed, the trees grow more slowly and may even die.

WOODLAND SUITABILITY GROUP B

This group consists of well drained to moderately well drained, medium-textured soils on moraines. The soils are of the Celina and Miami series. They have moderate to moderately slow internal drainage and high available moisture capacity. Natural fertility is moderately high.

These soils have few limitations for use as woodland. Competition from brush and other plants is moderate if the overstory is removed. It tends to slow the early growth rate of trees and delays establishment of a fully stocked stand. Seedling mortality is a slight hazard because of pests and diseases, and some replanting is needed. The erosion hazard is moderate on slopes of more than 12 percent, and for this reason, trees should be planted on the contour. Windthrow is not a hazard. The use of equipment is limited in places. Roads and trails should follow the contour, especially where slopes exceed 6 percent.

Well-managed stands of hardwoods can be expected to make an annual yield per acre of 325 board feet or 1.5 cords. The estimate for white pine is 160 board feet or 0.3 cord, and that for aspen is 1.3 to 1.5 cords.

In order of priority, the best trees to manage in natural stands are red oak, white oak, white ash, walnut, black cherry, yellow-poplar, basswood, and sugar maple. White spruce is considered best for planting; next are white pine, Norway spruce, and Austrian pine. Black walnut is best for interplanting. Yellow-poplar is second best.

WOODLAND SUITABILITY GROUP E

This group consists of well-drained, coarse-textured soils of the Oakville and Spinks series. The Spinks soils are underlain by thin bands of finer textured material, and the loamy substratum phase of the Oakville soil is underlain by finer textured material at a depth of 40 to 66 inches. The soils of this group are well aerated and have low to very low available moisture capacity. Natural fertility is moderately low to low.

Most areas have moderate limitations for use as woodland. Competition from other plants is slight and can be lessened by such simple methods as brush control. Seedling mortality is slight, but some replanting is needed. Droughtiness is a hazard in dry periods. Erosion is a hazard where slopes are greater than 6 percent. Trees should be planted on the contour, and a cover crop maintained. Windthrow is a hazard only where the trees are unprotected or where strong winds prevail. Some measures may be needed to make young trees secure. The equipment limitation is slight on the steeper slopes; roads and trails should follow the contour.

Well-managed stands of pine can be expected to make an annual yield per acre of 240 to 300 board feet or 0.8 cord to 1.3 cords. The estimate for hardwoods is 160 to 240 board feet or 0.3 to 0.8 cord.

In order of priority, the best trees to manage in natural stands are oak, aspen, and beech. Red pine is considered best for planting; then white pine and jack pine.

WOODLAND SUITABILITY GROUP G

This group consists of well drained and moderately well drained, coarse textured and moderately coarse textured soils of the Boyer, Dryden, Lapeer, Metea, and Sisson series. Metea soils and the loamy subsoil variant of Boyer soils have a medium-textured to fine-textured substratum at a depth of 20 to 40 inches.

The soils of this group have rapid to moderately slow internal drainage and are moderate to high in available moisture capacity. Natural fertility is moderate to moderately low except for Metea soils. The upper part of Metea soils is low to moderate both in available moisture capacity and natural fertility. All of the soils are calcareous below a depth of 18 to 42 inches.

Most areas have slight limitations for use as woodland. Nevertheless, competition from brush and weeds is severe in cutover areas. Seedling mortality is slight; little replanting is required. Erosion is a moderate hazard on slopes of more than 12 percent. As a result, trees should be planted on the contour and a vegetative cover should be maintained. Windthrow is not a hazard, but the use of equipment is limited in places.

Both hardwoods and pines can be expected to make an annual yield per acre of 300 to 325 board feet or 1.3 to 1.5 cords.

In order of priority, the best trees to manage in natural stands are red oak, white ash, yellow-poplar, black walnut, basswood, sugar maple, and black cherry. White pine is considered best for planting; next is white spruce or Norway spruce, and then Austrian pine and red pine.

WOODLAND SUITABILITY GROUP J

This group consists of somewhat poorly drained, moderately coarse textured to moderately fine textured soils of the Blount, Conover, Del Rey, Fulton, Metamora, and Nappanee series. These soils have moderately slow to slow internal drainage and are high in available moisture capacity. They have a seasonal high water table. Natural fertility is high and moderately high.

Most areas have such severe limitations for trees that their use as woodland is questionable. Plant competition is severe enough to require the use of chemicals and girdling. Seedling mortality as high as 50 percent can be expected. Pests and diseases are numerous because the soils are wet. Erosion is not a hazard. Windthrow is a severe hazard because the water table limits root growth. To help prevent damage to soil structure and tree roots, heavy equipment should be used only during dry periods or while the soils are frozen in winter.

Well-managed stands of hardwoods can be expected to make an annual yield per acre of 160 to 300 board feet or 0.3 cord to 1.3 cords. Yields of pine are very low, and yields of spruce are only slightly better.

In order of priority, the best trees to manage in natural stands are white ash, basswood, oak, and cottonwood. White spruce is considered best for planting; next are white pine and Norway spruce.

WOODLAND SUITABILITY GROUP K

This group consists of somewhat poorly drained, coarse-textured to moderately fine textured soils of the Locke, Metamora, Minoa, Selfridge, and Wasepi series. Metamora and Selfridge soils are underlain by calcareous loam to silty clay loam at a depth of 20 to 40 inches.

The soils of this group have moderately slow to rapid internal drainage. They are high to low in available moisture capacity and high to low in natural fertility. They have a seasonal high water table.

Most areas have severe limitations for use as woodland. Competition from brush and other plants is severe where the overstory has been removed. It prevents establishment of an adequate stand in some places and severely inhibits natural regeneration in others. Seedling mortality is moderate. Erosion is only a slight hazard because the areas are nearly level. Windthrow is a severe hazard because the water table prevents tree roots from penetrating deeply enough to hold the trees firm against high winds. To help prevent damage to soil structure and tree roots, heavy equipment should be used only during dry periods or when the soils are frozen.

Well-managed stands of pine can be expected to make an annual yield per acre of 125 to 160 board feet or 0.1 to 0.3 cord. The estimates for hardwoods are 160 to 240 board feet or 0.3 to 0.8 cord.

In order of priority, the best trees to manage in natural stands are white ash, red maple, silver maple, cottonwood, swamp white oak, basswood, and sycamore. White spruce is considered best for planting; next are Norway spruce, white-cedar, white pine, and Austrian pine.

WOODLAND SUITABILITY GROUP L

This group consists of somewhat poorly drained, coarse-textured soils of the Au Gres series. The loamy substratum phase of Au Gres sand has medium-textured to fine-textured material at a depth of 40 to 66 inches. These soils have very rapid internal drainage and very low available moisture capacity, though they have a seasonal high water table. Natural fertility is low.

Most areas have severe limitations for use as woodland. Plant competition slows the initial growth of trees and, in some places, is so severe that natural regeneration is undependable without using chemical or mechanical control measures. Seedling mortality is moderate; the loss normally is between 25 and 50 percent. Special planting techniques and a considerable amount of replanting are required in many places. Erosion is only a slight hazard because the soils are nearly level to gently sloping. Windthrow is a severe hazard because the water table prevents tree roots from penetrating deeply enough to hold the trees firm against high winds. The use of equipment is restricted less than 3 months, but some damage to the soils and tree roots can be expected if logging is done during periods of excessive wetness.

These soils normally produce few trees of commercial value. Spruce can be expected to make an annual yield per acre of 160 to 240 board feet or 0.3 to 0.8 cord. The estimates for pine are 160 board feet or 0.3 cord, and those for hardwoods are 125 board feet or 0.1 cord.

In order of priority, the best trees to manage in natural stands are aspen, red maple, silver maple, and sugar maple. White pine is considered best for planting; next is white spruce.

WOODLAND SUITABILITY GROUP M

This group consists of well-drained, coarse textured and moderately coarse textured soils of the Boyer series. Calcareous sand and gravel occur at a depth of 18 to 40 inches. These soils have moderately rapid to rapid internal drainage and are moderate in available moisture capacity. Natural fertility is moderately low.

Most areas have moderate limitations for use as woodland. They tend to be droughty during dry periods, and the underlying sand and gravel restrict root growth. Plant competition causes only a slight delay in the establishment of trees by either natural seeding or planting. Simple measures of brush control are sufficient. Seedling mortality is negligible. Erosion is a slight hazard, even on slopes of more than 18 percent, but roads, trails, and plantings should follow the contour. Windthrow is not a hazard, and the use of equipment is not limited.

Well-managed stands of pine can be expected to make an annual yield per acre of 240 to 300 board feet or 1.3 cords. The estimates for hardwoods are 160 to 240 board feet or 0.3 to 0.8 cord.

In order of priority, the best trees to manage in natural stands are oak, sugar maple, basswood, beech, and walnut. White pine is considered best for planting; next are red pine, white spruce, and jack pine.

WOODLAND SUITABILITY GROUP O

This group consists of somewhat poorly drained and poorly drained, moderately coarse textured to moderately fine textured soils of the Ceresco, Cohoctah, Saranac, Shoals, and Sloan series. Most areas of these soils have calcareous material at or near the surface. All have moderately rapid to moderately slow internal drainage and are moderate or high in available moisture capacity. The water table is high, and flooding is a hazard. Natural fertility is moderately high or moderate.

Most areas have such severe limitations for trees that their use as woodland is questionable. Plant competition is moderate to severe where the overstory has been removed. Natural regeneration is not dependable, because overflowing streams wash away the seeds and the stands tend to be scattered. Seedling mortality is severe. Erosion is only a slight hazard; many areas receive more soil through deposition than they lose through erosion. Windthrow is a moderate to severe hazard because the water table keeps tree roots from penetrating deeply enough to hold the trees firm against high winds. To help prevent damage to soil structure and tree roots, heavy equipment should be used only during dry periods or while the soils are frozen in winter.

Stands of pine, generally white pine, can be expected to make an annual yield per acre of 125 to 160 board feet or 0.1 to 0.3 cord. Estimates for hardwoods are 125 to 300 board feet or 0.1 to 0.8 cord.

In order of priority, the best trees to manage in natural stands are white ash, red maple, silver maple, cottonwood, sycamore, and red oak. Cottonwood is the best tree for planting.

WOODLAND SUITABILITY GROUP P

This group consists of poorly drained, medium-textured to very fine textured soils of the Hoytville, Lenawee, Parkhill, Paulding, Sims, and Toledo series. These soils have moderately slow and very slow inter-

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nal drainage and are high in available moisture capacity. The water table is high. Natural fertility also is high.

Most areas have severe limitations for use as woodland. Plant competition is so severe in some places that it slows natural regeneration of desirable trees. Seedling mortality of more than 50 percent can be expected as a result of the high water table and frost heaving, but enough seedlings grow for ultimate restocking. Dutch elm disease is common. Erosion is only a slight hazard because the soils are level or nearly level. Windthrow is a severe hazard since the water table prevents tree roots from penetrating deeply enough to hold the trees firm against high winds. To help prevent damage to soil structure and tree roots, equipment should be used only during dry periods or while the soils are frozen in winter.

Well-managed stands of hardwoods can be expected to make an annual yield per acre of 160 board feet or 0.3 cord. Estimates for spruce are 0.3 to 0.8 cord.

In order of priority, the best trees to manage in natural stands are red maple, white ash, basswood, and silver maple. White spruce is considered best for planting; next are Norway spruce, white pine, and Austrian pine.

WOODLAND SUITABILITY GROUP Q

Granby loamy fine sand, the only soil in this group, is poorly drained and coarse textured. It has rapid internal drainage and is very low in available moisture capacity. The water table is high. Natural fertility is low.

Most areas have severe limitations for use as woodland. Plant competition is moderate, but seedling mortality is almost 100 percent where this soil is in low areas and depressions. Planting should be confined to the higher areas. Water erosion is not a hazard, but soil blowing results unless a vegetative cover is maintained. Windthrow is a severe hazard because the water table limits root growth. If the water table is lowered, the soil then is droughty during dry periods. If equipment is used when the soil is wet, tree roots can be damaged.

Hardwoods can be expected to make an annual yield per acre of only 0.1 to 0.3 cord. Estimates for pine are even lower.

In order of priority, the best trees to manage in natural stands are silver maple, white ash, and pin oak. Planting is not recommended.

WOODLAND SUITABILITY GROUP S

This group consists of poorly drained, moderately coarse textured soils of the Brevort, Corunna, Ensley, Gilford, Lamson, and Selfridge series. The Corunna and Brevort soils are underlain by calcareous loam to clay at a depth of 20 to 40 inches.

The soils in this group have rapid to moderately slow internal drainage except in areas of Corunna and Brevort soils, which have moderately slow to slow internal drainage in the underlying loam to clay. All the soils are low to high in available moisture capacity and have a high water table. Natural fertility is high to moderately low.

Most areas have severe limitations for use as woodland. Plant competition is severe and is difficult to control. Seedling mortality is severe because of the water table and frost heaving. Dutch elm disease is common. Water erosion is not a hazard, because the soils are level or nearly level, but soil blowing is a hazard where the soils are coarse textured. Such soils need the protection of vegetation or windbreaks. Windthrow is a severe hazard because the water table limits the depth of the rooting zone and the trees are not held firm against high winds. To help prevent damage to soil structure and tree roots, equipment should be used only during dry periods or while the soils are frozen in winter.

Hardwoods can be expected to make an annual yield per acre of only 0.1 to 0.3 cord. Estimates for pine are even lower.

In order of priority, the best trees to manage in natural stands are white ash, red maple, and basswood. White ash is considered best for planting; next are Norway spruce, white pine, and Austrian pine.

WOODLAND SUITABILITY GROUP U

This group consists of poorly drained, mucky soils of the Edwards, Linwood, Lupton, Tawas, and Willette series. The muck grades to peat in the Lupton soils. The rest of the soils are underlain by coarse-textured to fine-textured mineral material at a depth of 12 to 42 inches. All the soils have rapid internal drainage and are very high in available moisture capacity. The water table is high. Natural fertility is low.

Most areas have very severe limitations for use as woodland. Plant competition is so severe that establishing a stand of planted trees is difficult. Seedling mortality is severe. Water erosion is not a hazard, but soil blowing is severe unless the soils are protected by vegetation or windbreaks. Windthrow is a very severe hazard because the water table limits the depth of the rooting zone and the trees are not held firm against high winds. Equipment limitations are severe; work generally is limited to periods when the soils are frozen.

These soils can be expected to make an annual yield per acre of roughly 0.1 to 0.8 cord. Even exceptional sites can be expected to yield only 125 to 200 board feet.

In order of priority, the best trees to manage in natural stands are red maple, silver maple, aspen, and tamarack. Austrian pine is considered best for planting as windbreaks; next are white pine and Scotch pine.

Wildlife

Table 3 rates the soils according to their suitability for elements of wildlife habitat and for general kinds of wildlife. A rating of *well suited* means that the soil is relatively free of limitations or that the limitations are easily overcome. *Suited* means that the limitations need to be recognized, but that they can be overcome by good management and careful design. *Poorly suited* means that limitations are severe enough to make use of the soil questionable for wildlife habitat. *Not suited* means that extreme measures are needed to overcome the limitations and that usage generally is not practical. The elements of wildlife habitat are discussed briefly in the following paragraphs.

Grain and seed crops.— Among these crops are corn, wheat, oats, barley, rye, buckwheat, millet, sorghum, soybeans, and sunflowers.

Grasses and legumes.—These are planted grasses and legumes commonly used for forage. Examples are bromegrass, fescue, timothy, redtop, trefoil, orchardgrass, reed canarygrass, clover, alfalfa, and sudangrass.

Wild herbaceous upland plants.—In this group are native annuals or other herbaceous plants that commonly grow in upland areas. Among them are strawberries, dandelions, goldenrod, wild oats, nightshade, ragweed, lambsquarters, and native grasses.

Hardwood plants.—These plants are hardwood trees and shrubs that grow vigorously and produce sprouts, fruits, or seeds that wildlife browse on. These woody plants either grow naturally or are planted. Examples are maple, beech, oak, poplar, birch, dogwood, willow, hawthorn, viburnum, wintergreen, raspberries, blackberries, cherries, grapes, and blueberries.

Coniferous plants.—Examples of native or planted coniferous trees and shrubs are pine, spruce, white-cedar, hemlock, balsam fir, yew, larch, and juniper.

Wetland food and cover plants.—These are plants that grow in moist or wet sites and that provide food and cover for waterfowl and furbearing animals. Examples are cattails, sedges, bulrushes, smartweed, wild millet, water plantain, wildrice, arrowhead, pondweed, pickerelweed, wildcelery, duckweed, and burreed.

Shallow-water developments.—These are impoundments of shallow water in marshy areas and stream channels. They consist of low dikes, nearly level ditches, dugouts, and devices to maintain water at a depth suitable for wetland wildlife.

Excavated ponds.—Migrating waterfowl are especially attracted to excavated ponds, or dugout ponds. Such ponds should have an independent source of water. They should not depend on runoff from surrounding areas, though they benefit from runoff that is not excessive.

The ratings shown in table 3 under the heading "Kinds of wildlife" apply to wildlife in general and not to a specific species. Not considered, therefore, are present land use, existing vegetation, and the extent of artificial drainage provided, because these factors are subject to change. Neither is consideration given to the ability of wildlife to move from place to place.

A rating of "well suited" or "suited" means that the soil can be managed most practically and with the best chance of success. A rating of "poorly suited" does not necessarily mean that a soil cannot be managed for wildlife, but it does show that a high level of management is required to improve the soil. Following are discussions of the kinds of wildlife.

Openland wildlife.—This kind of wildlife is made up of birds and mammals that normally frequent cropland, pasture, meadow, and areas overgrown with grasses, herbs, and shrubs. Examples are quail, pheasant, meadowlark, field sparrow, red fox, cottontail rabbit, woodchuck, and hawk.

Woodland wildlife.—These birds and mammals normally frequent wooded areas consisting of hardwood trees, coniferous trees, shrubs, or mixed stands of such plants. Among them are squirrel, raccoon, ruffed grouse, woodcock, woodpecker, warbler, nuthatch, deer, gray fox, and owl.

Wetland wildlife.—In this group are birds and mammals that normally frequent such wet areas as ponds, marshes, and swamps. Examples are muskrat, duck, geese, heron, rail, kingfisher, mink, crane, and bittern.

Engineering Uses of the Soils

This section describes properties of the soils that are important in engineering. Some soil properties are of special interest to engineers 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. Among the soil properties most important to engineers are permeability, shear strength, compaction characteristics, drainage, shrink-swell characteristics, grain size, plasticity, and soil reaction. The depth to the water table, depth to bedrock, and topography are also important.

The information in this section can be used to—

1. Make studies that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Develop information that can be used in planning drainage systems, farm ponds, irrigation systems, terraces and diversions, and other structures for conserving soil and water.
3. Make preliminary evaluations 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 soil mapping units to develop information that can be useful in designing and maintaining the pavements.
6. Supplement information obtained from 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 a 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 do 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

TABLE 3.—*Suitability for elements of*

[A rating of *well suited* means that the soil is relatively free of limitations or that the limitations are easily overcome. *Suited* *Poorly suited* means that limitations are severe enough to make use of the soil questionable for wildlife habitat. *Not suited*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood plants
Au Gres: AsB, AuB	Not suited	Poorly suited	Poorly suited	Poorly suited
Blount: BlA, BlB	Suited	Suited	Well suited	Suited
Boyer:				
BrA, BrB, BrC, BsA, BsB, BsC	Suited	Well suited	Well suited	Well suited
BsD, BsE	Poorly suited	Suited	Well suited	Well suited
BvB	Well suited	Well suited	Well suited	Well suited
Brevort: Bx. For Selfridge part, see Selfridge series.	Poorly suited	Suited	Suited	Suited
Celina: CeA, CeB	Well suited	Well suited	Well suited	Well suited
Ceresco: Cf	Suited	Suited	Well suited	Suited
Cohoctah: Cm	Poorly suited	Suited	Suited	Suited
Conover: CvA, CvB	Suited	Suited	Well suited	Suited
Corunna: Cw	Poorly suited	Suited	Suited	Suited
Del Rey: DlA, DlB, DmA, DmB. For Metamora part of DmA and DmB, see Metamora series.	Suited	Suited	Well suited	Suited
Dryden: DrA, DrB	Well suited	Well suited	Well suited	Well suited
Edwards: Ed	Not suited	Poorly suited	Poorly suited	Poorly suited
Ensley: Ep. For Parkhill part, see Parkhill series.	Poorly suited	Suited	Suited	Suited
Fulton: FtA, FuA	Suited	Suited	Well suited	Suited
Gilford:				
Gd	Poorly suited	Suited	Suited	Suited
Gf	Poorly suited	Suited	Suited	Suited
Granby: Gm	Not suited	Poorly suited	Poorly suited	Poorly suited
Hoytville: Hy	Suited	Suited	Well suited	Suited
Lamson: La. For Selfridge part, see Selfridge series.	Poorly suited	Suited	Suited	Suited
Lapeer:				
LeB	Well suited	Well suited	Well suited	Well suited
LeC	Suited	Well suited	Well suited	Well suited
LeD, LeE	Poorly suited	Suited	Well suited	Well suited
Lenawee: Lh, Lk. For Selfridge part of Lk, see Selfridge series.	Poorly suited	Suited	Suited	Suited
Linwood: Lm	Not suited	Poorly suited	Poorly suited	Poorly suited
Locke: LoA, LoB, LsB	Suited	Suited	Well suited	Well suited
Lupton: Lu	Not suited	Poorly suited	Poorly suited	Poorly suited
Made land: Md. Individual areas require onsite investigation.				
Metamora: MeA, MeB	Suited	Suited	Well suited	Suited

wildlife habitat and kinds of wildlife

means that the limitations need to be recognized, but that they can be overcome by good management and careful design. means that extreme measures are needed to overcome the limitations and that usage generally is not practical]

				Kinds of wildlife		
Coniferous plants	Wetland food and cover plants	Shallow-water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Well suited	Poorly suited	Suited	Suited	Poorly suited	Poorly suited	Poorly suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Poorly suited	Poorly suited	Suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Poorly suited	Well suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Well suited	Not suited	Well suited	Well suited	Poorly suited	Poorly suited	Poorly suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Poorly suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Poorly suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.

TABLE 3.—*Suitability for elements of wild*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood plants
Metea: MnA, MnB	Suited	Well suited	Well suited	Well suited
Miami:				
MoB	Well suited	Well suited	Well suited	Well suited
MoC	Suited	Well suited	Well suited	Well suited
MoD, MoE	Poorly suited	Suited	Well suited	Well suited
Minoa: MsB	Suited	Suited	Well suited	Suited
Nappanee: NaA, NcA, NcB	Suited	Suited	Well suited	Suited
Oakville: OaB, OkB	Not suited	Poorly suited	Poorly suited	Poorly suited
Parkhill: Pa	Poorly suited	Suited	Suited	Suited
Paulding: Pc	Poorly suited	Suited	Suited	Suited
Sanitary land fill: Sa. Individual areas require onsite investigation.				
Saranac: Sc	Poorly suited	Suited	Suited	Suited
Selfridge: SdA, SdB, SeA, SfB. For Lamson part of SeA, see Lamson series. For Lenawee part of SfB, see Lenawee series.	Suited	Suited	Well suited	Suited
Shoals: Sh	Suited	Suited	Well suited	Suited
Sims: Sl	Poorly suited	Suited	Suited	Suited
Sisson:				
SmB	Well suited	Well suited	Well suited	Well suited
SmC	Suited	Well suited	Well suited	Well suited
Sloan: Sn	Poorly suited	Suited	Suited	Suited
Spinks: SpA, SpB, SpC	Suited	Well suited	Well suited	Well suited
Tawas: Ta	Not suited	Poorly suited	Poorly suited	Poorly suited
Toledo: Ts, Tt	Poorly suited	Suited	Suited	Suited
Urban land: Ur. Individual areas require onsite investigation.				
Wasepi:				
WsA, WsB, WtA, WvB. For Au Gres part of WvB, see Au Gres series.	Suited	Suited	Well suited	Suited
WuB	Suited	Suited	Well suited	Suited
Willette: Wx	Not suited	Poorly suited	Poorly suited	Poorly suited

life habitat and kinds of wildlife—Continued

Coniferous plants	Wetland food and cover plants	Shallow-water developments	Excavated ponds	Kinds of wildlife: Openland wildlife	Kinds of wildlife: Woodland wildlife	Kinds of wildlife: Wetland wildlife
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Not suited	Not suited	Not suited	Suited	Poorly suited	Not suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Suited	Suited	Well suited	Well suited	Suited	Suited	Well suited.
Suited	Well suited	Poorly suited	Poorly suited	Suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Well suited	Poorly suited	Poorly suited	Suited	Suited	Suited.
Suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Poorly suited	Well suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Poorly suited	Well suited.

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 in this publication have a special meaning to soil scientists and a different meaning to engineers. The Glossary defines many such terms as they are used in soil science.

The engineering data are presented in three tables. Table 4 lists all the soil series in the county and gives estimates of soil properties significant in engineering. Tables 5 and 6 give interpretations and characteristics that affect specified engineering practices.

The data in tables 4, 5, and 6 and the detailed soil map can serve as a general guide for evaluating the engineering properties of the soil in a specific part of the county. At many construction sites, however, major variations in soil characteristics occur within the depth of the proposed excavation, and several kinds of soil occur within short distances. A detailed investigation at the site of the proposed construction is needed before planning detailed engineering work.

Engineering classification systems

The U.S. Department of Agriculture system of classifying soils according to texture is used primarily by agricultural scientists. In this system soils are classified according to their proportional amounts of sand, silt, and clay.

The system used by the American Association of State Highway Officials (AASHO) (*1*) is based on field performance of soils in highways. In this system soil materials are classified into seven principal groups, designated A-1 through A-7. The best materials for use in highway subgrades (gravelly soils of high bearing capacity) are classified as A-1, and the poorest (clayey soils having low strength when wet) are classified A-7.

The Unified system of soil classification was developed by the Waterways Experiment Station, Corps of Engineers (*9*). In this system soil materials are identified as coarse grained (GW, GP, GM, GC, SW, SP, SM, and SC), as fine grained (ML, CL, OL, MH, CH, and OH), or as highly organic (Pt).

Estimated properties

In table 4 the soil series of the county and their mapping unit symbols are listed, and estimates of some of the physical and chemical properties of the soils are given.

Generally, the information in this table applies to soil material to a depth of 5 feet or less. The soils in this county are deep enough over bedrock that bedrock generally does not affect their use. The depth from the surface is generally 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 of the series, but in most places there are variations of a foot or less in the depth to and in the thickness of the various layers. All of the organic soils are classified on the basis of the uppermost 40 inches. Below this depth there is considerable variation in texture and thickness.

Also given in table 4 are the textural classifications according to the three soil classification systems in general use. The figures giving the percentage of material passing 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.

Permeability, or the rate at which water moves downward through undisturbed soil material, as given in this table 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, 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 4, is the estimated range in pH value for each major horizon of the soils as determined in the field. It indicates acidity or alkalinity. 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 4 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 to the water table commonly is outside the range shown in the table.

Engineering interpretations

Tables 5 and 6 give estimates of the suitability of the soils of the county for specified engineering uses and list the soil properties that present hazards or difficulties in such use. The data in these tables apply to the representative profile of the series, which is described in the section "Descriptions of the Soils."

The suitability of the soils as a source of topsoil (table 5) refers specifically to the use of soil material, preferably rich in organic matter, as a topdressing for back slopes, embankments, lawns, and gardens. 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 considered suitable as a source of topsoil.

The suitability of the soils as a source of sand and gravel (table 5) refers to sources of such material within a depth of 5 feet from the surface. Boyer soils are a good source (fig. 14). In some soils, however, the depth to sand and gravel is either less than or more than 5 feet, and in adjacent areas of the same soil, unsuitable material can be just below 5 feet. Although some soils are rated in the table as unsuitable for sand and gravel, in places these soils 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.

The suitability of the soils as a source of road fill

Figure 14.—Gravel pit in an area of Boyer loamy sand, 0 to 2 percent slopes.

for pavements depends partly on the texture of the soil material. If the subsoil and substratum have contrasting characteristics, both are rated. Sand is generally the most desirable material for subgrade, and clay is the least desirable. The suitability of soils for impermeable material is based on the permeability of the material when compacted. Examples of use are fills for dams and linings of pond reservoir areas and sewage lagoons.

The entire soil profile was considered to determine the suitability of the soils as locations for highways. The features shown in table 5 are for undisturbed soils without artificial drainage. Additional information can be obtained from the State Highway Department of Michigan, which has rated the major soil series of the State according to their suitability for highway construction. This information is contained in the "Field Manual of Soil Engineering" (*3*).

Features that affect the suitability of undisturbed soils for foundations for buildings of no more than three stories are also shown in table 5. 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 for foundation material is the shrink-swell potential, which is shown in table 4 by specific horizons in the column headed "Shrink-swell potential." Paulding soils are examples of soils that have a high shrink-swell potential (fig. 15).

The suitability of soils for winter grading deals with the ease with which soil material can be handled and traversed by ordinary construction equipment during winter. This depends largely on the texture of the soil material, its natural content of water, and depth to the water table.

The important features affecting corrosion potential for conduits are soil texture and natural drainage because of their effect on aeration, moisture content, and movement of water. The soils were rated for uncoated steel pipes and concrete conduits. Generally, poor aeration and high reaction values, electrical conductivity, salt content, and moisture content are characteristic of soils that are corrosive to metal conduits. Soils with a low reaction value and a high moisture content are the most corrosive for concrete conduits.

In determining the limitations of the soils for sewage disposal systems, the factors considered were depth to the water table, permeability, hazard of flooding, and topography.

Features that affect the suitability of the soils for agricultural drainage (table 6) include soil texture, rate of water movement into and through the soil, depth to a restricting layer, 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 was 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 embankments are for disturbed soils. Features that affect the suitability of the soils for reservoirs and embankments are content of organic matter, permeability, shrink-swell potential, ground water level, and strength and stability.

Also considered in table 6 were features that affect the layout and construction of grassed waterways, the establishment of vegetation in the waterways, the con-

Figure 15.—An area of Paulding clay in which shrinking and swelling have caused the soil to crack.

TABLE 4.—*Esti*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Feet	*Inches*			
Au Gres:					
AsB	1 to 2.	0–9	Sand	SP–SM or SM	A–2 or A–3
		9–72	Sand	SP	A–3
AuB	1 to 2.	0–9	Sand	SP–SM or SM	A–2 or A–3
		9–48	Sand	SP	A–3
		48–60	Silty clay loam	CL	A–6
Blount: BlA, BlB	1 to 2.	0–8	Loam	ML	A–4
		8–24	Silty clay loam and silty clay.	CL or CH	A–6 or A–7
		24–36	Silty clay loam	CL	A–6
Boyer:					
BrA, BrB, BrC, BsA, BsB, BsC, BsD, BsE.	4 or more.	0–16	Sandy loam or loamy sand	SM	A–2
		16–36	Gravelly heavy sandy loam or sandy loam.	SC or SM	A–6 or A–2
		36–60	Stratified sand and gravel.	SP–SM or SP	A–1
BvB	3 or more.	0–17	Gravelly loamy sand	SM	A–2
		17–28	Gravelly sandy loam	SM	A–2 or A–6
		28–37	Sand and gravel	SP–SM or SP	A–1
		37–55	Silty clay loam	CL	A–6
Brevort: Bx For Selfridge part, see Selfridge series.	Less than 1.	0–8	Loamy sand	SM	A–2
		8–36	Loamy sand and sand	SP–SM or SM	A–1 or A–2
		36–66	Clay loam	CL	A–6
Celina: CeA, CeB	2 to 3.	0–11	Loam	ML	A–4
		11–29	Clay loam	CL	A–6
		29–60	Loam	ML	A–4
Ceresco: Cf	1 to 2.[2]	0–10	Fine sandy loam	SM or ML	A–4
		10–48	Fine sandy loam	SM or ML	A–4
		48–60	Sand	SP	A–3
Cohoctah: Cm	Less than 1.[2]	0–18	Fine sandy loam	SM or ML	A–4
		18–42	Fine sandy loam	SM or ML	A–4
		42–60	Sand and gravel	SP or SP–SM	A–1
Conover: CvA, CvB	1 to 2.	0–12	Loam	ML	A–4
		12–30	Clay loam	CL	A–6
		30–60	Loam	ML	A–4
Corunna: Cw	Less than 1.	0–11	Sandy loam	SM	A–2
		11–36	Heavy sandy loam	SC	A–2 or A–6
		36–60	Silty clay loam	CL	A–6
Del Rey: DlA, DlB, DmA, DmB For Metamora part of DmA, and DmB, see Metamora series.	1 to 2.	0–8	Sandy loam or loam	SM or ML	A–2 or A–4
		8–29	Silty clay or silty clay loam.	CL or CH	A–6 or A–7
		29–60	Silty clay loam	CL	A–6
Dryden: DrA, DrB	2 to 3.	0–14	Sandy loam	SM	A–2 or A–4
		14–30	Loam	ML	A–4
		30–60	Sandy loam	SM	A–2
Edwards: Ed	At surface.	0–13	Muck	Pt	------
		13–42	Marl.		
Ensley: Ep For Parkhill part, see Parkhill series.	Less than 1.	0–9	Sandy loam	SM	A–2 or A–4
		9–37	Sandy loam or loam	SM or ML	A–4 or A–6
		37–60	Sandy loam	SM	A–2
Fulton: FtA, FuA	1 to 2.	0–11	Loam or sandy loam	ML or SM	A–4 or A–2
		11–42	Silty clay	CH	A–7
		42–62	Stratified silty clay, silty clay loam, silt loam, and clay.	CH or CL	A–7 or A–6

See footnotes at end of table.

mated properties

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	*Inches per inch of soil*	*pH value*	
100	95–100	5–20	>10	0.05	6.1–6.5	Low.
100	95–100	0–5	>10	.04	6.1–7.3	Low.
100	95–100	5–20	>10	.05	5.6–7.3	Low.
100	95–100	0–5	>10	.04	5.6–7.3	Low.
100	95–100	80–90	0.05–0.2	.18	7.4–8.0	Moderate to high.
95–100	95–100	55–70	0.8–2.5	.17	6.1–6.5	Low.
95–100	95–100	75–90	0.2–0.8	.20	6.1–7.3	Moderate to high.
90–95	85–95	70–90	0.2–0.8	.16	7.4–8.0	Moderate.
95–100	90–100	15–35	2.5–10	.10	7.4–7.8	Low.
70–85	65–80	25–50	2.5–5.0	.12	6.6–7.8	Low.
55–80	50–70	0–10	5–10	.02	7.4–8.0	Low.
75–85	70–80	15–30	5–10	.10	6.6–7.3	Low.
75–85	70–80	30–45	2.5–5.0	.12	6.6–7.3	Low.
55–80	50–70	0–10	5–10	.02	7.4–7.8	Low.
95–100	95–100	80–90	0.05–0.2	.16	7.4–8.0	Moderate.
100	95–100	15–25	5–10	.05	6.6–7.3	Low.
100	95–100	5–30	5–10	.06	6.1–7.3	Low.
100	95–100	60–80	0.05–0.2	.17	7.4–8.0	Moderate.
100	95–100	60–75	0.8–2.5	.17	6.1–7.3	Low.
100	95–100	60–80	0.2–0.8	.18	6.6–7.3	Moderate.
95–100	95–100	55–75	0.8–2.5	.16	7.4–8.0	Low.
100	95–100	35–65	2.5–5.0	.14	6.6–7.3	Low.
100	95–100	35–65	2.5–5.0	.14	6.6–7.8	Low.
100	95–100	0–5	>10	.04	7.4–8.0	Low.
100	95–100	35–65	2.5–5.0	.14	7.4–8.0	Low.
100	95–100	35–65	2.5–5.0	.14	7.4–8.0	Low.
55–80	50–70	0–10	>10	.02	7.4–8.0	Low.
100	95–100	60–75	0.8–2.5	.17	5.6–6.5	Low.
100	95–100	60–80	0.2–0.8	.18	6.1–7.3	Moderate.
95–100	90–100	55–75	0.8–2.5	.16	7.4–8.0	Low.
100	95–100	25–35	2.5–5.0	.12	6.6–7.3	Low.
100	95–100	30–45	2.5–5.0	.12	6.1–7.3	Low.
100	95–100	80–90	0.2–0.8	.18	7.4–7.8	Moderate to high.
100	100	25–70	2.5–5.0	.15	6.6–7.3	Low.
100	100	70–95	0.2–2.5	.16	6.6–7.8	Moderate to high.
100	95–100	80–95	0.2–0.8	.17	7.4–8.0	Moderate.
95–100	95–100	25–45	2.5–5.0	.12	6.1–6.5	Low.
95–100	95–100	55–75	0.8–2.5	.15	6.6–7.3	Low.
90–95	80–90	20–30	2.5–5.0	.12	7.4–8.0	Low.
------	------	-----	5–10	.25	7.4–8.0	Variable.
95–100	95–100	25–45	2.5–5.0	.12	6.6–7.3	Low.
95–100	95–100	35–75	0.8–2.5	.15	6.6–7.8	Low.
90–95	80–90	20–30	2.5–5.0	.12	7.4–8.0	Low.
100	100	25–70	0.8–2.5	.18	5.6–6.5	Low.
100	100	80–90	<0.2	.16	5.6–7.4	High.
100	95–100	80–95	<0.2	.17	7.4–8.0	High.

TABLE 4.—*Estimated*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Feet	*Inches*			
Gilford:					
Gd	Less than 1.	0–10	Sandy loam	SM	A–2 or A–4
		10–30	Sandy loam and gravelly sandy loam.	SM or SC	A–2 or A–6
		30–50	Gravelly sand	SP–SM or SP	A–1
Gf	Less than 1.	0–25	Sandy loam	SM	A–2
		25–32	Heavy sandy loam	SC	A–2 or A–6
		32–38	Stratified sand and gravel.	SP–SM or SP	A–3 or A–1
		38–60	Stratified silt, fine sand, and very fine sand.	Layers of ML and SM	Layers of A–4 and A–2
Granby: Gm	Less than 1.	0–16	Loamy fine sand and loamy sand.	SM	A–2
		16–54	Sand	SP	A–1
Hoytville: Hy	Less than 1.	0–13	Clay loam and silty clay loam.	CL	A–6
		13–20	Silty clay	CH	A–7
		20–60	Clay	CH	A–7
Lamson: La	Less than 1.	0–10	Fine sandy loam	SM	A–4
		10–24	Fine sandy loam	ML or SM	A–4
		24–60	Stratified silt and very fine sand.	Layers of ML and SM	Layers of A–4 and A–2
Lapeer: LeB, LeC, LeD, LeE	3 or more.	0–20	Sandy loam	SM	A–2 or A–4
		20–30	Loam	ML	A–4
		30–60	Sandy loam	SM	A–2
Lenawee: Lh, Lk For Selfridge part of Lk see Selfridge series.	Less than 1.	0–13	Clay loam	CL	A–6
		13–31	Heavy silty clay loam	CL	A–6
		31–50	Clay loam	CL	A–6
Linwood: Lm	At surface.	0–20	Muck	Pt	------
		20–42	Loam	CL or ML–CL	A–4 or A–6
Locke: LoA, LoB, LsB	1 to 2.	0–12	Sandy loam	SM	A–2 or A–4
		12–29	Loam	ML	A–4
		29–50	Sandy loam	SM	A–2
Lupton: Lu	At surface.	0–60	Muck and Peat	Pt	------
Made land: Md. Soil material variable; onsite investigation needed.					
Metamora: MeA, MeB	1 to 2.	0–18	Fine sandy loam	SM	A–4
		18–36	Light loam and sandy loam.	ML or SM	A–4
		36–60	Silty clay loam	CL	A–6
Metea: MnA, MnB	3 or more.	0–29	Sand	SP or SP–SM	A–3
		29–32	Silty clay loam	CL	A–6
		32–60	Clay loam	ML–CL	A–6
Miami: MoB, MoC, MoD, MoE	3 or more.	0–14	Loam	ML	A–4
		14–30	Clay loam	CL	A–6
		30–60	Loam	ML	A–4
Minoa: MsB	1 to 2.	0–15	Fine sandy loam	SM	A–4
		15–42	Stratified fine sand and very fine sand.	SM	A–4 and A–2
Nappanee: NaA, NcA, NcB	1 to 2.	0–7	Clay loam	CL	A–6
		7–27	Silty clay and clay	CH	A–7
		27–60	Silty clay	CH	A–7
Oakville:					
OaB	4 or more.	0–7	Fine sand	SP–SM or SM	A–2 or A–3
		7–66	Fine sand	SP	A–3

See footnotes at end of table.

properties—Continued

Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*	*pH value*	
95–100 70–85	95–100 65–80	25–45 30–45	2.5–5.0 2.5–5.0	.12 .12	7.4–7.8 7.4–7.8	Low. Low.
55–80	50–70	0–10	5–10	.02	------	Low.
95–100 100 55–80	95–100 95–100 50–70	15–30 30–45 0–10	2.5–5.0 2.5–5.0 5–10	.14 .14 .02	7.4–7.8 6.6–7.3 7.4–8.0	Low. Low. Low.
100	95–100	30–70	0.05–0.20	.16	7.4–8.0	Low.
100	95–100	15–20	5–10	.05	6.6–7.3	Low.
100	95–100	0–5	>10	.04	6.6–7.3	Low.
100	95–100	60–75	0.2–0.8	.17	6.1–6.5	Moderate.
100 100	95–100 95–100	80–90 80–95	0.05–0.2 <0.05	.16 .16	6.6–7.3 6.6–7.3	High. High.
100 100 100	95–100 95–100 95–100	35–50 35–65 30–70	0.8–2.5 0.8–2.5 0.2–0.8	.15 .15 .18	6.1–6.5 6.6–7.8 7.4–8.0	Low. Low. Low.
95–100 95–100 90–95	95–100 95–100 80–90	25–45 55–75 20–30	2.5–5.0 0.8–2.5 2.5–5.0	.12 .15 .12	5.6–7.3 5.6–6.0 7.4–8.0	Low. Low. Low.
100 100 100	100 100 95–100	60–80 80–95 60–80	0.2–0.8 0.2–0.8 0.2–0.8	.17 .17 .16	6.1–7.3 6.6–7.8 7.4–8.0	Moderate. Moderate. Moderate.
------ 95–100	------ 90–100	----- 60–90	5–10 0.8–2.5	.25 .14	6.6–7.3 6.6–7.8	Variable. Moderate.
95–100 95–100 90–95	95–100 95–100 80–90	25–45 55–75 20–30	2.5–5.0 0.8–2.5 2.5–5.0	.12 .15 .12	6.1–7.3 6.1–7.3 7.4–8.0	Low. Low. Low.
------	------	-----	5–10	.25	6.6–7.8	Variable.
100 100	95–100 95–100	35–50 35–75	2.5–5 2.5–5	.14 .15	6.1–7.3 6.6–7.8	Low. Low.
100	95–100	80–90	0.2–0.8	.18	7.4–8.0	Moderate.
100 100 85–95	95–100 90–100 80–95	0–10 60–80 60–85	5–10 0.8–2.5 0.2–0.8	.05 .17 .18	5.6–7.3 6.6–7.3 7.4–8.0	Low. Moderate. Moderate.
95–100 95–100 95–100	90–100 95–100 90–100	60–75 60–80 55–75	2.5–5.0 0.2–0.8 0.8–2.5	.14 .18 .16	6.6–7.3 6.6–7.3 7.4–8.0	Low. Moderate. Low.
100 100	95–100 95–100	35–50 30–55	0.8–2.5 0.8–10	.15 .18	6.1–7.8 7.4–8.0	Low. Low.
100 100 100	95–100 95–100 95–100	60–75 80–90 80–95	0.2–0.8 0.05–0.2 0.05–0.2	.17 .16 .16	6.1–6.5 6.1–6.5 7.4–8.0	Moderate. High. High.
100 100	95–100 95–100	5–20 0–5	>10 >10	.05 .04	6.6–7.3 6.1–7.3	Low. Low.

TABLE 4.—*Estimated*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Feet	*Inches*			
OkB	4 or more.	0–9	Fine sand	SP–SM or SM	A–2 or A–3
		9–50	Sand	SP	A–3
		50–66	Clay loam	CL	A–6
Parkhill: Pa	Less than 1.	0–12	Loam	ML	A–4
		12–36	Heavy loam and clay loam.	CL	A–6
		36–60	Loam	ML	A–4
Paulding: Pc	Less than 1.	0–7	Clay	CH	A–7
		7–42	Clay	CH	A–7
Sanitary land fill: Sa. Soil material variable; onsite investigation needed.					
Saranac: Sc	Less than 1.[3]	0–11	Clay loam	CL	A–6
		11–50	Clay loam to silty clay	CL	A–6 or A–7
		50–60	Sand	SP	A–3
Selfridge: SdA, SdB, SeA, SfB. For Lamson part of SeA, see Lamson series. For Lenawee part of SfB, see Lenawee series.	1 to 2.	0–29	Fine sand	SP–SM	A–3
		29–42	Clay loam	CL	A–6
Shoals: Sh	1 to 2.[3]	0–10	Loam	ML	A–4
		10–54	Silt loam	ML	A–4
Sims: Sl	Less than 1.	0–8	Clay loam	CL	A–6
		8–30	Silty clay loam	CL	A–6
		30–54	Silty clay loam	CL	A–6
Sisson: SmB, SmC	3 or more.	0–7	Fine sandy loam	SM	A–4
		7–29	Silt loam	ML	A–6
		29–60	Stratified silt and very fine sand.	Layers of ML and SM	Layers of A–4 and A–2
Sloan: Sn	Less than 1.[3]	0–11	Loam	ML	A–4
		11–55	Silt loam or loam	ML–CL	A–4
		55–60	Sand	SP or SP–SM	A–3
Spinks: SpA, SpB, SpC	4 or more.	0–16	Loamy sand	SM	A–2
		16–23	Sand	SP	A–3
		23–48	Layers of sand and sandy loam.	Layers of SP–SM and SM	A–2
		48–60	Sand	SP	A–3
Tawas: Ta	At surface.	0–18	Muck	Pt	------
		18–60	Sand	SP–SM or SP	A–1
Toledo: Ts, Tt	Less than 1.	0–7	Silty clay loam or clay	CL or CH	A–6 or A–7
		7–48	Silty clay	CH	A–7
		48–60	Heavy silty clay loam	CL	A–6
Urban land: Ur. Soil material variable; onsite investigation needed.					
Wasepi:					
WsA, WsB, WtA, WvB. For Au Gres part of WvB, see Au Gres series.	1 to 2.	0–11	Sandy loam or loamy sand.	SM	A–2
		11–28	Heavy sandy loam	SC	A–6
		28–60	Stratified sand and gravel.	SP–SM or SP	A–1

See footnotes at end of table.

properties—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	*Inches per inch of soil*	*pH value*	
100	95–100	5–20	>10	.05	6.1–7.3	Low.
100	95–100	0–5	>10	.14	6.1–7.3	Low.
100	95–100	70–80	0.05–0.2	.18	7.4–8.0	Moderate.
100	95–100	60–75	0.8–2.5	.17	6.1–7.3	Low.
100	95–100	60–80	0.2–0.8	.18	6.1–6.5	Moderate.
95–100	95–100	55–75	0.8–2.5	.16	7.4–8.0	Low.
100	100	80–100	0.05–0.2	.21	6.6–7.3	High.
100	100	80–100	<0.05	.16	6.6–7.8	High.
100	100	70–90	0.2–0.8	.18	7.4–7.8	Moderate.
100	100	70–90	0.2–0.8	.16	7.4–7.8	Moderate.
100	95–100	0–5	>10	.04	7.4–7.8	Low.
100	95–100	5–10	5–10	.05	5.6–7.3	Low.
100	95–100	60–80	0.2–0.8	.14	7.4–7.8	Moderate.
100	100	55–75	0.8–2.5	.17	7.4–7.8	Low.
100	100	80–90	0.8–2.5	.20	7.4–7.8	Low.
95–100	95–100	60–80	0.2–0.8	.18	6.1–6.5	Moderate.
95–100	95–100	80–90	0.2–0.8	.20	6.1–7.3	Moderate to high.
90–95	85–95	80–90	0.2–0.8	.16	7.4–8.0	Moderate.
100	95–100	35–50	0.8–2.5	.15	7.4–7.8	Low.
100	95–100	55–75	0.8–2.5	.18	6.6–7.8	Low.
100	95–100	30–85	0.2–2.5	.18	7.4–8.0	Low.
100	95–100	55–75	0.8–2.5	.17	7.4–7.8	Low.
100	95–100	60–90	0.8–2.5	.18	7.4–7.8	Low.
100	95–100	0–10	5–10	.04	7.4–8.0	Low.
100	95–100	15–30	5–10	.05	6.1–6.5	Low.
100	95–100	0–5	5–10	.04	6.6–7.3	Low.
100	95–100	10–30	2.5–10	.08	6.6–7.3	Low.
100	95–100	0–5	>10	.04	7.4–8.0	Low.
------	------	-----	5–10	.25	6.6–7.3	Variable.
100	95–100	0–10	>10	.04	7.4–8.0	Low.
100	100	80–95	0.2–0.8	.19	7.4–7.8	High.
100	100	80–95	0.00–0.05	.16	7.4–7.8	High.
100	95–100	85–95	0.2–0.8	.18	7.4–8.0	High.
95–100	90–100	15–35	2.5–10	.10	6.6–7.3	Low.
90–100	80–100	35–45	2.5–5.0	.12	6.6–7.8	Low.
55–80	50–70	0–10	5–10	.02	7.4–8.0	Low.

TABLE 4.—*Estimated*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Feet	*Inches*			
WuB	1 to 2.	0–16	Sandy loam	SM	A–2
		16–25	Heavy sandy loam	SC	A–2 or A–6
		25–35	Stratified sand and gravel	SP–SM or SP	A–1
		35–60	Stratified silt and very fine sand.	Layers of SM and ML	A–4 or A–2
Willette: Wx	At surface.	0–18	Muck	Pt	------
		18–42	Clay	CH	A–7

[1] Estimated depth to seasonal high water table assumes that no artificial drainage practices are in operation.
[2] Soil is subject to flooding.

TABLE 5.—*Engineering inter*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
Au Gres:					
AsB	Very poor: sandy; droughty; moderate content of organic matter; seasonal high water table.	Good: sandy material to depth of more than 60 inches; high water table hinders excavation in wet periods.	Not suitable	Fair to good: low volume change; fair compaction; very slight frost action; seasonal high water table.	Not suitable: sandy; very rapid permeability.
AuB	Very poor: sandy; droughty; moderate content of organic matter; seasonal high water table.	Good: sandy material to depth of 5 feet; high water table hinders excavation in wet periods.	Not suitable	Fair to good in subsoil: low volume change. Poor to fair in substratum: moderate to high volume change; difficult to work when wet; periodic high water table.	Not suitable in subsoil: sandy; very rapid permeability. Good in substratum: periodic high water table.
Blount: BlA, BlB	Fair: thin; crusts slightly when dry; seasonal high water table.	Not suitable	Not suitable	Poor to fair: moderate to high volume change; difficult to work and compact when wet; seasonal high water table.	Good: difficult to work and compact when wet.
Boyer:					
BrA, BrB, BrC, BsA, BsB, BsC, BsD, BsE.	Poor: droughty; low content of organic matter; gravel and cobblestones on surface in many areas.	Good: sand with some fines and gravel.	Fair: more than 50 percent sand with some fines.	Good: low volume change; sandy and gravelly material provides good subgrade material.	Good to fair in uppermost 24 to 40 inches. Not suitable in sand and gravel: rapid permeability; subject to piping.

properties—Continued

Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*	*pH value*	
95–100	95–100	15–30	2.5–5.0	.12	7.4–7.8	Low.
90–100	90–100	30–45	2.5–5.0	.12	7.4–7.8	Low.
55–80	50–70	0–10	5–10	.02	7.4–8.0	Low.
100	95–100	30–85	0.2–0.8	.18	7.4–8.0	Low.
------	------	-----	5–10	.25	5.6–7.3	Variable.
100	100	80–100	0.05–0.2	.14	6.6–7.8	High.

pretations for specified uses

Soil features affecting suitability for— Highway location	Foundations for low buildings	Winter grading	Corrosivity: Uncoated steel	Corrosivity: Concrete	Limitations for septic tank disposal fields
Seasonal high water table; sandy material loses stability and flows when wet; fill needed.	Seasonal high water table; volume change on wetting or drying; very low compressibility; fair to good shear strength; flows when wet.	Wetness commonly hinders operations.	Low	Moderate	Severe: seasonal high water table; very rapid percolation of effluent may pollute water supply; onsite investigation needed.
Seasonal high water table; wetness may hinder construction; substratum subject to frost heaving.	Seasonal high water table; moderate to high volume change on wetting or drying; medium compressibility and shear strength.	Wetness commonly 'hinders operations.	Moderate in sand; high in substratum.	Low to moderate	Severe: seasonal high water table; onsite investigation needed.
Seasonal high water table hinders construction in some areas; subject to frost heaving.	Seasonal high water table; moderate volume change on wetting or drying; medium compressibility and shear strength.	Moisture content commonly too high for good compaction; poor stability on thawing.	High	Low	Severe: seasonal high water table; moderately slow permeability; onsite investigation needed.
Cuts and fills needed in many steep areas; substratum is good source of material for subbase and fill.	Low volume change on wetting or drying; very low compressibility; medium to high shear strength.	Low to medium moisture content commonly prevails; fair stability on thawing.	Low to moderate	Low	Slight on slopes of 0 to 12 percent: rapid permeability at depth of 24 to 40 inches. Severe on slopes of more than 12 percent because of difficulty in installing and operating filter beds; possible contamination of water supply.

TABLE 5.—*Engineering interpreta*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
BvB	Poor: droughty; low content of organic matter; gravel and cobblestones on surface in many areas.	Good in uppermost 20 to 40 inches: sand with some fines and gravel. Not suitable below depth of 20 to 42 inches.	Fair in uppermost 20 to 40 inches: more than 50 percent sand with some fines. Not suitable below depth of 20 to 42 inches.	Good in uppermost 20 to 40 inches: low volume change; sandy and gravelly material provides good subgrade material. Poor to fair below depth of 20 to 42 inches.	Good to fair in uppermost 20 to 40 inches. Not suitable in sand and gravel: rapid permeability; subject to piping. Good below depth of 20 to 42 inches; difficult to work and compact when wet.
Brevort: Bx. For Selfridge part, see Selfridge series.	Poor: sandy; subject to wind erosion; high water table.	Fair: limited source of sandy material to depth of 20 to 40 inches.	Not suitable	Fair to good to depth of 20 to 40 inches: low volume change. Fair to poor for clayey material: moderate to high volume change; difficult to work when wet.	Not suitable to depth of 20 to 40 inches: sandy; rapid permeability. Good in clayey material: difficult to work when wet.
Celina: CeA, CeB	Fair: may be thin where erosion has taken place.	Not suitable	Not suitable	Poor to fair: low to moderate volume change; difficult to work and compact when wet.	Good: difficult to work and compact when wet.
Ceresco: Cf	Fair: sandy layers; subject to stream overflow; seasonal high water table.	Not suitable	Not suitable	Fair to good: low volume change; fair workability; seasonal high water table.	Fair: some seepage possible; subject to piping.
Cohoctah: Cm	Fair: slightly droughty; moderate content of organic matter; subject to stream overflow.	Not suitable	Not suitable	Fair to good: low volume change; fair workability; slight to high potential for frost action; high water table.	Fair: some seepage possible; high water table; subject to piping.
Conover: CvA, CvB	Good: loamy; gravel and cobblestones on surface in some areas.	Not suitable	Not suitable	Poor to fair: low to moderate volume change; difficult to work and compact when wet.	Good: difficult to work and compact when wet.
Corunna: Cw	Surface: good. Subsoil: fair; high water table.	Not suitable	Not suitable	Subsoil: fair to poor; low volume change. Substratum: poor to fair; moderate to high volume change.	Subsoil: fair; thin. Substratum: good; high water table.

tions for specified uses—Continued

Soil features affecting suitability for—			Corrosivity		Limitations for septic tank disposal fields
Highway location	Foundations for low buildings	Winter grading	Uncoated steel	Concrete	
Cuts and fills needed in many areas; loamy material subject to frost heaving.	Low compressibility in uppermost 20 to 40 inches; moderate volume change in loamy material; medium shear strength and compressibility.	Low to medium moisture content commonly prevails; fair stability on thawing.	Low to moderate	Low	Moderate to severe: slow permeability to depth of 20 to 40 inches; large filter beds necessary; onsite investigation needed.
High water table; wetness hinders construction.	High water table; moderate to high volume change; medium compressibility and shear strength.	High water table; moisture content too high for good compaction; poor stability on thawing; wetness hinders operations.	High	Low	Severe: high water table; slow permeability at depth of 20 to 40 inches; filter fields saturated during wet periods.
Cuts and fills needed in many places; subject to frost heaving.	Low volume change on wetting or drying; medium shear strength and compressibility.	Moisture content too high for good compaction; poor stability on thawing.	Moderate	Low	Moderate: moderate or moderately slow permeability; onsite investigation needed.
Seasonal high water table; subject to stream overflow.	Seasonal high water table; low volume change and compressibility; may become quick and flow when wet.	High moisture content may hinder operations.	Moderate	Low	Severe: seasonal high water table and stream overflow; onsite investigation needed.
High water table; subject to stream overflow.	High water table; low volume change and compressibility; medium to high shear strength; subject to flooding.	High water table; wetness hinders operations; poor stability on thawing.	Moderate	Low	Severe: high water table; stream overflow; filter fields saturated during wet periods.
Seasonal high water table; wetness hinders construction in some areas; subject to frost heaving.	Seasonal high water table; low volume change on wetting or drying; medium compressibility and shear strength.	Moisture content too high for good compaction; poor stability on thawing.	High	Low	Severe: seasonal high water table; moderately slow permeability; onsite investigation needed.
High water table; wetness hinders construction.	High water table; moderate to high volume change; medium compressibility; moderate shear strength.	High water table; poor stability on thawing.	High	Low	Severe: high water table.

TABLE 5.—*Engineering interpreta*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
Del Rey: DlA, DlB, DmA, DmB. For Metamora part of DmA and DmB, see Metamora series.	Good: seasonal high water table; crusts slightly when wet.	Not suitable	Not suitable	Poor to fair: moderate volume change; difficult to work and compact when wet; very high frost action; seasonal high water table.	Good: impervious; difficult to work and compact when wet; seasonal high water table.
Dryden: DrA, DrB	Fair: thin; loamy; stones on surface in some areas.	Not suitable	Not suitable	Fair to good: low volume change.	Fair to good: good workability and compaction.
Edwards: Ed	Poor: erodible; oxidizes readily; fair to good if mixed with mineral material; high water table.	Not suitable	Not suitable	Not suitable in uppermost organic layer and marl; unstable; highly compressible; high water table.	Not suitable in uppermost organic layers and marl; unstable; highly compressible.
Ensley: Ep. For Parkhill part, see Parkhill series.	Surface: good. Subsoil: fair; high water table.	Not suitable	Not suitable	Fair to good: low volume change; some stones.	Subsoil: fair to good; thin. Substratum: fair; high water table.
Fulton: FtA, FuA	Poor: thin; low organic-matter content; crusts when dry.	Not suitable	Not suitable	Poor: high volume change; poor workability when wet.	Good: high volume change; poor workability and compaction when wet.
Gilford:					
Gd	Surface: good. Subsoil: fair; thin; high water table.	Good: stratified sand and gravel; wetness hinders excavation in many areas.	Fair: more than 50 percent sand; wetness hinders excavation in many areas.	Fair in uppermost 20 to 40 inches: low volume change; good to fair workability and compaction. Good in sandy and gravelly material: low volume change; wetness hinders excavation.	Fair in uppermost 20 to 40 inches: low volume change. Not suitable in sand and gravel: rapid permeability; subject to piping.
Gf	Good to depth of 10 to 14 inches: moderate to high content of organic matter.	Good in uppermost 20 to 40 inches: sandy with some fines and gravel; wetness hinders excavation in many areas. Not suitable in substratum.	Fair in uppermost 20 to 40 inches: less than 50 percent gravel; wetness hinders excavation in many areas. Not suitable in substratum.	Fair in uppermost 20 to 40 inches: low volume change; high water table. Poor in substratum: low volume change.	Fair in subsoil. Not suitable in sand and gravel: rapid permeability; subject to piping. Fair in substratum: liquefies readily and flows when wet; high water table.

tions for specified uses—Continued

Soil features affecting suitability for—			Corrosivity		Limitations for septic tank disposal fields
Highway location	Foundations for low buildings	Winter grading	Uncoated steel	Concrete	
Seasonal high water table hinders construction in some areas; subject to frost heaving; difficult to work and compact when wet.	Medium compressibility; moderate to high volume change; seasonal high water table; substratum unstable when wet.	Moisture content too high for good compaction; poor stability on thawing.	High	Low	Severe: seasonal high water table; moderately slow permeability; onsite investigation needed.
Cuts and fills needed in many areas; stones hinder grading in some areas.	Low volume change on wetting or drying; low compressibility; may become quick and flow when wet.	Medium to high moisture content; difficult to obtain good compaction; poor stability on thawing.	Low to moderate	Low	Slight: moderate permeability; stones hinder construction in some places.
High water table; organic material unstable and must be removed.	High water table; unstable organic soil to depth of 12 to 40 inches; marl has poor shear strength.	High water table; unstable organic material.	High	Low	Severe: high water table; unstable organic material; filter fields saturated during wet periods.
High water table; wetness hinders construction.	High water table; low volume change and compressibility; fair to good shear strength; may flow when wet.	High water table; wetness hinders operations.	High	Low	Severe: high water table; filter fields saturated during wet periods.
Seasonal high water table; plastic, clayey material; unstable and slippery when wet.	Seasonal high water table; high volume change on wetting or drying; high compressibility; low shear strength; hard when dry.	High moisture content hinders operations in many places; poor stability on thawing.	High	Low	Severe: seasonal high water table; slowly permeable, clayey material; onsite investigations needed.
High water table; wetness hinders compaction.	High water table; low volume change; very low compressibility; fair to good shear strength; flows when wet.	High water table; wetness hinders operations in many places.	High	Low	Severe: high water table; rapid permeability in sandy and gravelly material at depth of 20 to 40 inches; filter fields saturated during wet periods.
High water table; wetness hinders construction; silty and sandy substratum loses stability and flows when wet; subject to frost heaving.	High water table; may flow when wet.	High water table; wetness hinders operations in many places.	High	Low	Severe: high water table; slowly permeable and unstable soil material at depth of 20 to 40 inches.

TABLE 5.—*Engineering interpreta*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
Granby: Gm	Poor: sandy; subject to wind erosion; high water table.	Good: sandy material; excess wetness hinders excavation in many areas.	Not suitable	Fair to good: low volume change and compressibility; fair workability; high water table.	Not suitable: sandy; rapid permeability; high water table; subject to piping.
Hoytville: Hy	Fair for loamy texture: moderate content of organic matter; high water table.	Not suitable	Not suitable	Poor: poor shear strength, workability, and compaction; high volume change; high water table.	Good: high volume change; poor workability when wet; high water table.
Lamson: La	Good: erodible; moderate content of organic matter; high water table.	Not suitable	Not suitable	Poor: low volume change; material flows when wet; high water table; subject to frost heaving.	Fair: liquefies readily and flows when wet; high water table.
Lapeer: LeB, LeC, LeD, LeE.	Fair: thin; loamy; stones on surface in some areas.	Not suitable	Not suitable	Fair to good: low volume change; stones.	Fair to good: good workability and compaction.
Lenawee: Lh, Lk For Selfridge part of Lk, see Selfridge series.	Fair: sticky when wet; high water table.	Not suitable	Not suitable	Fair to poor: moderate volume change; difficult to work and compact when wet; high water table.	Good: impervious; difficult to work and compact when wet.
Linwood: Lm	Poor: erodible; oxidizes readily; fair to good if mixed with mineral material; high water table.	Not suitable	Not suitable	Not suitable in uppermost organic layer: unstable; highly compressible. Fair to poor in loamy material: moderate volume change; high water table.	Not suitable in uppermost organic layer: unstable; highly compressible. Good in loamy material: fair workability when wet; high water table.
Locke: LoA, LoB, LsB.	Fair: thin; loamy; stones on surface in some areas.	Not suitable	Not suitable	Fair to good: low volume change; slight to moderate potential for frost action; seasonal high water table.	Fair to good: good workability and compaction.

tions for specified uses—Continued

Soil features affecting suitability for—			Corrosivity		Limitations for septic tank disposal fields
Highway location	Foundations for low buildings	Winter grading	Uncoated steel	Concrete	
High water table; sandy material loses stability and flows when wet.	High water table; low volume change; very low compressibility; good shear strength; flows when wet.	High water table; wetness hinders operations.	High	Low	Severe: high water table; rapid permeability; filter fields saturated during wet periods.
High water table; plastic, clayey material unstable and slippery when wet; low shear strength.	High water table; high volume change and compressibility; low shear strength; hard when dry.	High water table; clayey; poor stability on thawing.	High	Low	Severe: high water table; very slowly permeable, expansive, clayey material; filter fields saturated during wet periods.
High water table; silty and sandy substratum loses stability and flows when wet; subject to frost heaving.	High water table; subject to liquefaction; low volume change and compressibility; fair shear strength.	High water table; poor stability on thawing.	High	Low	Severe: high water table; material flows when wet.
Cuts and fills needed in many steep areas; stones hinder grading operations in some areas.	Low volume change on wetting or drying; low compressibility; may become quick and flow when wet.	Medium to high moisture content in many places; difficult to obtain good compaction; poor stability on thawing.	Low to moderate	Low	Slight on slopes of 0 to 12 percent; severe on slopes of more than 12 percent because of difficulty in installing and operating filter fields; moderate or moderately rapid permeability.
High water table; wetness hinders construction.	High water table; moderate volume change; medium compressibility and shear strength.	High water table; poor stability on thawing.	High	Low	Severe: high water table; moderately slowly permeable material within 2 feet of the surface; filter fields saturated during wet periods.
High water table; organic material is unstable and must be removed.	High water table; uppermost 12 to 40 inches unstable organic soil; substratum has fair shear strength.	High water table; unstable organic material.	High	Low	Severe: high water table; unstable organic material at depth of 12 to 40 inches.
Seasonal high water table; wetness hinders construction in some areas; subject to frost heaving.	Seasonal high water table; low volume change on wetting or drying; low compressibility; medium shear strength; may flow when wet.	Moisture content usually too high for good compaction; poor stability on thawing.	Moderate	Low	Severe: seasonal high water table; moderate permeability; onsite investigation needed.

TABLE 5.—*Engineering interpreta*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
Lupton: Lu	Poor: erodible; oxidizes readily; fair to good if mixed with mineral material; high water table.	Not suitable	Not suitable	Not suitable: unstable; high compressibility.	Not suitable: unstable; high compressibility.
Made land: Md. Material variable; onsite investigation needed.					
Metamora: MeA, MeB.	Fair: thin; moderate content of organic matter; seasonal high water table.	Not suitable	Not suitable	Good in uppermost 20 to 40 inches: low volume change. Fair to poor below; moderate volume change.	Good: uppermost 20 to 40 inches has good workability; material below has poor workability when wet.
Metea: MnA, MnB	Very poor: thin; low content of organic matter; droughty.	Fair: limited source of sandy material to depth ranging from 20 to 40 inches.	Not suitable	Fair to good at depth of 20 to 40 inches: low volume change. Fair to poor for loamy material: moderate to low volume change; fair workability.	Not suitable at depth of 20 to 40 inches; sandy; rapid permeability. Good in loamy material: fair workability when wet.
Miami: MoB, MoC, MoD, MoE.	Fair: thin; gravel and cobblestones on surface in some areas.	Not suitable	Not suitable	Poor to fair: low to moderate volume change; difficult to work and compact when wet.	Good: difficult to work and compact when wet.
Minoa: MsB	Good: moderate content of organic matter; seasonal high water table.	Not suitable	Not suitable	Poor: low volume change; difficult to work; material flows when wet.	Fair: liquefies readily and flows when wet.
Nappanee: NaA, NcA, NcB.	Good to fair: low content of organic matter; crusts and becomes hard when dry; seasonal high water table.	Not suitable	Not suitable	Poor: poor shear strength, workability, and compressibility; seasonal high water table.	Good: high volume change; poor workability when wet.

tions for specified uses—Continued

Soil features affecting suitability for—			Corrosivity		Limitations for septic tank disposal fields
Highway location	Foundations for low buildings	Winter grading	Uncoated steel	Concrete	
High water table; organic material is unstable and must be removed.	High water table; very high compressibility; unstable.	High water table; unstable organic material.	High	Low	Severe: high water table; unstable organic material.
Seasonal high water table; wetness hinders construction in some areas.	Seasonal high water table; subject to frost heaving and liquefaction; moderate volume change on wetting or drying.	Moisture content usually too high for good compaction; poor stability on thawing.	High	Low	Severe: seasonal high water table; variable permeability; onsite investigation needed.
Cuts and fills needed in many areas; erodible when exposed on embankments.	Moderate volume change on wetting or drying; medium shear strength and compressibility.	Moisture content commonly too high for good compaction; poor stability on thawing.	Moderate	Low	Moderate: moderately slow permeability at depth of 20 to 40 inches.
Cuts and fills needed in many steep areas; subject to frost heaving.	Low volume change on wetting or drying; medium shear strength; subject to frost heaving.	Moisture content usually too high for good compaction; poor stability on thawing.	Moderate	Low	Moderate on slopes of 0 to 12 percent; severe on slopes of more than 12 percent because of difficulty in installing and operating filter fields; moderately slow permeability in some areas.
Seasonal high water table; silty and sandy substratum loses stability and flows when wet; subject to frost heaving.	Seasonal high water table; subject to liquefaction; low volume change on wetting or drying.	Moisture content usually too high for good compaction; poor stability on thawing.	Moderate	Low	Severe: seasonal high water table; when wet, soil material may flow into and plug tile and filter beds; onsite investigation needed.
Seasonal high water table; plastic, clayey material unstable and slippery when wet.	Seasonal high water table; high volume change on wetting or drying; high compressibility; low shear strength; hard when dry.	High moisture content hinders operations in many places; poor stability on thawing.	High	Low	Severe: seasonal high water table; slowly permeable, expansive, clayey material; onsite investigation needed.

TABLE 5.—*Engineering interpreta*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
Oakville:					
OaB	Very poor: thin; sandy; low content of organic matter; droughty.	Good: sandy material to a depth of more than 60 inches.	Not suitable	Good: low volume change; fair workability and compaction.	Not suitable: sandy; very rapid permeability; subject to piping.
OkB	Surface: very poor. Subsoil: poor; sandy; droughty.	Fair: 40 to 66 inches of sandy material with some fines.	Not suitable	Fair to good for sandy material: low volume change. Fair to poor for loamy material: moderate volume change; difficult to work and compact when wet.	Not suitable in sandy material: very rapid permeability; subject to piping. Good for loamy material.
Parkhill: Pa	Good at surface: loamy; low to high content of organic matter; high water table.	Not suitable	Not suitable	Fair to poor: low to moderate volume change; fair workability when wet; high water table.	Good: fair workability when wet.
Paulding: Pc	Very poor: thin; clayey; poor workability; high water table.	Not suitable	Not suitable	Poor: poor shear strength and workability; high volume change; high water table.	Good: high volume change; poor workability when wet; high water table.
Sanitary land fill: Sa. Soil material variable; onsite investigation needed.					
Saranac: Sc	Fair in surface layer: loamy; medium content of organic matter.	Not suitable	Not suitable	Poor to very poor: moderate volume change; difficult to work and compact when wet.	Good: moderate volume change; difficult to compact and work when wet; high water table.
Selfridge: SdA, SdB, SeA, SfB. For Lamson part of SeA, see Lamson series. For Lenawee part of SfB, see Lenawee series.	Very poor: thin; low content of organic matter; droughty.	Fair: limited source of sandy material to a depth ranging from 20 to 40 inches.	Not suitable	Fair to good at depth of 20 to 40 inches: low volume change. Fair to poor for loamy material: moderate volume change.	Not suitable at depth of 20 to 40 inches: sandy; rapid permeability. Good in loamy material: fair workability when wet.

tions for specified uses—Continued

Soil features affecting suitability for—			Corrosivity		Limitations for septic tank disposal fields
Highway location	Foundations for low buildings	Winter grading	Uncoated steel	Concrete	
Cuts and fills needed; seasonal high water table in some excavated areas; loose sand easily excavated but sometimes hinders hauling; subject to soil blowing.	Low volume change on wetting or drying; very low compressibility; becomes quick when wet and flows.	Sandy; usually low moisture content; good stability on thawing.	Low	Low to moderate	Slight to severe: seasonal high water table in some excavated areas; possible pollution of shallow water supplies by effluent; onsite investigation needed.
Cuts and fills needed in places; seasonal high water table in excavated areas; loose sand hinders hauling; substratum slippery when wet and slows construction.	Moderate to high volume change on wetting or drying; low shear strength; medium to high compressibility.	Moisture content low in sandy material, high in loamy material.	Low in sand; moderate in substratum.	Low	Slight: possible pollution of shallow water supplies by effluent; onsite investigation needed.
High water table; wetness hinders construction; subject to frost heaving.	High water table; low volume change; medium compressibility; subject to liquefaction.	High water table; poor stability on thawing.	High	Low	Severe: high water table; moderately slow permeability; filter fields saturated during wet periods.
High water table; plastic, clayey material unstable and slippery when wet; fair to poor shear strength.	High water table; high volume change and compressibility; low shear strength; hard when dry.	High water table; clayey; poor stability on thawing.	High	Low	Severe: high water table; very slowly permeable, expansive clay within 2 feet of surface; filter fields saturated during wet periods.
High water table; subject to stream overflow; subject to frost heaving.	High water table; high volume change; medium compressibility and shear strength.	High water table; wetness hinders operations; poor stability on thawing.	High	Low	Severe: high water table; stream overflow; moderately slow permeability.
Seasonal high water table; subject to frost heaving.	Seasonal high water table; moderate volume change on wetting and drying; medium shear strength and compressibility.	Seasonal high water table; moisture content usually too high for good compaction; poor stability on thawing.	Moderate	Low	Severe: moderately slow permeability at depth of 20 to 40 inches; seasonal high water table.

TABLE 5.—*Engineering interpreta*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
Shoals: Sh	Good: thick; loamy; moderate content of organic matter; subject to flooding; seasonal high water table.	Not suitable	Not suitable	Poor: low volume change; poor subgrade material.	Fair to good: fair workability and compaction when wet.
Sims: Sl	Good in surface layer: loamy; high content of organic matter; high water table.	Not suitable	Not suitable	Poor to fair: moderate to high volume change; difficult to work and compact when wet.	Good: difficult to work and compact when wet.
Sisson: SmB, SmC	Fair in surface layer: loamy; low content of organic matter.	Poor: highly variable, stratified material; thin layers of sand.	Not suitable	Poor: low volume change; medium to high potential for frost action; material flows when wet.	Fair: liquefies readily and flows when wet.
Sloan: Sn	Good: thick; loamy; high content of organic matter; subject to flooding; seasonal high water table.	Not suitable	Not suitable	Poor: low volume change; medium to very high potential for frost action; poor subgrade material; high water table.	Fair to good: fair workability and compaction when wet; high water table.
Spinks: SpA, SpB, SpC.	Very poor: sandy; low content of organic matter; droughty.	Good: sandy; thin layers not suitable.	Not suitable	Fair to good: low volume change and compressibility; fair to good workability and compaction.	Not suitable: sandy; rapid permeability; subject to piping.
Tawas: Ta	Poor: erodible; oxidizes readily; fair to good if mixed with mineral material.	Fair below depth of 12 to 40 inches: high water table; some fines.	Not suitable	Not suitable: unstable muck; high water table; sand is fair to good below depth of 12 to 40 inches.	Not suitable; unstable; rapid permeability.
Toledo: Ts, Tt	Poor: high content of organic matter; poor workability; high water table.	Not suitable	Not suitable	Poor: high volume change; poor workability; high water table.	Good: high volume change; poor workability and compaction when wet; high water table.
Urban land: Ur. Soil material variable; onsite investigation needed.					

tions for specified uses—Continued

Soil features affecting suitability for—			Corrosivity		Limitations for septic tank disposal fields
Highway location	Foundations for low buildings	Winter grading	Uncoated steel	Concrete	
Seasonal high water table; subject to stream overflow; subject to frost heaving.	Seasonal high water table; low volume change; medium compressibility and shear strength; subject to flooding.	Wetness hinders operations; poor stability on thawing.	High	Low	Severe: seasonal high water table; subject to stream overflow; moderate permeability; onsite investigation needed.
High water table; wetness hinders construction; subject to frost heaving.	High water table; moderate volume change; medium compressibility and shear strength.	High water table; poor stability on thawing.	High	Low	Severe: high water table; moderately slowly permeable material within 2 feet of surface; filter fields saturated during wet periods.
Unstable; silty and sandy substratum; subject to frost heaving.	Subject to frost heaving; may flow when wet; low volume change.	Moisture content usually too high for good compaction; poor stability on thawing.	Moderate	Low	Slight to moderate: when wet, soil material may flow into and plug tile and filter beds.
High water table; subject to stream overflow; subject to frost heaving.	High water table; moderate volume change; medium compressibility and shear strength.	High water table; wetness hinders operations; poor stability on thawing.	High	Low	Severe: high water table; stream overflow.
Loose sand makes excavation easy but hinders hauling in some places; subject to soil blowing.	Low volume change on wetting or drying; very low compressibility; becomes quick when wet and flows.	Sandy; low moisture content; good stability on thawing.	Low	Low	Slight: possible pollution of shallow water supplies by effluent.
High water table; organic material is unstable and must be removed; sandy substratum.	High water table; unstable organic soil to depth of 12 to 40 inches; substratum has low volume change and compressibility, tends to flow when wet.	High water table; unstable organic material.	High	Low	Severe: high water table; unstable organic material at depth of 12 to 40 inches; filter fields saturated during wet periods.
High water table; plastic, clayey material unstable and slippery when wet; low shear strength.	High water table; high volume change and compressibility; low shear strength; hard when dry.	High water table; clayey; poor stability on thawing.	High	Low	Severe: high water table; very slowly permeable material within 24 inches of surface; filter fields saturated during wet periods.

TABLE 5.—*Engineering interpreta*

Soil series and map symbols	Suitability as source of—				
	Topsoil	Sand	Gravel	Road fill	Impermeable material
Wasepi: WsA, WsB, WtA, WvB. For Au Gres part of WvB, see Au Gres series.	Fair for sandy loam; poor for loamy sand: moderate content of organic matter.	Good: sand with some fines and gravel.	Fair: less than 50 percent gravel.	Fair in uppermost 24 to 40 inches: low volume change. Good in sandy and gravelly material: low volume change; hinders excavation.	Not suitable: pervious; seasonal high water table.
WuB	Fair: moderate content of organic matter; seasonal high water table.	Good in uppermost 20 to 40 inches: sand with some fines and gravel. Not suitable in substratum.	Fair in uppermost 20 to 40 inches: less than 50 percent gravel. Not suitable in substratum.	Good in uppermost 20 to 40 inches: low volume change; wetness hinders excavation. Poor below depth of 18 to 42 inches: low volume change; material flows when wet.	Fair to poor in uppermost 20 to 40 inches: subject to piping. Fair in stratified silt and fine sand: liquefies readily and flows when wet.
Willette: Wx	Poor when used alone: oxidizes readily; erodible; fair to good if mixed with mineral soil; high water table.	Not suitable	Not suitable	Organic layer, 12 to 40 inches thick, not suitable: unstable. Substratum poor: high water table.	Organic layer, 12 to 40 inches thick, not suitable. Substratum good: impervious; difficult to work and compact when wet; high water table.

tions for specified uses—Continued

Soil features affecting suitability for—			Corrosivity		Limitations for septic tank disposal fields
Highway location	Foundations for low buildings	Winter grading	Uncoated steel	Concrete	
Seasonal high water table; wetness hinders construction in some areas.	Seasonal high water table; low volume change on wetting or drying; very low compressibility; fair to good shear strength; flows when wet.	High moisture content hinders operations in some areas.	Moderate	Low	Moderate to severe: seasonal high water table; rapid permeability in sand and gravel; possible pollution of shallow water supplies by effluent; onsite investigation needed.
Seasonal high water table; wetness hinders construction in some areas; silty and sandy substratum loses stability and flows when wet.	Seasonal high water table; subject to frost heaving; may flow when wet.	High moisture content hinders operations in some areas.	Moderate	Low	Moderate to severe: seasonal high water table; when wet, soil material may flow into and plug tile and filter beds; onsite investigation needed.
High water table; organic material is unstable and must be removed; clayey substratum.	High water table; uppermost 12 to 40 inches is unstable organic soil; substratum has high compressibility and poor shear strength.	High water table; unstable organic material.	High	Low	Severe: high water table; slowly permeable, clayey material in substratum; unstable organic material to depth ranging from 12 to 40 inches.

TABLE 6.—*Engineering interpretations for farm uses*

Soil series and map symbols	Soil features affecting suitability for—					
	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
	Reservoir areas	Embankments				
Au Gres: AsB	Material too porous to hold water; seal blanket required.	Seasonal high water table; fair stability and compaction; rapid seepage rate; subject to piping.	Drainage usually needed; sandy; very rapid permeability; tiling questionable; wet depressions; ditchbanks unstable.	Very low available water capacity; very rapid water intake rate; frequent applications of water required.	Usually not needed; sandy soil; gentle slopes; little runoff.	Usually not needed; sandy soil; gentle slopes; little runoff.
AuB	Rapid seepage rate in sandy material; slow rate in substratum.	Fair stability in sandy material; medium to rapid seepage rate; piping hazard; fair to good stability and compaction in substratum; slow seepage rate.	Drainage needed; seasonal high water table; sandy to depth of 42 inches and slow permeability below; special blinding of tile required.	Very low available water capacity; very rapid water intake rate.	Usually not needed; sandy soil; gentle slopes; little runoff.	Usually not needed; sandy soil; gentle slopes; little runoff.
Blount: BlA, BlB	Slow seepage rate	Fair to good stability and compaction; slow seepage rate.	Drainage usually needed; moderately slow permeability; seasonal high water table; depressions need surface drains.	High available water capacity; medium water intake rate.	Seasonal high water table; dense, clayey subsoil; difficult to vegetate.	No restrictions other than rapid runoff.
Boyer: BrA, BrB, BrC, BsA, BsB, BsC, BsD, BsE.	Medium to rapid seepage rate in subsoil; seal blanket required when porous sand and gravel substratum is exposed.	Fair stability in subsoil; medium seepage rate; fair to good compaction; good stability in substratum; rapid seepage rate; subject to piping.	Not needed	Medium available water capacity; very rapid water intake rate; sloping relief; subject to runoff and erosion.	Moderate depth to sand and gravel; erodible; short, irregular slopes and slopes of more than 12 percent hinder construction.	Difficult to vegetate if deep cuts expose sand and gravel; slopes subject to runoff and erosion.
BvB	Moderately rapid seepage rate in uppermost 20 to 40 inches; subject to piping; slow seepage rate in loamy material; fair stability and compaction; moderate volume change on wetting or drying.	Medium seepage rate in uppermost 20 to 40 inches; subject to piping; fair stability and compaction in loamy material; slow seepage rate; moderate volume change on wetting or drying.	Not needed	Medium available water capacity; very rapid water intake rate.	Moderate depth to sand and gravel; erodible.	Difficult to vegetate if cuts expose sand and gravel.

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Brevort: Bx. For Selfridge part, see Selfridge series.	High water table; sandy material has rapid seepage rate; substratum has slow seepage rate; suitable for pit-type ponds.	High water table; fair stability and compaction; slow seepage rate below depth of 20 to 40 inches.	Drainage needed; high water table; slow permeability below depth of 20 to 40 inches; wet depressions.	Sandy; low available water capacity; rapid water intake rate; high water table.	Not needed; nearly level; high water table.	Not needed; nearly level relief; high water table.
Celina: CeA, CeB	Fair stability and compaction; slow seepage rate.	Moisture content usually too high for good compaction; poor stability on thawing.	Not needed	High available water capacity; medium water intake rate; slopes subject to erosion.	No restrictions	Subject to rapid runoff and severe erosion.
Ceresco: Cf	Subject to stream overflow; moderately rapid seepage rate.	Seasonal high water table; fair stability; fair to good compaction; moderate seepage rate; subject to piping.	Drainage usually needed; seasonal high water table.	Medium available water capacity; moderately rapid to rapid water intake rate; subject to stream overflow.	Not needed; on nearly level stream bottoms that are subject to flooding.	Not needed; on nearly level stream bottoms that are subject to flooding.
Cohoctah: Cm	High water table; moderately rapid seepage rate; suitable for pit-type ponds; subject to stream overflow.	High water table; fair stability; fair to good compaction; moderate seepage rate; subject to piping.	Drainage needed; high water table; subject to stream overflow.	Medium available water capacity; rapid water intake rate; requires drainage and protection from stream overflow.	Not needed; on nearly level flood plains.	Not needed; on nearly level flood plains.
Conover: CvA, CvB	Moderately slow seepage rate.	Fair to good stability and compaction; slow seepage rate.	Drainage usually needed; moderately slow permeability; seasonal high water table; depressions need surface drains.	High available water capacity; medium water intake rate.	Seasonal high water table.	Seasonal high water table.
Corunna: Cw	High water table; moderately slow seepage rate; suitable for pit-type ponds.	High water table; fair to good stability and compaction; slow seepage rate.	Drainage needed; moderately slow permeability in substratum; high water table; wet depressions; surface drains needed.	Medium available water capacity; rapid water intake rate; drainage required.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Usually not needed; high water table; nearly level or depressional relief.
Del Rey: DlA, DlB, DmA, DmB. For Metamora part of DmA, DmB, see Metamora series.	Moderate to slow seepage rate.	Moisture content usually too high for good compaction; poor stability on thawing.	Drainage usually needed; moderately slow permeability; seasonal high water table; wet depressions; surface drains needed.	High available water capacity; medium water intake rate.	Usually not needed; gentle slopes; little runoff.	Seasonal high water table.

TABLE 6.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting suitability for—					
	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
	Reservoir areas	Embankments				
Dryden: DrA, DrB	Seepage rate medium in subsoil; medium to rapid in substratum.	Subsoil has fair stability; medium seepage rate; good compaction; substratum has fair stability and compaction; medium seepage rate.	Not needed	Medium available water capacity; moderately rapid water intake rate.	No restrictions	Stones hinder construction in some areas.
Edwards: Ed	High water table; rapid seepage rate to depth of 12 to 40 inches, slow below; suitable for pit-type ponds; flotation of organic matter possible.	High water table; unstable organic material to depth of 12 to 40 inches; marl has poor compaction and stability.	Drainage needed; high water table; organic material subsides if overdrained; controlled drainage desirable.	Very high available water capacity; very rapid water intake rate; drainage required.	Terraces not needed; level organic soil; low stability; high water table; diversions helpful in adjacent areas.	Not needed; high water table; organic material; level or depressional relief.
Ensley: Ep For Parkhill part, see Parkhill series.	High water table; medium seepage rate; suitable for pit-type ponds.	High water table; fair stability; fair to good compaction; medium seepage rate; subject to piping.	Drainage needed; high water table; moderate permeability.	Medium available water capacity; rapid water intake rate; drainage required.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Usually not needed; high water table; nearly level or depressional relief.
Fulton: FtA, FuA	Slow seepage rate	Seasonal high water table; fair stability; high volume change on wetting or drying; fair to poor compaction; slow seepage rate.	Slow permeability; seasonal high water table; special blinding and close spacing of tile required; surface drainage needed.	High available water capacity; medium water intake rate; slow permeability.	Seasonal high water table; dense, clayey subsoil; difficult to vegetate.	Deep cuts expose clayey material; difficult to vegetate; rapid runoff.
Gilford:						
Gd	High water table; suitable for pit-type ponds; sand and gravel has rapid seepage rate.	High water table; uppermost 20 to 40 inches has fair to good stability; slow seepage rate; substratum has fair stability; rapid seepage rate; subject to piping.	Drainage needed; high water table; moderately rapid permeability to depth of 20 to 40 inches, rapid below; sandy substratum makes blinding necessary.	Medium available water capacity; rapid water intake rate; drainage required.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Usually not needed; high water table; nearly level relief.
Gf	High water table; suitable for pit-type ponds; sides of pond	High water table; fair to poor stability; medium seepage rate;	Drainage needed; high water table; silt and very fine sand	Medium available water capacity; rapid water intake	Terraces not needed; level; high water table; diversions reduce	Usually not needed; high water table; nearly level relief.

	unstable when wet.	fair to poor compaction; subject to piping.	in substratum may flow into and plug tile; ditchbanks unstable.	rate; drainage required.	overflow from adjacent areas.	
Granby: Gm	High water table; rapid seepage rate; subject to piping.	High water table; fair stability and compaction; rapid seepage rate; subject to piping.	Drainage needed; high water table; very sandy substratum makes tiling questionable; wet depressions; ditchbanks unstable.	Sandy; very low available water capacity; rapid water intake rate; drainage required.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Usually not needed; wet, sandy soils; nearly level or depressional relief.
Hoytville: Hy	High water table; very slow seepage rate; suitable for pit-type ponds.	High water table; fair stability; poor compaction; slow seepage rate; volume changes on wetting or drying.	Very slow permeability; high water table; special blinding and close spacing of tile required; surface drainage needed.	High available water capacity; slow water intake rate; drainage required before irrigating.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Clayey subsoil and high water table make construction difficult.
Lamson: La	High water table; moderately slow seepage rate; suitable for pit-type ponds; sides of pond unstable when wet.	High water table; subsoil has fair stability; slow seepage rate; substratum has poor stability; moderate seepage rate; piping hazard.	Drainage needed; high water table; silt and very fine sand in substratum may flow into and plug tile; ditchbanks unstable.	High available water capacity; medium water intake rate; drainage required.	Not needed	Usually not needed; high water table; nearly level relief.
Lapeer: LeB, LeC, LeD, LeE	Seepage rate medium in subsoil; medium to rapid in substratum.	Subsoil has fair stability; medium seepage rate; good compaction; substratum has fair stability and compaction; medium seepage rate.	Not needed	Medium available water capacity; rapid water intake rate.	Short, irregular slopes and slopes of more than 12 percent hinder construction.	Stones hinder construction in some areas.
Lenawee: Lh, Lk For Selfridge part of Lk, see Selfridge series.	High water table; moderately slow seepage rate; suitable for pit-type ponds.	High water table; fair to good stability and compaction; slow seepage rate.	High water table; moderately slow permeability; surface or subsurface drainage needed; depressions often wet.	High available water capacity; medium water intake rate; drainage required.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Usually not needed; high water table; nearly level or depressional relief.
Linwood: Lm	High water table; rapid seepage rate to depth of 12 to 40 inches, slow below; suitable for pit-type ponds; flotation of organic material possible.	High water table; uppermost 12 to 40 inches unstable organic material; substratum has fair to poor compaction; fair stability.	Drainage needed; high water table; organic material subsides if overdrained; controlled drainage desirable.	Very high available water capacity; very rapid water intake rate; drainage required.	Terraces not needed; level organic soil; low stability; high water table; diversions helpful in adjacent areas.	Not needed; high water table; organic material; level or depressional relief.

TABLE 6.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting suitability for—					
	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
	Reservoir areas	Embankments				
Locke: LoA, LoB, LsB	Medium seepage rate.	Fair stability; good compaction; medium seepage rate.	Drainage usually needed; seasonal high water table; moderate permeability; sandy pockets.	Medium available water capacity; rapid water intake rate.	Usually not needed; gentle slopes; little runoff.	Seasonal high water table.
Lupton: Lu	High water table; rapid seepage rate; suitable for pit-type ponds; flotation and caving of organic material likely.	Organic material unstable; high water table.	Drainage needed; high water table; organic material subsides if overdrained; controlled drainage desired.	Very high available water capacity; very rapid water intake rate; drainage required.	Terraces not needed; level organic soil; low stability; high water table; diversions helpful on adjacent slopes.	Not needed; high water table; organic material; level or depressional relief.
Made land: Md. Material variable; onsite investigation needed.						
Metamora: MeA, MeB	Medium to moderately slow seepage rate.	Fair to good stability and compaction; slow seepage rate.	Drainage usually needed; moderately slow permeability below depth of 20 inches; seasonal high water table; random tile or surface drainage needed in wet depressions.	Medium available water capacity; rapid water intake rate.	Usually not needed; gentle slopes; little runoff.	Seasonal high water table.
Metea: MnA, MnB	Rapid seepage rate above depth of 20 to 40 inches; medium to slow rate below; seal blanket required unless sandy material is removed.	Fair stability and compaction; slow seepage rate; moderate volume change on wetting or drying.	Not needed	Low available water capacity; very rapid water intake rate; sloping areas subject to erosion.	Sandy; erodible; difficult to vegetate.	Sandy; slopes erode readily; difficult to vegetate.
Miami: MoB, MoC, MoD, MoE	Medium to moderately slow seepage rate.	Fair stability and compaction; slow seepage rate; moderate volume change on wetting or drying.	Not needed	High available water capacity; medium water intake rate; sloping areas subject to erosion.	Short, irregular slopes and slopes of more than 12 percent hinder construction.	Stones in some areas; sloping to steep areas subject to rapid runoff and erosion.
Minoa: MsB	Medium to moderately slow seepage rate; sides of ponds unstable when wet.	Subsoil has fair stability and compaction; slow seepage rate; substratum has poor stability; medium	Drainage needed; high water table; silt and very fine sand may flow into and plug drainageways; ditch-	High available water capacity; rapid water intake rate.	Not needed; nearly level; little runoff.	Usually not needed; gentle slopes; little runoff.

		seepage rate; subject to piping	banks unstable.			
Nappanee: NaA, NcA, NcB	Slow seepage rate.	Seasonal high water table; fair stability; high volume change on wetting or drying; fair to poor compaction; slow seepage rate.	Slow permeability; seasonal high water table; special blinding and close spacing of tile required; surface drainage needed.	High available water capacity; medium water intake rate; slow permeability.	Seasonal high water table; dense, clayey subsoil; difficult to vegetate.	Deep cuts expose clayey material; difficult to vegetate; rapid runoff.
Oakville:						
OaB	Very rapid seepage rate; too sandy and porous to hold water unless seal blanket is used.	Rapid seepage rate; fair stability and compaction; subject to piping; low volume change on wetting or drying.	Not needed	Very low available water capacity; very rapid water intake rate; frequent applications needed; subject to soil blowing.	Not needed; sandy; slow runoff; difficult to vegetate.	Usually not needed; sandy; slow runoff; difficult to vegetate.
OkB	Very rapid seepage rate above depth of 42 to 66 inches, slow rate below; seal blanket required unless sandy material is removed.	Sandy material has fair stability; rapid seepage rate; subject to piping; substratum has fair to good stability; slow seepage rate.	Not needed	Very low available water capacity; very rapid water intake rate; subject to soil blowing.	Not needed; sandy; slow runoff; erodible; difficult to vegetate.	Sandy; erodible; difficult to vegetate.
Parkhill: Pa	High water table; moderately slow seepage rate; suitable for pit-type ponds.	High water table; fair to good stability and compaction; slow seepage rate.	High water table; moderately slow permeability; subsurface or surface drainage needed; depressions usually wet.	High available water capacity; medium water intake rate; drainage required.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Usually not needed; high water table; nearly level or depressional relief.
Paulding: Pc	High water table; very slow seepage rate; suitable for pit-type ponds.	High water table; fair stability; poor compaction; slow seepage rate; high volume change on wetting or drying.	Drainage needed; very slow permeability; high water table; special backfilling and close spacing of tile required.	High available water capacity; slow water intake rate; drainage needed before irrigation.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Clayey subsoil and high water table make construction and seeding difficult.
Sanitary land fill: Sa. **Soil material variable; onsite investigation needed.**						
Saranac: Sc	High water table; moderately slow seepage rate; suitable for pit-type ponds; subject to stream overflow.	High water table; fair to good stability and compaction; slow seepage rate.	Drainage needed; high water table; subject to stream overflow.	High available water capacity; medium water intake rate; subject to stream overflow; high water table.	Not needed; on nearly level flood plains; high water table.	Not needed; on nearly level flood plains; high water table.

TABLE 6.—*Engineering interpretations for farm uses*—Continued

Soil series and map symbols	Soil features affecting suitability for—					
	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
	Reservoir areas	Embankments				
Selfridge: SdA, SdB, SeA, SfB. For Lamson part of SeA, see Lamson series. For Lenawee part of SfB, see Lenawee series.	Seasonal high water table; rapid seepage rate above depth of 20 to 40 inches, medium to moderately slow rate below; seal blanket required unless sandy material is removed.	Seasonal high water table; fair stability and compaction; slow seepage rate below depth of 20 to 40 inches.	Seasonal high water table; moderately slow permeability below depth of 20 to 40 inches; wet depressions; random tile or surface drains needed.	Low to medium available water capacity; very rapid water intake rate; seasonal high water table.	Usually not needed; sandy soil; gentle slopes; little runoff.	Usually not needed; sandy soil; gentle slopes; little runoff.
Shoals: Sh	Subject to stream overflow; moderate seepage rate.	Seasonal high water table; fair to good stability and compaction; slow seepage rate.	Drainage usually needed; seasonal high water table.	High available water capacity; moderately rapid water intake rate; subject to stream overflow; seasonal high water table.	Not needed; on nearly level stream bottoms that are subject to flooding.	Not needed; on nearly level bottom lands; subject to stream overflow; seasonal high water table.
Sims: Sl	High water table; slow seepage rate; suitable for pit-type ponds.	High water table; fair to good stability and compaction; slow seepage rate.	High water table; moderately slow permeability; subsurface or surface drainage needed; depressions usually wet.	High available water capacity; medium intake rate; drainage required.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Usually not needed; high water table; nearly level or depressional relief.
Sisson: SmB, SmC	Moderate seepage rate; seal blanket required; sides of pond unstable when substratum is exposed.	Uppermost 24 to 42 inches has fair to good stability; slow seepage rate; fair compaction. Substratum has fair to poor stability; subject to piping.	Not needed	High available water capacity; medium water intake rate.	Moderate depth to highly erodible silt and sand; channels subject to siltation.	Sloping areas subject to erosion and runoff; subject to siltation.
Sloan: Sn	High water table; moderate seepage rate; suitable for pit-type ponds; subject to stream overflow.	High water table; fair to good stability and compaction; slow seepage rate.	Drainage needed; high water table; subject to stream overflow.	High available water capacity; moderately rapid water intake rate; subject to stream overflow; drainage required.	Not needed; on nearly level flood plains; high water table.	Not needed; on nearly level flood plains; high water table.
Spinks: SpA, SpB, SpC	Rapid seepage rate; too sandy and porous to hold water un-	Rapid to medium seepage rate; fair stability and compaction;	Not needed	Low available water capacity; rapid water intake rate; sub-	Usually not needed; sandy soil; gentle slopes; slow runoff.	Usually not needed; sandy soil; slow runoff.

	less seal blanket is used.	subject to piping; low volume change on wetting or drying.		ject to soil blowing.		
Tawas: Ta	High water table; rapid seepage rate; suitable for pit-type ponds; flotation of organic material possible.	High water table; uppermost 12 to 40 inches unstable organic material; sandy substratum; rapid permeability; subject to piping.	Drainage needed; high water table; ditchbanks unstable.	Very high available water capacity; very rapid water intake rate; drainage required.	Terraces not needed; level organic soil; low stability; high water table; diversions helpful in adjacent areas.	Not needed; high water table; organic material; level relief.
Toledo: Ts, Tt	High water table; very slow seepage rate; suitable for pit-type ponds.	High water table; fair stability; poor compaction; slow seepage rate; high volume change on wetting or drying.	Very slow permeability; high water table; special blinding and close spacing of tile required; surface drainage needed.	High available water capacity; slow water intake rate; drainage required before irrigating.	Terraces not needed; level; high water table; diversions reduce overflow from adjacent areas.	Clayey subsoil and high water table make construction difficult.
Urban land: Ur. Soil material variable; onsite investigation needed.						
Wasepi: WsA, WsB, WtA, WvB. For Au Gres part of WvB, see Au Gres series.	Moderately rapid seepage rate in uppermost 24 to 40 inches; seal blanket required when porous sand and gravel are exposed.	Uppermost 24 to 40 inches has fair stability; medium seepage rate; fair to good compaction; substratum has fair stability and compaction; rapid seepage rate.	Drainage usually required; seasonal high water table; sand and gravel substratum makes blinding of tile necessary.	Medium available water capacity; rapid water intake rate; moderate depth to sand and gravel.	Usually not needed; gentle slopes; little runoff.	Usually not needed; gentle slopes; little runoff.
WuB	Moderately slow seepage rate; seal blanket usually required; sides of pond unstable when substratum is exposed.	Fair to poor stability; medium seepage rate; fair to poor compaction; subject to piping.	Drainage needed; seasonal high water table; silt and very fine sand may flow into and plug drainage tile; ditchbanks unstable.	Medium available water capacity; rapid water intake rate.	Usually not needed; gentle slopes; little runoff.	Usually not needed; gentle slopes; little runoff.
Willette: Wx	High water table; rapid seepage rate to depth of 12 to 40 inches, slow rate below; suitable for pit-type ponds.	High water table; uppermost 12 to 40 inches unstable organic material; clayey substratum has fair stability; fair to poor compaction.	Drainage required; high water table; organic material subsides if overdrained; controlled drainage desirable.	Very high available water capacity; very rapid water intake rate; drainage required.	Terraces not needed; level organic soil; low stability; high water table; diversions helpful in adjacent areas.	Not needed; level organic soil; high water table.

tinued growth of plants, and maintenance of the 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 available water 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, the depth to soil material unfavorable for production of crops, and topography.

Use of the Soils for Community Development

Appraisers, realtors, city planners, builders, and others interested in developing a community need information about the soils before they can select the most suitable sites for structures and other facilities that are to be built. Useful information can be obtained in other sections of the soil survey, for example, "Engineering Uses of the Soils," "Descriptions of the Soils," and "Capability Grouping." Among the soil features shown in those sections are slope, drainage and permeability, susceptibility to flooding and erosion, and the texture and stability of the soil material. Such features affect suitability of the soils for (1) providing foundation material for houses and commercial buildings, (2) laying out of streets, driveways, and sidewalks, (3) burying underground utility lines, (4) constructing devices for control of runoff and erosion, (5) planting of gardens and landscaping, (6) protecting the public health, and (7) providing suitable recreational areas.

Houses and commercial buildings.—Help in locating soils with the fewest limitations for use as foundation material can be obtained from the columns "Shrink-swell potential" in table 4 and "Foundations for low buildings" in table 5 in the section "Engineering Uses of the Soils." Boyer, Oakville, and Spinks soils are a good source of foundation material. Brevort, Ensley, Gilford, Hoytville, Toledo, and Paulding soils are poorly drained and have a high water table. Basements built in areas of such soils are hard to keep dry. Ceresco, Cohoctah, Saranac, Shoals, and Sloan soils are on bottom lands and are subject to flooding. Soils such as these have severe limitations for building sites. Edwards, Lupton, Tawas, and Willette soils also have severe limitations because they consist of unstable organic material and marl.

Streets, driveways, and sidewalks.—For information about suitability of the soils as foundations for trafficways, see the data given under "Shrink-swell potential" in table 4 and "Road fill" and "Highway location" in table 5 in the section "Engineering Uses of the Soils." Del Rey, Lamson, Minoa, Shoals, Sloan, and Sisson soils are high in silt content and are subject to frost heaving (fig. 16). A cover of sandy and gravelly material should be put on these soils before concrete is laid. Otherwise, the concrete cracks readily. Soils that have a high water table or a high clay content tend to shift and also cause trafficways to crack. Poorly drained soils, such as Edwards, Lupton, Tawas, and Willette soils, settle unevenly, especially after they are drained.

Figure 16.—Section of pavement broken by frost heaving in an area of Del Rey loam, 0 to 2 percent slopes.

Underground utility lines.—Some soils have properties that cause breakage or corrosion of lines buried in them to conduct water, gas, sewage, communication lines, and the like. The physical, chemical, electrical, and biological characteristics of the soils cause at least some corrosion of all buried metals. Among these characteristics are moisture content and a concentration of oxygen or of anaerobic bacteria. Also, design and construction of the lines are important considerations. Corrosivity is increased where dissimilar metals are connected, the metals are placed at different depths, and the pipelines are laid through different kinds of soils.

In soils that have a high shrink-swell potential, stress as a result of changes brought about as the soil becomes wet and dry can break cast-iron pipe. In some places it is necessary to cushion the pipe with sandy material. Information about shrink-swell potential and corrosivity is given in tables 4 and 5.

Control of runoff and erosion.—Control of erosion and deposition is a serious problem where structures are built on sloping soils. Construction work compacts the soils and increases the amount of paved surface, thereby increasing runoff 2 to 10 times. This runoff collects in streets and gutters instead of flowing into drainageways as it once did, and then floods and deposits sediments in low areas. Boyer, Lapeer, and Miami soils are especially subject to rapid runoff and severe erosion. Small residential areas can be protected by—

1. Locating driveways, walks, and fences on the contour or straight across the slope.
2. Grading to decrease the slope. The topsoil can be removed and used later.
3. Building diversions to intercept runoff and control erosion.

4. Constructing or improving waterways to prevent gullying.
5. Draining seepy and waterlogged areas.

Information about features of the soils that affect their use for diversions, grassed waterways, and artificial drainage is given in table 6.

Gardening and landscaping.—Homeowners and landscape architects need to know the kinds of soils present in an area before they can make the right choice of flowers, shrubs, and trees for planting. The best soils are those that have a deep root zone, a loamy texture, a balanced supply of plant nutrients, an adequate amount of organic matter, adequate available moisture capacity, good drainage, and a structure that permits free movement of water. Miami, Celina, and Lapeer soils that are not too steep closely approach the ideal. Boyer, Oakville, and Spinks soils are so sandy and droughty that lawns and shrubs dry out quickly in dry periods and need to be watered frequently. Hoytville, Lenawee, Parkhill, Paulding, and Toledo soils, which are poorly drained, are difficult to work when wet and dry out hard and cloddy. Seeding of lawn grasses is difficult once these soils are disturbed by construction equipment. Additional information about the soils is given in the section "Capability Grouping."

Public health.—Maintenance of a pure water supply, proper disposal of sewage, and prevention of disease are among the problems to be met in protecting the public health. Careful construction of sewage lagoons, sewage lines, and septic tank systems is needed to avoid pollution of the water supply. Sandy soils, such as Oakville and Spinks soils, have rapid or very rapid permeability. Effluent percolates rapidly through such soils and causes pollution of a water supply near the surface. Leakage from sewage lagoons and runoff from clogged filter fields contaminate wells, streams, and lakes. Shrink-swell potential, corrosivity, and stability of the soils are important considerations in locating sewer lines. Features that affect suitability of the soils for embankments and septic tank filter fields (fig. 17) are given in tables 5 and 6.

***Figure 17.*—Ponded area of Corunna sandy loam. Limitations of this soil for septic tank filter fields are severe because of a high water table.**

Among the major soil features to consider in selecting sites for sanitary land fills are topography, drainage, texture, permeability, reaction, and the nature of the underlying material. Table 4 shows these features.

Mosquitoes, fleas, and other disease-carrying insects breed in stagnant water and in areas that are wet because of poor internal drainage and nearly level relief. Areas such as these need to be drained and sprayed.

Recreation.—Soil features of importance in choosing areas suitable for campsites, picnic areas, and intensive play areas are natural drainage, slope, soil texture, flood hazard, and stoniness. Ensley, Gilford, Hoytville, Lamson, Parkhill, Paulding, Sims, and Toledo soils have severe limitations for recreation areas because they are poorly drained and have a high water table. Pit-type ponds, however, are suited to these soils. Edwards, Lupton, Tawas, Willette, and other organic soils also have severe limitations because they are very poorly drained and unstable. Sloping to steep areas of Boyer, Lapeer, and Miami soils have severe limitations except for paths and trails. Nearly level to gently sloping areas of Boyer, Lapeer, Metea, Oakville, and Spinks soils make fair to good sites. They dry out quickly after rains and provide a firm surface for trafficways. Ceresco, Cohoctah, Saranac, Shoals, and Sloan soils are of limited use because of a flood hazard.

Formation and Classification of the Soils

The first part of this section describes the factors that affect formation of the soils. The second part tells about the processes that take place in the formation of soil horizons. The last part gives the classification of the soil series.

Factors of Soil Formation

Soil is formed by weathering and other processes that act on material deposited or accumulated by geologic agents. The characteristics of a soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and has existed since accumulation, (3) the living organisms on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil development have been active.

Climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks, and in this county the action of glaciers, and slowly change it into a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile.

The amount of time may be much or little, but generally a long time is required for the development of distinct horizons.

The five factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the weathered rock or partly weathered soil material from which soil has formed. It determines the limits of the chemical and mineralogical characteristics of soil. In Macomb County the parent material was deposited by glaciers and lakes. It consisted of gravel, sand, a mixture of sand and gravel, silt, loam, clay, and organic material that was deposited on outwash plains, till plains, lake plains, flood plains, and moraines and in drainageways.

Climate

The climate of Macomb County is cold and humid. It is uniform throughout the county and presumably is similar to that under which the soils formed. Consequently, climate alone does not account for local differences among the soils. Its effects are modified by the effects of the other four factors of soil formation.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. They contribute to gains in organic-matter content and nitrogen, gains or losses in plant nutrients, and changes in structure and porosity. The vegetation, which in this county consisted mainly of hardwood and coniferous trees, has affected soil formation more than have other living organisms.

Relief

Relief affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. That of Macomb County varies widely from depressional to steep and hilly. Some areas rise to a height of 150 to 200 feet, and others are broad, nearly level plains where the slope is less than 2 percent. Many small, nearly level areas are interspersed with the hilly areas and receive runoff from them. The water table is at or near the surface in depressional areas and in some of the nearly level areas. In these places the soils are somewhat poorly drained or poorly drained. Examples are soils of the Fulton and Toledo series.

Time

The difference in length of time that parent material has been in place is commonly reflected in the degree of development of soil horizons. The soils in this county range from young to old. The young soils, such as those of the Ceresco series, are those that formed in alluvium. Their horizons are weakly expressed. Soils of the Miami series are examples of older soils that have well-expressed horizons.

Processes of Soil Formation

Several processes take place in the formation of soil horizons. Among these are (1) the accumulation of organic matter, (2) the leaching of calcium carbonates and bases, (3) the reduction and transfer of iron, and (4) the formation and translocation of silicate clay minerals. In most of the soils in Macomb County, more than one of these processes has been active.

The accumulation of organic matter is an important process in formation of an A1 horizon. The soils of this county range from high to very low in organic-matter content.

Moderate to strong leaching of carbonates and bases has occurred in nearly all of the soils, and this has contributed to the development of genetic horizons.

The reduction and transfer of iron, or gleying, occurs in poorly drained and very poorly drained soils. The process of gleying is evident in the gray color of the subsoil. Some horizons contain reddish-brown mottles and concretions, a condition which indicates segregation of iron.

Where the translocation of clay minerals has taken place, the eluviated A2 horizon of some soils in this county has a platy structure and is lower in clay content and generally lighter in color than the B horizon, which has an accumulation of clay (clay flows) in pores and on ped surfaces. The leaching of bases and the translocation of silicate clays are among the more important processes in horizon differentiation. Soil scientists generally agree that leaching normally precedes translocation. Soils of the Miami series are examples of those in which clay has accumulated in the B horizon in the form of clay flows.

In some soils of this county, iron and humus have moved from the surface layer into the B horizon and have imparted to it a dark reddish-brown to yellowish-brown color. Soils of the Au Gres series are examples.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationships to one another and to the whole environment, and understand their behavior and response to management. First through classification and then through use of soil maps, we can apply our knowledge to specific tracts of land.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*6*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967 and in September 1968 (*8*). This system is under continual study, and readers interested in the development of the system should refer to the latest literature available.

The current system of classification defines classes in terms of observable or measurable properties of soils (*5*). It has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. The placement of some soil series, particularly in families, may change as more precise information becomes available.

In table 7 the soil series of Macomb County are classified according to the current system. Following are brief descriptions of the six categories.

ORDER.—Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are Entisols and Histosols, which occur in many different climates.

As shown in table 7, six soil orders are represented in Macomb County: Entisols, Inceptisols, Alfisols, Mollisols, Spodosols, and Histosols. Entisols are recent soils; they lack genetic horizons or have only the beginning of such horizons. Inceptisols occur most often on young, but not recent, land surfaces. Alfisols have a clay-enriched B horizon that is high in base saturation. Mollisols generally form under grass vegetation. They have a thick, dark-colored surface layer. Spodosols have an iron-enriched and humus-enriched B horizon. Histosols formed in organic material. They are composed of muck or peat.

SUBORDER.—Each order is divided into suborders, which are based primarily on characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the

TABLE 7.—*Classification of soil series*

Series	Family	Subgroup	Order
Au Gres [1]	Sandy, mixed, frigid	Entic Haplaquods	Spodosols.
Blount	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Brevort [1]	Sandy over loamy, mixed, nonacid, frigid	Mollic Haplaquents	Entisols.
Celina [2]	Fine, mixed, mesic	Aquic Hapludalfs	Alfisols.
Ceresco	Coarse-loamy, mixed, mesic	Aquic Fluventic Hapludolls	Mollisols.
Cohoctah [3]	Coarse-loamy, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols.
Conover	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Corunna	Coarse-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Del Rey [4]	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Dryden	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Edwards	[5]	[5]	Histosols.
Ensley [1,4]	Coarse-loamy, mixed, nonacid, frigid	Aeric Haplaquepts	Inceptisols.
Fulton	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Gilford	Coarse-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Granby [6]	Sandy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Hoytville	Fine, illitic, mesic	Mollic Ochraqualfs	Alfisols.
Lamson [4]	Coarse-loamy, mixed, nonacid, mesic	Aeric Haplaquepts	Inceptisols.
Lapeer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Lenawee [2]	Fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Linwood	[5]	[5]	Histosols.
Locke	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Lupton	[5]	[5]	Histosols.
Metamora	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Metea	Fine-loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Miami	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Minoa [7]	Coarse-loamy, mixed, mesic	Aquic Eutrochrepts	Inceptisols.
Nappanee	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Oakville	Mixed, mesic	Typic Udipsamments	Entisols.
Parkhill	Fine-loamy, mixed, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Paulding	Very fine, illitic, nonacid, mesic	Typic Haplaquepts	Inceptisols.
Saranac	Fine, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols.
Selfridge	Fine-loamy, mixed, mesic	Aquic Arenic Hapludalfs	Alfisols.
Shoals	Fine-loamy, mixed, nonacid, mesic	Aeric Fluventic Haplaquepts	Inceptisols.
Sims [1]	Fine, mixed, nonacid, frigid	Mollic Haplaquepts	Inceptisols.
Sisson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Sloan	Fine-loamy, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols.
Spinks	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Tawas	[5]	[5]	Histosols.
Toledo	Fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Wasepi	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Willette	[5]	[5]	Histosols.

[1] This soil typically has an average annual soil temperature of less than 47° F.

[2] Classification at the family level was under study at the time this survey was sent to the printer.

[3] In Macomb County this soil is more alkaline in reaction than is typical of the series.

[4] In Macomb County this soil is grayer in color throughout the profile than is typical of the series.

[5] Histosols are not classified at the subgroup and family levels, because classification at these levels was provisional at the time this survey was sent to the printer.

[6] In Macomb County this soil has a thinner mollic epipedon than is typical of the series.

[7] In Macomb County this soil has a darker surface layer and is shallower to carbonates than is typical of the series.

presence or absence of waterlogging, or those that reflect differences resulting from the climate or vegetation.

GREAT GROUP.—Each soil order is divided into great groups on the basis of similarity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated; or those that have a pan that interferes with the growth of roots or the movement of water. The features used are the self-mulching properties of clay; soil temperature; major differences in chemical composition, mainly in calcium, magnesium, sodium, and potassium; and the like.

SUBGROUP.—Each great group is divided into subgroups, one representing the central, or typic, segment of the group and the others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be established in those instances where soil properties intergrade outside the range of any recognized great group, suborder, or order.

FAMILY.—Families are established within a subgroup primarily on the basis of properties important in the growth of plants or in the behavior of soils when used in engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series has the narrowest range of characteristics of the categories in the classification system. It is described fully in the section "How This Survey Was Made." For a description of each series, turn to the section "Descriptions of the Soils."

General Nature of the County

This section provides some general information about the climate, geology, and vegetation of the county and gives some important farming statistics. The statistics are from reports published by the United States Bureau of the Census.

Climate [2]

Macomb County, in the southeastern part of Michigan, is bordered on the southeast by Lake St. Clair. It is less strongly influenced by the Great Lakes than are many counties in Michigan. The most noticeable effect is an increase in cloudiness late in fall and early in winter when prevailing westerly winds move cold air masses across the warmer lake water.

Annual temperature and precipitation data, compiled at the U.S. Weather Bureau station at Mount Clemens, are shown in table 8. The highest temperature ever recorded was 106° F., on July 5, 1911, and the lowest was −24°, on February 12, 1912. On an average, 4 days each winter have a temperature of 0° or lower and 11 days each summer have a temperature of 90° or higher. The temperature reaches 100° or higher in only about 1 year out of 5. The average highest monthly temperature, 78.7°, was recorded in July 1955, and the average lowest monthly temperature, 13.5°, was recorded in January 1912.

Table 9 shows the probabilities of the last freezing temperatures in spring and the first freezing temperatures in fall. The average date of the last in spring is May 1; that of the first in fall is October 14.

Precipitation is heaviest during the growing season. About 56 percent of the annual total falls between April 1 and September 30. The greatest average monthly precipitation, 3.10 inches, occurs in May. The smallest, 1.76 inches, occurs in January. The greatest amount of precipitation ever received in a 1-month pe-

[2] This section was prepared by NORTON D. STROMMEN, State climatologist, Weather Bureau, U.S. Department of Commerce, Environmental Science Services Administration.

TABLE 8.—*Temperature and precipitation at Mount Clemens 1930–59*

Month	Temperature				Precipitation				
			Two years in 10 will have at least 4 days with—			One year in 10 will have—			
	Average daily maximum	Average daily minimum	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Average total	Less than—	More than—	Days with snow cover	Average depth of snow on days with snow cover
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	32.2	18.7	47	2	1.76	0.67	3.08	17	2.8
February	33.4	18.4	48	3	1.96	.76	3.66	14	2.6
March	41.5	26.0	60	13	2.18	1.02	3.67	5	2.4
April	54.9	36.5	74	25	2.60	1.17	4.29	1	1.3
May	67.3	47.0	83	36	3.10	.98	5.61	0	0
June	77.9	57.8	91	47	2.64	1.07	4.63	0	0
July	83.0	62.6	93	53	2.22	.81	4.00	0	0
August	81.0	61.2	93	50	2.54	.92	4.60	0	0
September	73.0	53.6	87	40	2.37	1.05	4.09	0	0
October	61.6	43.3	77	31	2.14	.79	4.03	0	0
November	46.4	32.4	62	18	1.98	.77	3.30	2	2.2
December	35.0	22.7	50	6	1.96	.62	3.47	9	1.9
Year	57.3	40.0	[1] 97	[2] −2	27.45	19.40	35.80	48	2.5

[1] Average annual maximum temperature.
[2] Average annual minimum temperature.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall at Mount Clemens 1930–59*

Probability	Dates for given probability and temperature [1]				
	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 9	April 18	May 2	May 16
2 years in 10 later than	March 27	April 4	April 13	April 27	May 11
5 years in 10 later than	March 17	March 25	April 3	April 17	May 1
Fall:					
1 year in 10 earlier than	November 16	November 7	October 29	October 15	September 28
2 years in 10 earlier than	November 21	November 12	November 3	October 20	October 3
5 years in 10 earlier than	December 2	November 23	November 14	October 31	October 14

[1] In the western part of Macomb County, the date in spring is 5 to 7 days later than the date shown. The date in fall is 5 to 7 days earlier than the date shown.

riod was 8.15 inches, in June 1940. The least amount in a 1-month period was 0.06 inch, in December 1900.

About once in 2 years, as much as 1.2 inches of precipitation can be expected in 1 hour; 1.4 inches in 2 hours; and 2.3 inches in 24 hours. In a 24-hour period, 3.4 inches can be expected about once in 10 years and 4.3 inches about once in 50 years.

The average annual snowfall is 31.3 inches, but the amount varies considerably from year to year. During the past 30 years, the total has ranged from as much as 49.9 inches, in the 1951–52 season, to as little as 12.4 inches, in the 1952–53 season. Measurable amounts of snow generally fall during all the months of November through April.

According to evaporation data available at Dearborn, which is about 15 miles southwest of Macomb County, the average total evaporation from April 1 through October 31 is 43.04 inches. This is almost two and a half times the average rainfall, which totals 17.61 inches during the same period. Successful farming, therefore, depends largely on the recharge of moisture in winter and early in spring and the capacity of the soils to hold this moisture until rains can replenish the supply.

Cloudiness is greatest late in fall and early in winter and is least late in spring and in summer. Records kept at Detroit, the nearest station that keeps data 24 hours a day, show that in December there is an average of 23 cloudy days, 3 partly cloudy days, and 5 clear days. Records for July show an average of 8 cloudy days, 12 partly cloudy days, and 11 clear days. The annual percentage of possible sunshine is 5 to 10 percent greater in Macomb County than it is in the western counties near Lake Michigan.

Geology

Macomb County is part of the basin of glacial lakes that were forerunners of the Great Lakes. All except the northwestern part of the county was a glacial lake, or a succession of gradually receding lakes. The oldest lake levels are characterized by distinct beach ridges. Soils that are underlain by sand and gravel commonly extend well out from the present lakeshore of Lake St. Clair. Successive glacial lake stages, from the oldest to the most recent, are Lakes Maumee, Wayne, Warren, Whittlesey, Arkona, St. Clair, Grassmere, Elkton, and Algonquin.

Several ice sheets advanced and retreated over Macomb County during the glacial period. The most recent occurrence was during the late Wisconsin period, some 9,000 years ago. As the last ice sheets melted, they deposited glacial rock and soil material over parts of the county. As a result, moraines and other distinctive geological features were formed.

The range of hills in the northwestern corner of the county represents the Birmingham moraine. The undulating areas that cross the northern part represent the till plains or ground moraines. The Mount Clemens moraine lies in a northeast to southwest direction in the eastern part of the county. It is 1 to 3 miles wide and extends from the town of Richmond through Mount Clemens and then past Centerline and East Detroit into Wayne County. This moraine, which was water laid, is gently sloping. The west-central part of the county is covered by sandy glacial outwash.

Most of this county is drained by the Clinton River and its tributaries. A minor part in the northeastern corner is drained by the Belle River. The highest point in the county, 1,167 feet, is in section 18 of Bruce Township, about 3 miles northwest of the village of Romeo. The lowest point, 575 feet, is at Lake St. Clair, in the southeastern part.

A few natural lakes occur in the northwestern part of the county. Stony Creek Lake is manmade. It occurs on Stony Creek, in the southwestern part of Washington Township.

Vegetation

When Macomb County was first settled, all except a small acreage of marshland was covered by forest. Nearly all the forest has now been cleared. In recent years, plantings of red pine, white pine, Scotch pine, and spruce trees have increased throughout the county.

Mixed hardwoods once grew on the well-drained, sandy soils; those soils still wooded are in second-growth trees. Sugar maple, oak, hickory, beech, and basswood grew on the better drained, medium-textured to fine-textured soils. Stands on these soils now consist mainly of oak, hickory, sugar maple, ash, cherry, beech, basswood, and elm. Dense stands of elm, ash, and red maple formerly grew on the poorly drained mineral soils, which now support scattered stands of elm and red maple. Red maple, elm, willow, tamarack, white-cedar, and black spruce were the major trees that grew on the organic soils. Trees that remain on these soils are mainly aspen, white-cedar, tamarack, elm, and red maple. Bulrushes, sedges, cattails, reeds, sawgrass, and scattered white-cedar, balsam, and tamarack grew in the small acreage of marshland, and this vegetation has remained unchanged.

Farming

The total land area of Macomb County is about 307,840 acres. Of this, about 44 percent, or 135,767 acres, is in farms. The rest consists mainly of State land, privately owned woodland, abandoned farmland, urban areas, and areas used for recreation and industry. Of the acreage in farms in 1964, 57 percent was in cultivated cropland and 7 percent was in pasture.

There were 1,609 farms in the county in 1964. Of these, 693 were from 1 to 49 acres in size; 446 were from 50 to 99 acres; 394 were from 100 to 259 acres; 66 were from 260 to 499 acres; and 8 were from 500 to 999 acres. Only 2 farms were larger than 1,000 acres.

Among the farms in the county, 719 were miscellaneous or unclassified farms; 340 were dairy farms; 106 were poultry and livestock farms, other than dairy; 198 were vegetable farms; 50 were general farms; and 30 were fruit and nut farms.

Corn is the chief row crop, and in 1964, there were 18,399 acres of corn harvested for grain and 4,789 cut for silage. Small grain is also an important crop. In 1964, there were 11,399 acres in wheat; 9,340 acres in oats; 117 acres in barley; and 501 acres in rye. There were 2,449 acres in soybeans. Of the hay crops harvested, 13,804 acres were in alfalfa and alfalfa mixtures; 3,487 acres were in clover or timothy; and only 333 acres were in other hay crops. Alfalfa and red clover for seed were grown on 235 acres; potatoes on 832 acres; beans on 1,318 acres; tree fruits, nuts, and grapes on 2,071 acres; and vegetables other than potatoes harvested for sale on 5,724 acres.

Apples are the main tree fruits. Harvested in 1964 were 16,926,984 pounds of apples; 768,508 pounds of peaches; 620,248 pounds of pears; 188,872 pounds of plums; 180,995 pounds of cherries; 53,405 pounds of grapes; and 86,465 pounds of strawberries.

Nursery products were grown on 76 farms for a cash value of more than $340,000. Cut flowers, potted plants, florist greens, and bedding plants were grown on 112 farms for a cash value of almost 2 million dollars. Vegetables grown under glass, flower and vegetable seeds, vegetable plants, bulbs, and mushrooms were grown on 57 farms for a cash value of more than 1 million dollars.

Literature Cited

(1) American Association of State Highway Officials.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., 401 and 617 pp., illus.

(2) Baldwin, M., Kellogg, C. E., and Thorp, J.
1938. SOIL CLASSIFICATION. U.S. Dept. of Agr. Yearbook: 979–1001.

(3) Michigan State Highway Department.
1960. FIELD MANUAL OF SOIL ENGINEERING. Ed. 4, 416 pp., illus.

(4) Michigan State University.
1966. FERTILIZER RECOMMENDATIONS FOR MICHIGAN VEGETABLES AND FIELD CROPS. Ext. Bul. E–550 (rev.), 24 pp.

(5) Simonson, Roy W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Sci. 137: 1027–1034.

(6) Thorp, J., and Smith, Guy D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117–126, illus.

(7) United States Department of Agriculture.
1951. SOIL SURVEY MANUAL. U.S. Dept. of Agr. Handbook 18, 503 pp., illus.

(8) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. 265 pp., illus. [Supplements issued in March 1967 and in September 1968]

(9) Waterways Experiment Station, Corps of Engineers.
1953. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. 3–357, 2 v., illus., and appendix.

Glossary

Acidity. See Reaction.

Alkalinity. See Reaction.

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 soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Blowout. An excavation produced by wind action in loose soil, usually sand.

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 when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

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 of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below a depth of 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Glacial outwash (geology). Sandy and gravelly materials deposited in layers on plains or in old glacial drainageways by water from melting glaciers.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Green manure. A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

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

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

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.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

pH. See Reaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor 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	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal; percentage of slope is the vertical distance, divided by horizontal distance times 100. Thus a slope of 10 percent is a drop of 10 feet in 100 feet of horizontal distance.

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 on earthy 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).

Subsidence. A settling or packing down of the soil material, as exemplified by muck that has been drained and cultivated many times.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing 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."

Till plain. A level or undulating land surface covered by till, which is unstratified glacial drift consisting of clay, sand, gravel, and boulders intermingled.

Weathering. The physical and chemical disintegration and decomposition of rocks and minerals. Soil is the result of weathering and other chemical, physical, and biological alterations that have made changes in the upper part of the earth's crust through various periods of time.

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