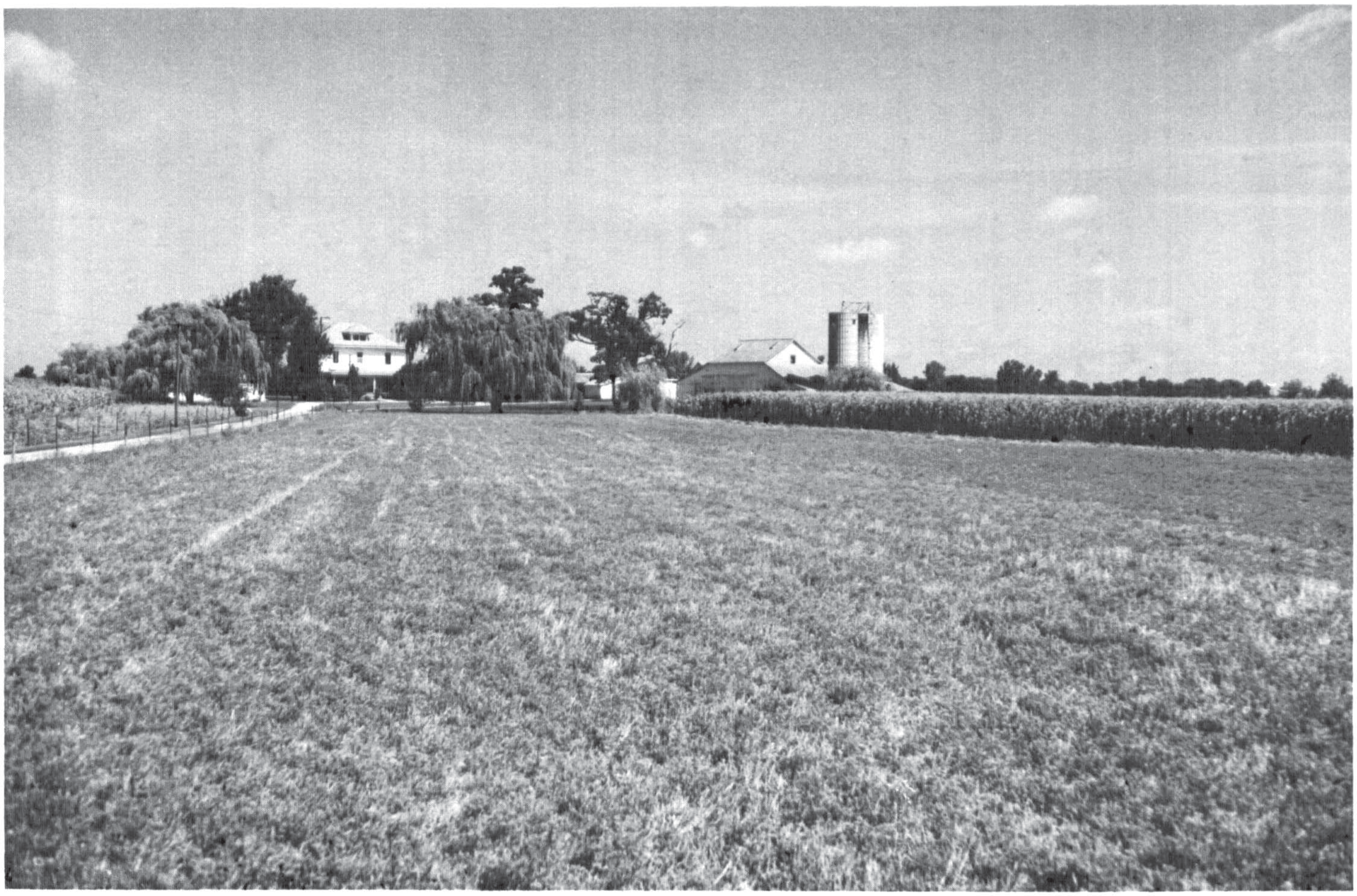
SOIL SURVEY OF

Union County, Ohio



United States Department of Agriculture
Soil Conservation Service
in cooperation with
Ohio Department of Natural Resources
Division of Lands and Soil
and
Ohio Agricultural Research and Development Center

Major fieldwork for this soil survey was done in the period 1963–1968. Soil names and descriptions were approved in May, 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service, the Ohio Department of Natural Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Union Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

All the soils of Union 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, shows the page where each soil is described, and gives the capability classification of each.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soil from the soil descriptions and from the discussions of the capability groups of soils.

Foresters and others can refer to the section "Woodland," where management of the soils for trees and windbreaks is suggested.

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 recreational areas in the section "Town and Country Planning."

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

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

Newcomers in Union 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 information about the county given in the section "General Nature of the County."

Cover: **Typical farm scene on Brookston-Crosby association. Buildings are on Crosby soil.**

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SOIL SURVEY OF UNION COUNTY, OHIO

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF LANDS AND SOIL, AND THE OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

UNION COUNTY, in the central part of Ohio (fig. 1), has a total land area of about 434 square miles. Marysville, the county seat, is about 31 miles northwest of Columbus, the State capital.

Figure 1.—Location of Union County in Ohio.

Farming is the main occupation. A large part of the farm income in 1964 was derived from the sale of livestock and livestock products, mainly dairy products, beef cattle, and swine. Corn, oats, wheat, soybeans, and hay are grown extensively on many farms and are the main source of income on some farms. Only a small part of the farm income is derived from wood products.

Most of the soils are deep. All the soils formed in glacial till or glacial outwash of Wisconsin age or in recent alluvium.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Union 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.

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. Miamian and Brookston, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil indicates a feature that affects management. For example, Fox silt loam, 0 to 2 percent slopes, is one of several phases within the Fox 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 in the back of this publication was prepared from the aerial photographs.

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

In most areas surveyed there are places where 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. Gravel pits is a land type in Union County.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then 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 method of use and management.

General Soil Map

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

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, and other details that help in drawing boundaries accu- building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The seven soil associations in Union County are described on the following pages.

1. Blount-Wetzel-Pewamo association

Somewhat poorly drained and very poorly drained soils that formed in moderately fine textured glacial till; on uplands

Part of this association is a large area in the northern part of the county, and the rest extends from just east of Marysville to the eastern border. This association makes up about 47 percent of the county. It is 64 percent Blount soils, 18 percent Wetzel soils, 13 percent Pewamo soils, and 5 percent Morley and other soils.

This association is underlain by compact glacial till. The landscape is a nearly level to gently sloping and undulating till plain (fig. 2). Low knolls are typical.

Blount soils are deep, nearly level to gently sloping, and somewhat poorly drained. Pewamo and Wetzel soils are deep, nearly level, and very poorly drained. In places they are in depressions. Both of these soils are darker colored than Blount soils.

Nearly all of this association is farmed. The chief enterprise is cash-grain farming. Dairying and the raising of hogs and beef cattle also are parts of most farm enterprises.

All the major soils in this association are seasonally wet. Fieldwork is delayed in spring unless the soils are adequately drained. Much of the association is drained. Slow permeability and a seasonal high water table are major limitations for many nonfarm uses.

2. Blount-Morley-Pewamo association

Somewhat poorly drained, moderately well drained, and very poorly drained soils that formed in moderately fine textured glacial till; on uplands

This association makes up two distinct belts several miles wide that extend northwest to southeast across the county north of Big Darby Creek. The association makes up about 23 percent of the county. It is 50 percent Blount soils, 34 percent Morely soils, 14 percent Pewamo soils, and 2 percent other soils.

Most of the association is underlain by compact glacial till. Both belts are on a landform common to recessional moraines. The landscape is one of irregularly shaped broad ridges, gently rolling hills, and steeper slopes adjacent to streams. Slopes range from nearly level to very steep.

Blount soils are deep, nearly level to gently sloping, and somewhat poorly drained. Morely soils are deep, mainly gently sloping to moderately steep, and moderately well drained. They are on the sides and tops of knolls. Pewamo soils are deep, nearly level, dark colored, and very poorly drained. They are mostly adjacent to drainageways.

Most of this association is farmed. The chief enterprise is cash-grain farming. A significant acreage is in pasture.

*Figure 2.—**Top:*** Dark-colored Pewamo soils and light-colored Blount soils. ***Bottom:*** Hogs in pasture on Blount-Wetzel-Pewamo soil association.

Dairying and the raising of sheep and beef cattle are parts of most farm enterprises.

Most of the dominant soils that are cultivated are seasonally wet. Fieldwork is delayed in spring unless soils are adequately drained. Much of the association is drained. Slow permeability and a seasonal high water table in the Blount and Pewamo soils are limitations for many nonfarm uses.

3. Morley-Blount association

Moderately well drained and somewhat poorly drained soils that formed in moderately fine textured glacial till; on uplands

This association consists of long, narrow, hilly areas adjacent to the major streams north of Big Darby Creek. It is mostly in the east-central part of the county. It makes up about 1 percent of the county. It is 65 percent Morley soils, 30 percent Blount soils, and 5 percent Pewamo and other soils.

This association is underlain by compact glacial till. The dominant soils are mostly sloping to very steep. The landscape is characterized by hills, slopes along streams, and small areas of gently sloping, somewhat poorly drained soils.

Morley soils are deep, gently sloping to very steep, and moderately well drained. Blount soils are mostly gently sloping and are somewhat poorly drained.

Most of this association is farmed. Much of the acreage is pasture, and the rest is used for cash-grain farming. Dairying and the raising of sheep and beef cattle are parts of most farm enterprises.

The dominant soils in this association are moderately well drained and are subject to erosion. Wetness delays fieldwork on the somewhat poorly drained soils in spring. Most of these soils are artificially drained. Slow permeability and a seasonal high water table in the Blount soils are limitations for many nonfarm uses.

4. Nappanee-Paulding-St. Clair association

Somewhat poorly drained, very poorly drained, and moderately well drained soils that formed in wave-modified, fine-textured glacial till; on old glacial lakebeds.

This association is a large area that extends northwest from Marysville to the boundary of Union and Logan Counties. It makes up about 11 percent of the county. It is 50 percent Nappanee soils, 25 percent Paulding soils, 20 percent St. Clair soils, and 5 percent other soils.

The landscape is one of nearly level to sloping till plains and moraines. The dominant soils are fine textured. They formed in clayey till at the bottom of former glacial lakes. The upper part of the till was modified by water action.

All the soils are deep. Nappanee soils are nearly level to gently sloping and somewhat poorly drained. Pauling soils are nearly level and very poorly drained. They are darker colored than Nappanee soils. St. Clair soils are gently sloping to sloping and moderately well drained. They are on slight rises and low knolls and are adjacent to streams.

A large part of this association is farmed. The rest is forest and pasture. The chief enterprise is raising grain for livestock, mainly dairy cattle and beef cattle and a few sheep.

The dominant soils in this association are seasonally wet and are slow to dry out. Fieldwork is delayed in spring unless drainage is adequate. A seasonal high water table is a limitation for many nonfarm uses.

5. Brookston-Crosby association

Very poorly drained and somewhat poorly drained soils that formed in medium-textured glacial till; on uplands

This association is south of Big Darby Creek in the southern part of the county. It makes up about 13 percent of the county. It is 55 percent Brookston soils, 35 percent Crosby soils, and 10 percent Miamian, Celina, and other soils.

This association is nearly level to undulating. Most of it is underlain by loam-textured glacial till.

The dark-colored Brookston soils are nearly level and very poorly drained. In places they are in depressions. The lighter colored Crosby soils are nearly level to gently sloping and gently undulating and are on low knolls. Miamian and Celina soils are steeper than Brookston and Crosby soils.

A large part of this association is cultivated. A small acreage, mainly the undrained Brookston soil, is wooded. The chief enterprise is cash-grain farming. Also important are dairying and the raising of hogs and beef cattle. Most farms are family enterprises.

The dominant soils in this association are seasonally wet. Fieldwork is delayed in spring unless the soils are artificially drained. Much of the association is drained by tile. Slow permeability and a seasonal high water table are limitations for many nonfarm uses.

6. Fox-Lippincott association

Well-drained and very poorly drained soils that formed in medium-textured outwash material underlain by stratified sand and gravel; on terraces

This association is nearly level to moderately steep and is on terraces along Big Darby Creek in the southern part of the county. It makes up about 2 percent of the county. It is 50 percent Fox soils, 25 percent Lippincott soils, and 25 percent Sloan, Ross, Genesee, and Warsaw soils.

Fox soils are well drained, nearly level to moderately steep, and moderately deep over calcareous sand and gravel. The dark-colored Lippincott soils are nearly level, very poorly drained, and moderately deep over sand and gravel. The Sloan, Ross, Genesee, and Warsaw soils are on bottom lands.

Much of this association is used for cash-grain crops. Also important are dairying and the raising of hogs and beef cattle. Most farms are family enterprises.

Most of this association is well suited to most farm crops. Fieldwork on the wetter Lippincott soils is delayed in spring. Except for seasonal wetness in the Lippincott soils and occasional flooding on some of the lower terraces, the dominant soils in this association have few limitations for most nonfarm uses.

This association is an important source of sand and gravel for use in construction. Fox and Lippincott soils are underlain by thick deposits of sand and gravel.

7. *Genesee-Eel-Shoals-Fox association*

Well drained, moderately well drained, and somewhat poorly drained soils that formed in medium textured or moderately fine textured material; on flood plains and terraces

This association is mostly along the major streams. It makes up about 3 percent of the county. It is about 30 percent Genesee soils, 20 percent Eel soils, 15 percent Shoals soils, 10 percent Fox soils, and 25 percent Montgomery, Westland and other soils.

The Genesee, Eel, and Shoals soils are deep and nearly level and are on flood plains. Shoals soils are wetter than the other soils in this association. Fox soils are on low terraces and are subject to occasional flooding. They are nearly level to sloping, well drained, and moderately deep over sand and gravel.

Most of this association is farmed. The majority of the farms are of the cash-grain type. Dairying and the raising of swine and beef cattle are other important enterprises.

Most of this association is subject to periodic flooding in winter and spring. Flooding is a serious limitation for most nonfarm uses.

Use and Management of the Soils

The capability classification system, used by the Soil Conservation Service, in which the soils are grouped according to their suitability for crops, is explained on the pages that follow. Management of the soils for row crops, hay, and pasture is suggested by capability units, and estimated yields of the principal crops grown under two levels of management are shown in table 1.

This part of the survey also contains information on irrigation and on management of the soils for woodland and windbreak plantings and wildlife. It gives data from engineering tests and interpretations of soil properties that affect highway construction and other engineering structures. It also contains information on use of the soils for 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 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 forest trees or for engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These levels are described 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 or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows 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 or range, woodland, wildlife, or recreation. In Union County there are no Class V or Class VIII soils.

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 IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitations; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

The capability units in Union County are described on the pages that follow. The descriptions point out hazards and limitations to be considered in management. No specific practices are recommended for drainage or erosion control. Many are possible on any given tract of land, depending on the ability and need of the operator and on future land use.

Capability unit numbers generally are assigned locally, but are a part of a statewide system. All of the units in the system are not represented by the soils of Union County; therefore the numbers are not consecutive.

CAPABILITY UNIT I-1

This unit consists of nearly level, moderately well drained and well drained soils that have a silt loam surface layer. These soils are in the Celina and Kendallville series. They are on till plains and moraines.

The root zone in these soils is moderately deep and normally is medium acid to very strongly acid. Permeability is moderate to slow, and available moisture capacity is medium.

No features limit the use of these soils for field crops and pasture. If the soils are well managed, there is little or no hazard of erosion. Deterioration of the soil structure can be prevented by growing crops that supply a large amount of residue.

These soils are suited to all field crops, hay, and pasture plants commonly grown in the county. They are also suited to some specialty crops. Under intensive management they can be used for cultivated crops year after year. The Kendallville soil is well suited to irrigation. The Celina soil is less well suited than the Kendallville soil, but can be irrigated.

CAPABILITY UNIT IIe-1

This unit consists of gently sloping, moderately well drained and well drained soils that have a silt loam surface layer. These soils are on till plains and moraines on uplands. They are in the Celina, Kendallville, and Miamian series.

These soils have a moderately deep root zone, moderate to moderately slow permeability, and medium available moisture capacity. In most places the root zone is medium acid to very strongly acid.

The erosion hazard is medium. Practices that help to control erosion and that maintain a good supply of plant nutrients and favorable soil tilth are needed.

Soils of this unit are suited to all the field crops, specialtly crops, and hay and pasture plants commonly grown in the county. Under intensive management, they can be used for cultivated crops year after year. If less than intensive management is used, erosion control is essential. An adequate plant cover is needed in pastures and hayfields.

CAPABILITY UNIT IIe-2

Morely silt loam, 2 to 6 percent slopes, the only soil in this unit, is moderately well drained. It formed in compact glacial till on uplands.

This soil has a moderately deep root zone, slow permeability, and medium available moisture capacity. In most places the root zone is strongly acid.

This soil is moderately eroded. The hazard of further erosion is moderate to severe. Runoff is rapid because permeability is slow in the clayey subsoil and the underlying compact glacial till. If erosion continues, the plow layer will be essentially subsoil material. Practices that help to control erosion and that maintain a good supply of plant nutrients and favorable soil tilth are needed.

The soil in this unit is suited to all the field crops, specialty crops, and hay and pasture plants commonly grown in the county. Under intensive management, it can be used for cultivated crops year after year. If less than intensive management is used, erosion control is essential. An adequate plant cover is needed in pastures and hayfields.

CAPABILITY UNIT IIe-3

This unit consists of gently sloping, well-drained soils that have a silt loam surface layer and a loamy subsoil and are 24 to 42 inches deep over sand and gravel. These soils are in the Fox and Warsaw series. They are on terraces, mostly along the major streams in the county.

The surface layer is easy to till. The root zone in most places is moderately deep and commonly is strongly acid. Permeability is moderate. Available moisture capacity is medium to low, depending on the thickness of the surface layer and subsoil.

The major limitation to use of these soils for row crops is a moderate hazard of erosion. Droughtiness in dry periods is also a hazard. The soils are well suited to irrigation if erosion is controlled. Keeping them in good tilth is difficult unless the crop provides a large amount of crop residue, especially where the surface layer is silt loam or is eroded. Warsaw soils have a higher content of organic matter and are easier to keep in good tilth than Fox soils.

Soils of this unit are suited to all of the field crops, hay and pasture plants, and specialty crops commonly grown in the county. Droughtiness makes them better suited to early maturing crops than to crops that mature late in summer. Where management is intensive, row crops can be grown year after year. Where management is less than intensive, practices that help to control erosion are needed. Practices that help to control erosion and that maintain good tilth are beneficial. An adequate plant cover is needed in pastures and hayfields.

CAPABILITY UNIT IIw-1

This unit consists of nearly level, moderately well drained and well drained soils that have a silt loam surface layer. These soils are in the Eel, Genesee, and Ross series. They are on flood plains subject to occasional flooding. Flooding generally occurs in winter and spring.

These soils have a deep root zone. In most places they are neutral to mildly alkaline. Permeability is moderate, and available moisture capacity is high.

Flooding is the main limitation. It is a greater hazard to winter cover crops and to crops grown in spring than to those grown in summer. During floods, more soil material generally is deposited than is lost through erosion. The lighter colored Eel and Genesee soils are susceptible to surface crusting. A crust is less likely to form on Ross soils because the content of organic matter is higher than in Eel and Genesee soils.

All these soils are well suited to specialty crops and to row crops grown in summer. Under intensive management, they can be cultivated year after year. They are well suited to irrigation.

Soils of this unit are well suited to adapted grasses and legumes grown for hay or pasture. Low areas subject to frequent flooding are better suited to permanent grass and trees than to cultivated crops.

CAPABILITY UNIT IIw-2

This unit consists of nearly level, somewhat poorly drained soils that have a silt loam surface layer. These soils are in the Algiers and Shoals series. They are in low areas on flood plains that are subject to occasional flooding.

These soils have a high water table during winter and spring. They remain wet until late in spring unless they are artificially drained. They have a deep root zone if they are adequately drained; the root zone generally is deep in summer. Reaction is commonly slightly acid or neutral. Permeability is moderate, and available moisture capacity is high.

Wetness and the hazard of flooding are the major limitations to use of these soils for crops. Maintaining good tilth is difficult because the soils are frequently worked when wet. If tilled when wet, the soils are likely to puddle and become cloddy.

Under intensive management, these soils can be used for cultivated crops year after year. There is little or no hazard of erosion.

If adequately drained, these soils are suited to most of the commonly grown field crops and hay and pasture plants that tolerate wetness. In areas where flooding is frequent, they should be protected by a permanent cover of grass or trees.

CAPABILITY UNIT IIw-3

This unit consists of nearly level, somewhat poorly drained soils that have a silt loam surface layer. These soils are in the Henshaw, Homer, Kane, and Sleeth series. The Homer, Kane, and Sleeth soils are underlain by gravel and sand at a depth of 30 to 60 inches. The Henshaw soils are underlain by stratified medium textured to moderately fine textured material below a depth of 35 to 45 inches.

These soils have a deep to moderately deep root zone if they are adequately drained. They are strongly acid to neutral. Permeability is moderate to slow, and available moisture capacity is medium.

Poor natural drainage and wetness are the major limitations to the use of these soils for crops. The soils are saturated, particularly in spring. They can be artificially drained.

These soils are suited to most of the field crops and hay pasture plants commonly grown in the county. Under intensive management, cultivated crops can be grown year after year. Crops that supply a large amount of residue are needed to keep the soils in good tilth. Where less than intensive management is used, practices that help to control erosion are needed on the more sloping Sleeth and Henshaw soils.

In undrained areas these soils are suited to most of the commonly grown field crops, but planting generally is delayed in spring. Hay and pasture plants that tolerate wetness can be seeded in undrained areas. There is little or no hazard of erosion in areas used for pasture or hay or protected by an adequate plant cover.

CAPABILITY UNIT IIw-4

This unit consists of nearly level, very poorly drained soils that have a dark-colored silty clay loam surface layer. These soils are in the Lippincott and Westland series. They are on low outwash terraces that are subject to flooding. They are underlain by gravel and sand at a depth of 24 to 60 inches.

These soils have a seasonal high water table during winter and spring. The root zone is deep or moderately deep. Reaction is commonly neutral to slightly acid. Permeability is moderate.

The major limitation to use of these soils for crops is a seasonal high water table. Surface crusting is no particular hazard because the content of organic matter is high. If tilled when wet, these soils, especially the Lippincott soil, are likely to become compacted and cloddy.

These soils can be drained easily. Where adequately drained, they are suited to the field crops, specialty crops, and hay and pasture plants commonly grown in the county. Under intensive management they can be cultivated year after year. There is little or no hazard of erosion. In some years undrained areas are too wet for crops to grow well.

These soils are suited to pasture, even in undrained areas. Pasture plants used for seeding should tolerate some soil wetness. The soils compact if pasture is grazed when wet, and the carrying capacity of the pasture decreases.

CAPABILITY UNIT IIw-5

This unit consists of nearly level to gently sloping, somewhat poorly drained soils that have a silt loam surface layer. These soils are in the Crosby, Odell, and Blount series. They formed in calcareous glacial till.

These soils have a moderately deep root zone if they are adequately drained. They are commonly slightly acid to strongly acid. Permeability is slow to moderate, and available moisture capacity is medium.

Poor natural drainage and wetness are the major limitations to use of these soils for crops. Part of the time the soils in this unit are saturated, particularly in winter and spring. They are subject to surface crusting in cultivated areas. The gently sloping Crosby and Blount soils are also subject to erosion.

Soils of this unit can be artificially drained. Where adequately drained, they are suited to most of the field crops (fig. 3), hay, and pasture plants commonly grown in the county. Under intensive management, cultivated crops can be grown year after year. Crops that supply a large amount of residue are needed to keep the soil in

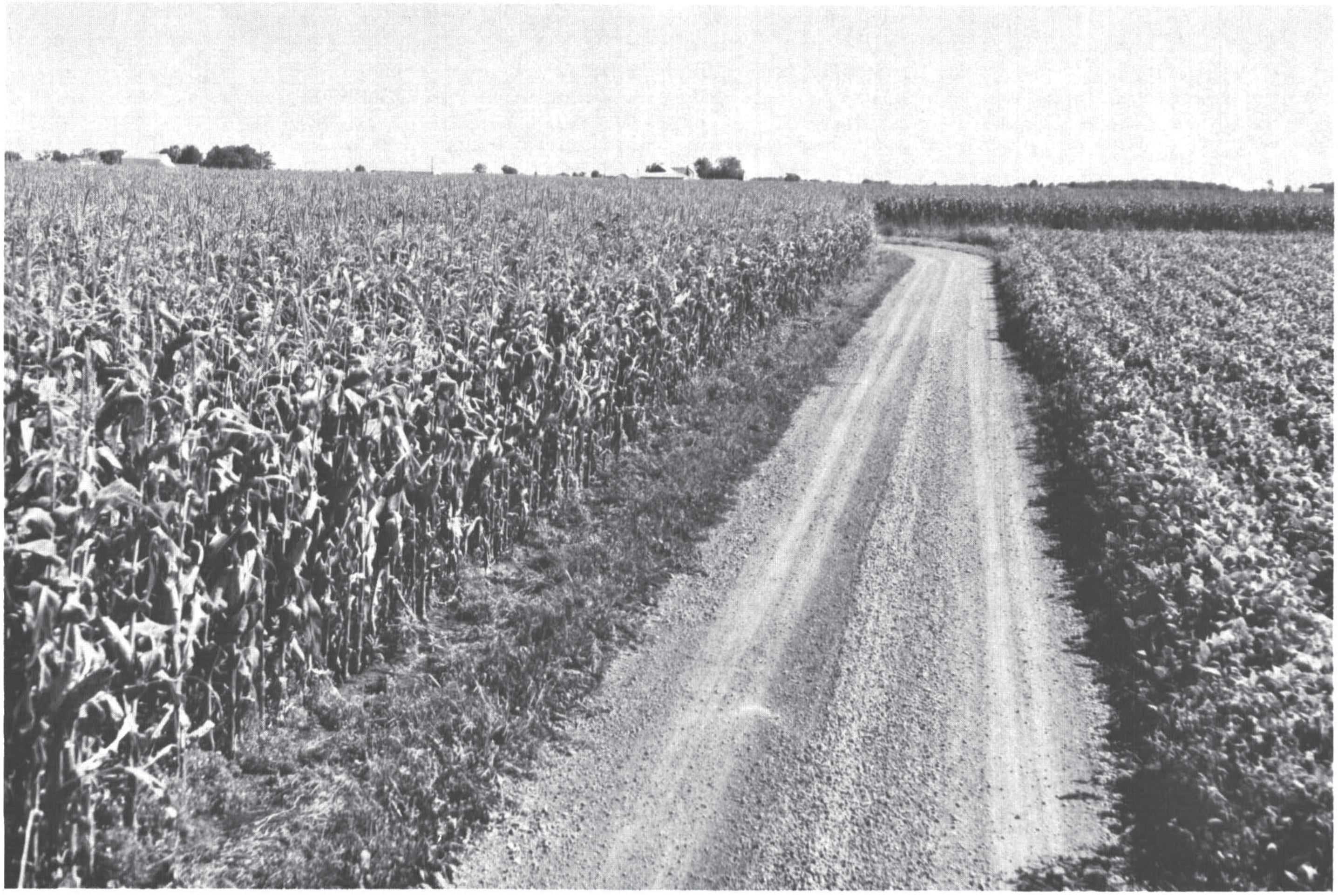

Figure 3.—Corn and soybeans on Blount soil.

good tilth. Where less than intensive management is used, practices that help to control erosion are needed in gently sloping areas. Undrained areas are suited to most of the commonly grown field crops, but planting generally is delayed in spring. Hay and pasture plants that tolerate wetness can be seeded in undrained areas. There is little or no hazard of erosion in areas used for pasture or hay or adequately protected by other vegetation.

CAPABILITY UNIT IIw-6

This unit consists of nearly level, very poorly drained soils that have a silty clay loam surface layer. These soils are in the Brookston, Pewamo, and Wetzel series. They are underlain by calcareous glacial till.

These soils have a seasonal high water table. They dry out slowly in spring unless they are adequately drained. In summer the root zone is normally deep or moderately deep. Reaction generally is slightly acid or neutral. Permeability is slow, and available moisture capacity is high or medium.

Poor natural drainage and wetness are the major limitations to use of these soils for crops. The soils can be tilled satisfactorily within only a narrow range of moisture content. They are easily compacted and become cloddy if they are tilled or used for pasture when wet.

Where drainage is adequate and management is intensive, cultivated crops can be grown year after year. Unless adequate drainage is provided, these soils are too wet for cultivated crops in most years.

Drained areas are suited to most of the commonly grown pasture and hay plants, including alfalfa. Undrained areas are suited only to pasture and hay plants that can tolerate wetness for long periods.

CAPABILITY UNIT IIs-1

Fox silt loam, 0 to 2 percent slopes, the only soil in this unit, is well drained. It is 24 to 42 inches deep over stratified sand and gravel. It is on low terraces along streams and is occasionally flooded.

This soil has a moderately deep root zone. It commonly is strongly acid. Available moisture capacity is low to medium, and permeability is moderate.

The major limitation to use of this soil for crops is the low to medium available moisture capacity.

This soil is well suited to field crops, specialty crops, and hay and pasture plants commonly grown in the county. Because it is droughty, it is better suited to early maturing crops than to crops that mature late in summer. It is well suited to irrigation. Crops that supply a large amount of crop residue help to keep the soil in good tilth and to conserve moisture by increasing the content of organic matter. There is little or no hazard of erosion.

Generally, this soil is not used for pasture. It is suited to pasture plants that are drought resistant.

CAPABILITY UNIT IIIe-1

This capability unit consists of sloping, well drained soils that have a silt loam surface layer and are moderately eroded. These soils are in the Fox and Miamian series. The Fox soils are moderately deep over sandy and gravelly material, and the Miamian soils are moderately deep over compact glacial till.

These soils are easy to cultivate. They generally are medium acid to strongly acid. They mostly have moderate permeability and low to medium available moisture capacity.

The major limitation to use of these soils for cultivated crops is a severe hazard of further erosion. Droughtiness also is a limitation during dry periods. Because the content of organic matter generally is low, maintaining favorable soil structure is difficult.

Soils of this unit are suited to field crops, specialty crops, and hay or pasture plants commonly grown in the county. Because they are droughty, they are better suited to early maturity crops than to late maturing crops. Returning a large amount of crop residue to the soils is essential so that water will enter the soils readily and good soil structure can be maintained. Row crops can be grown frequently if the cropping system includes crops that are not clean tilled. Close-growing crops and grasses or legumes are needed to help control erosion and to supply a large amount of crop residue. These sloping soils can be irrigated, but controlling erosion is difficult.

CAPABILITY UNIT IIIe-2

This unit consists of gently sloping soils that have a silt loam surface layer and are underlain by glacial till. These soils are in the Morley, St. Clair, and Blount series. Morley and St. Clair soils are moderately well drained, and Blount soils are somewhat poorly drained.

These soils have a moderately deep root zone that is commonly medium acid to very strongly acid. Permeability is slow to very slow, and available moisture capacity is medium.

Most of the acreage is moderately eroded, and the hazard of further erosion is severe. Practices that help to control erosion and that maintain a good supply of plant nutrients and favorable tilth are needed. Blount soils are wet during winter and spring, and drainage is needed to avoid delay in tillage.

Soils of this unit are suited to all field crops and hay and pasture plants commonly grown in the county. Cultivated crops can be grown frequently. Under intensive management, the cropping system includes close-growing crops and sod or pasture plants. Where less than intensive management is used, soil loss generally is high and tilth is poor.

These soils are well suited to grasses and legumes grown for hay or pasture. An adequate plant cover is needed in hayfields and pastures to protect the soils from erosion.

CAPABILITY UNIT IIIe-3

This unit consists of eroded and uneroded soils in the Morley series. These soils are moderately well drained, have a silt loam surface layer, and are underlain by compact glacial till.

These soils have a moderately deep root zone. They are commonly strongly acid. Permeability is slow, and available moisture capacity is medium. These soils are saturated for short periods, mostly in the spring, and tillage is delayed.

The major limitation to use of these soils for crops is the hazard of further erosion. Controlling erosion is the major management requirement. Maintaining a good supply of plant nutrients and a high content of organic matter is also essential. The soils are subject to surface crusting if they are cultivated.

The soils of this unit are suited to field crops commonly grown in the county. Erosion is difficult to control. If it is controlled, cultivated crops can be grown frequently. Under intensive management, the cropping system includes close-growing crops and sod or pasture plants. Where less than intensive management is used, soil loss generally is high and tilth is poor.

These soils are well suited to grasses and legumes grown for hay or pasture. An adequate plant cover is needed in the hayfields and pastures to help protect these soils from erosion.

CAPABILITY UNIT IIIw-1

This unit consists of nearly level and gently sloping soils of the Nappanee series and nearly level soils of the Paulding series. The somewhat poorly drained Nappanee soils have a silt loam surface layer, and the very poorly drained Paulding soils have a silty clay surface layer. These soils are underlain by clayey glacial till.

These soils have a seasonal high water table. If adequately drained, they have a moderately deep root zone. Permeability is very slow, and available moisture capacity is medium. Reaction is commonly slightly to strongly acid in Nappanee soils and medium acid to neutral in Paulding soils.

Poor natural drainage and wetness are the major limitations to use of these soils for crops. The soils can be tilled satisfactory within only a narrow range of moisture content. They are easily compacted and become cloddy if tilled or used for pasture when wet. Because the content of organic matter is high, these soils are not particularly susceptible to surface crusting. The gently sloping Nappanee soils are subject to erosion if used for clean-tilled row crops.

If adequately drained and under intensive management, these soils can be used for cultivated crops year after year. Otherwise, they are too wet for cultivated crops in most years.

Drained areas of these soils are suited to most of the commonly grown pasture and hay crops, including alfalfa. Undrained areas are suited only to pasture and hay crops that can tolerate wetness for long periods.

CAPABILITY UNIT IIIw-2

This unit consists of very poorly drained soils that are subject to ponding or flooding. These soils are in the

Montgomery, Muskego, and Sloan series. They have a dark-colored surface layer. The surface layer of Montgomery and Sloan soils is silty clay loam, and that of Muskego soils is muck. Both are dark colored.

Sloan soils are subject to flooding. Montgomery soils are on low stream terraces and in depressions in the uplands. They generally are at a slightly higher elevation than Sloan soils. They are subject to shallow flooding and to ponding. Muskego soils are in low-lying, swampy areas and are subject to ponding. Most flooding and ponding occurs in winter and spring.

These soils have a seasonal high water table and dry out slowly in spring. The root zone is deep if the soils are adequately drained. Reaction ranges from slightly acid to mildly alkaline. Available moisture capacity is high to very high. Permeability is very slow to moderately slow in the Montgomery and Sloan soils and moderately rapid in Muskego soils.

Very poor natural drainage and the hazard of flooding are limitations to the use of these soils for crops. Drains can be installed if suitable outlets are available. Muskego soils are subject to subsidence, but this limitation can be overcome by controlling the level of the water table. During dry periods, Muskego soils are subject to soil blowing.

Unless artificially drained, these soils generally are too wet for cultivated crops. Where adequately drained, they are suited to summer-grown row crops. They are not so well suited to winter small grain because flooding is a hazard. Under intensive management, cultivated crops can be grown year after year. Muskego soils are well suited to specialty crops. These organic soils are also suited to high value irrigated truck crops.

The soils in this unit generally are well suited to pasture grasses and legumes that can tolerate wetness. Areas that are not readily drained or that are frequently flooded can be kept in permanent pasture or trees.

CAPABILITY UNIT IVe-1

This unit consists of sloping to moderately steep, moderately well drained and well drained soils that have a silt loam surface layer. These soils are in the Miamian, Morley, and St. Clair series. They are on uplands and are underlain by glacial till.

These soils have a moderately deep root zone. They commonly are strongly acid to very strongly acid. Permeability ranges from very slow to moderately slow, and available moisture capacity is medium.

In most areas the soils are moderately eroded and the hazard of further erosion is severe. Controlling erosion is the major management requirement. Maintaining good tilth and a good supply of plant nutrients is also important. All the soils are low in content of organic matter. As a result, they are subject to surface crusting, and clods form if they are tilled when too wet or too dry. Poor germination of seed is likely in cloddy areas.

These soils are suited to the grasses, legumes, and other crops commonly grown in the county. Cultivated crops should be grown infrequently, and control of erosion is essential. Intensive management is needed. The cropping sequence should consist mostly of grasses or legumes grown for pasture (fig. 4) or hay.

CAPABILITY UNIT VIe-1

This unit consists of steep and very steep, well-drained soils that have a silt loam surface layer. These soils are in the Miamian and Morely series. They are adjacent to drainageways in uplands and are underlain by glacial till. Limy glacial till is exposed in some places.

These soils are mostly moderately eroded. Except in severely eroded areas, they generally are strongly acid. They have a moderately deep root zone. The content of organic matter is low, and available moisture capacity is medium to low.

Steep slopes and a severe hazard of erosion are the major limitations to use of these soils for crops. Runoff is rapid. The content of organic matter is low.

These soils are too steep and too eroded to be used for cultivated crops. They are well suited to hay or pasture plants. The carrying capacity of pasture generally is low during dry periods.

CAPABILITY UNIT VIIe-1

Morley silt loam, 25 to 50 percent slopes, moderately eroded, the only soil in this unit, is adjacent to drainageways. It is moderately well drained, has a silt loam surface layer, and is underlain by compact glacial till. Limy glacial till is exposed in some places. The root zone is moderately deep. Reaction commonly is strongly acid, except where the underlying limy glacial till is exposed. Available moisture capacity is medium to low.

This soil is too steep for cultivated crops or hay and for farm equipment. Its use for permanent pasture is limited, and pastures generally have low carrying capacity. The hazard of erosion is very severe if the plant cover is removed.

This soil is suited to trees. Its use as woodland would help protect watersheds.

Estimated yields

Table 1 shows estimated yields per acre of the principal crops under two levels of management. The yields are averages expected over a period of several years. Only arable soils and soils suited to the specified crops are listed.

Figures in columns A indicate yields obtained under improved management. Those in columns B indicate yields obtained under optimum management. Under optimum management—

1. Intake of water into the soil and available moisture capacity are increased. Excess water is disposed of by appropriate means.
2. Management provides for erosion control.
3. Suitable methods are used in plowing, preparing the seedbed, and cultivating.
4. Weeds, diseases, and insects are controlled.
5. Fertility is maintained at the highest level. Lime and fertilizer are applied according to needs of the soil and crop. The fertilizer contains trace elements, such as zinc, cobalt, manganese, and copper, if they are needed.
6. Crop varieties suited to the soil are selected.
7. All field work is done at the proper time and in the proper way.

Figure 4.—**St. Clair soils are well suited to pasture.**

An improved level of management consists of some, but not all, of the practices listed under optimum management, or practices that are not adequate for the needs of the crops.

The yields given in table 1 do not apply to a specific field for any particular year because the soils vary from place to place, management practices vary from farm to farm, and the weather varies from year to year.

The yields are intended only as a guide to show relative productivity of the soils, the response of soils to management, and the relationship of soils to each other. Although the general level of crop yields may change as new methods and new crop varieties are developed, the relationship of the soils to each other is not likely to change.

The estimates of yields given in table 1 are based primarily on information obtained from farmers and on observations and field trials made by the county agent and district conservationists of the Soil Conservation Service. They are also based on experiments made by the Ohio Agricultural Research and Development Center and on field observations made by members of the soil survey party.

Irrigation

Irrigation requires very intensive management. In Union County irrigation is used mostly for growing such specialized crops as lawn grasses for commercial testing, nursery stock, and apple and peach trees. Sprinkler irrigation is the method most commonly used.

Generally, soils well suited to irrigation absorb water readily, have adequate available moisture capacity, and have good drainage. The soils in Union County considered suitable for irrigation are the nearly level and gently sloping Fox, Kendallville, and Warsaw soils. Other soils in the county can be irrigated, depending on the type of crop grown, the soil characteristics, and the weather conditions. Erosion is a hazard on gently sloping soils that are irrigated. Additional information on irrigability of Union County soils can be found in the section "Engineering Uses of the Soils."

The water supply for irrigation in Union County is limited (*11*).[1] Wells in most places yield only enough water for domestic use. Streamflow varies, and the irrigation water supply from this source is not dependable. Most farm ponds can be used for irrigating only a very limited acreage.

Waste water from industrial plants can be used for irrigation if pollutants have been removed. Industrial waste diverted to a natural stream pollutes the stream. Where no outlet for industrial waste is available except through a stream, the pollutants should be eliminated

[1] Italic numbers in parentheses refer to Literature Cited, p. 78.

TABLE 1.—*Estimated yields per acre of principal crops on arable soils under two levels of management*

[Figures in columns A indicate yields to be expected under improved management; figures in columns B indicate yields to be expected under optimum management. Absence of figure indicates that the crop is not commonly grown under the management level indicated]

Soil	Corn		Wheat		Oats		Soybeans		Alfalfa-grass hay [1]	
	A	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*
Algiers silt loam	75	125	35	45	60	80	25	40	2.6	4.5
Blount silt loam, 0 to 2 percent slopes	80	110	34	46	60	80	33	46	3.0	5.0
Blount silt loam, 2 to 6 percent slopes	75	105	32	46	60	80	30	40	3.0	5.0
Blount silt loam, 2 to 6 percent slopes, moderately eroded	75	95	30	44	55	75	28	38	3.0	5.0
Brookston silty clay loam	90	130	40	54	66	86	34	44	3.5	5.0
Celina silt loam, 0 to 2 percent slopes	75	115	35	45	60	80	30	40	3.5	5.0
Celina silt loam, 2 to 6 percent slopes	75	110	30	45	45	70	30	40	2.6	5.0
Crosby silt loam, 0 to 2 percent slopes	65	110	25	40	42	70	30	40	3.0	5.0
Crosby silt loam, 2 to 6 percent slopes	51	115	30	40	50	75	30	40	3.0	5.0
Eel silt loam	80	115	34	44	50	76	28	40	3.0	5.0
Fox silt loam, 0 to 2 percent slopes	60	95	26	40	50	76	23	32	3.0	4.5
Fox silt loam, 2 to 6 percent slopes	60	95	26	40	50	76	22	32	3.0	4.5
Fox silt loam, 2 to 6 percent slopes, moderately eroded	55	90	24	38	48	74	22	32	3.0	4.5
Fox silt loam, 6 to 12 percent slopes, moderately eroded	50	85	20	36	40	66	18	26	2.0	3.0
Genesee silt loam	80	125	38	48	50	80	30	46	3.0	5.0
Henshaw silt loam, 0 to 2 percent slopes	70	110	26	40	46	76	26	40	3.0	5.0
Homer silt loam	60	90	22	36	46	76	22	34	3.0	4.5
Kane silt loam	65	95	22	38	48	78	24	36	3.0	4.5
Kendallville silt loam, 0 to 2 percent slopes	80	110	35	45	45	73	24	34	3.0	4.5
Kendallville silt loam, 2 to 6 percent slopes	80	110	35	45	45	73	24	34	3.0	4.5
Lippincott silty clay loam	90	125	40	54	66	86	34	44	3.2	4.6
Miamian silt loam, 2 to 6 percent slopes	60	100	30	40	55	80	22	40	3.0	4.5
Miamian silt loam, 6 to 12 percent slopes, moderately eroded	50	85	26	36	46	70	20	26	2.5	4.0
Miamian silt loam, 12 to 18 percent slopes, moderately eroded	35	75	17	26	28	45	12	20	1.5	2.8
Miamian silt loam, 18 to 35 percent slopes, moderately eroded	------	------	------	------	20	46	------	------	1.5	2.5
Montgomery silty clay loam	75	125	24	44	60	85	28	42	3.0	5.0
Morley silt loam, 2 to 6 percent slopes	60	90	30	42	52	70	24	34	3.0	4.5
Morley silt loam, 2 to 6 percent slopes, moderately eroded	60	95	28	40	40	70	20	34	2.5	4.0
Morley silt loam, 6 to 12 percent slopes	60	95	28	40	40	70	20	34	2.5	4.0
Morley silt loam, 6 to 12 percent slopes, moderately eroded	60	90	28	40	38	68	18	32	2.5	4.0
Morley silt loam, 12 to 18 percent slopes, moderately eroded	45	75	20	34	36	65	------	------	2.5	4.0
Morley silt loam, 18 to 25 percent slopes, moderately eroded	------	------	------	------	20	46	------	------	1.5	2.5
Morley silt loam, 25 to 50 percent slopes, moderately eroded	------	------	------	------	------	------	------	------	1.5	2.5
Muskego muck	90	120	30	40	------	------	------	------	------	------
Nappanee silt loam, 0 to 2 percent slopes	70	95	36	44	50	72	26	34	3.0	4.5
Nappanee silt loam, 2 to 6 percent slopes	70	95	36	44	50	70	24	30	3.0	4.5
Odell silt loam, 0 to 2 percent slopes	80	115	26	40	50	76	30	40	3.0	5.0
Paulding silty clay	66	100	30	38	38	58	26	38	2.5	4.0
Pewamo silty clay loam	90	130	40	54	66	86	34	44	3.5	5.0
Ross silt loam	95	125	38	48	54	80	32	46	3.0	5.0
St. Clair silt loam, 2 to 6 percent slopes	60	90	30	40	50	76	24	34	2.5	4.5
St. Clair silt loam, 2 to 6 percent slopes, moderately eroded	55	85	26	38	48	72	22	30	2.2	3.8
St. Clair silt loam, 6 to 12 percent slopes	50	80	24	34	44	68	20	28	2.0	3.2
St. Clair silt loam, 6 to 12 percent slopes, moderately eroded	45	75	22	32	42	66	18	26	1.9	2.9
Shoals silt loam	67	105	28	40	50	75	28	40	3.0	5.0
Sleeth silt loam, 0 to 2 percent slopes	80	115	26	40	60	76	30	40	2.5	4.5
Sloan silty clay loam	80	110	30	44	50	70	30	46	3.0	5.0
Warsaw silt loam, 1 to 4 percent slopes	75	110	28	40	52	75	28	40	3.5	4.5
Westland silty clay loam	80	130	26	40	50	76	28	38	3.0	5.0
Wetzel silty clay loam	85	125	38	52	64	84	32	42	3.0	5.0

[1] Cow-acre-days, a term used to express the carrying capacity of pasture, is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30 days of grazing for two cows has a carrying capacity of 60 cow-acre-days. Pasture yields in cow-acre-days can be calculated by converting tons of alfalfa-grass hay to pounds (multiply by 2,000) and dividing total pounds by 40.

before the waste water is delivered to the stream. The site for disposal of pollutants should be selected carefully to prevent contamination of the underground water supply. Some soils are not deep enough to insure adequate filtration.

Woodland

When the first settlers arrived, most of Union County was wooded. Trees were mainly hardwoods. Today, after a century and a half of agricultural development, only about 19,000 acres, or 8 percent of the county, is woodland.

The areas now wooded are small, widely scattered woodlots. These woodlots have been downgraded in quality by repeated cutting of the best trees. Only the poorer quality specimens and less desirable species have been left for future growth.

Compared with the returns from the sale of other farm products, income from the sale of wood products is small. Some good quality logs of red oak, white oak, and black walnut are still cut from the better managed woodland, however, and these bring a good return when sold. Farm woodlots are a source of wood for fireplaces and lumber for rough construction and of edible nuts and maple syrup. Production of maple syrup has declined. The demand for fireplace wood and for clear, high-quality logs has increased. Consequently, there is need for improving the care and quality of stands of sugar maple, white and red oaks, and black walnut trees through planting and through management of existing woodland.

In addition to adding to farm income, woodland provides esthetic benefits that cannot be measured in monetary terms. Trees add natural beauty to the landscape and provide a more desirable environment.

Woodland is becoming increasingly more important for its recreational value. As the population increases, the need increases for more areas of woodland for camping, hiking, and hunting.

The total acreage of woodland in Union County can be increased by planting programs adapted to the various kinds of soils. All of the soils in the county are suited to selected species. Steep or eroded soils are particularly suited to a woodland type of permanent cover. A transitional crop of conifer trees would improve soil and site conditions in most newly planted open areas. In time these sites would support high-quality hardwoods, similar to those in native woodland.

Because most of the soils are too valuable for crops to be used extensively for trees, information about potential productivity of the soils in terms of board feet per acre is limited. Table 2 shows the results of studies of site index and of potential yield (fig. 5) in board feet per acre on soils in nearby counties that are similar to those in Union County. The site index is the average height, in feet, of the dominant trees in a stand at 50 years of age. It is used to measure the potential of a soil for producing forest trees (7).

Determining the suitable kinds of trees for planting and for favoring in existing woodland depends, to a great extent, on drainage of the soils. Some trees grow well only on well drained or moderately well drained soils. Others grow best in moist areas. In the following paragraphs are examples of soils in this county grouped according to natural drainage and trees that grow best on the soils of each group.

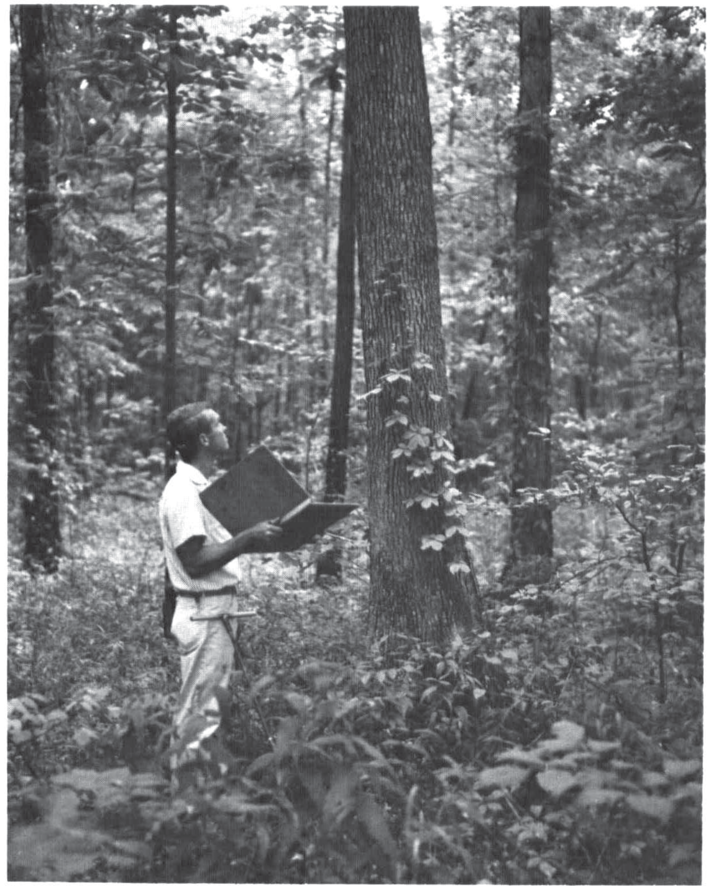

***Figure 5.*—Evaluating white oak on Crosby soil.**

Well drained and moderately well drained soils.—Examples of these soils are the Miamian, Celina, and Fox soils. Trees to be favored in existing stands are red oak, white oak, tulip-poplar, and black walnut. Species suitable for interplanting in wooded areas are black walnut, white pine, tulip-poplar, red pine, and black locust.

Somewhat poorly drained soils.—Examples of these soils are the Blount and Henshaw. Trees to be favored in existing stands are bur oak, white ash, and soft maple. Species suitable for planting in woodland openings are white pine, soft maple, and white ash.

Poorly drained soils of bottom lands.—The Sloan soils are examples of these soils. Trees to be favored in existing stands are sweetgum, pin oak, bur oak, and soft maple. Species suitable for planting in woodland openings are white pine, soft maple, and white ash.

Very poorly drained soils.—Examples of these wet soils are the Pewamo and Lippincott. Trees to be favored in existing stands are sweetgum, pin oak, soft maple, and white ash. Trees are not generally planted on these soils, nor on Muskego muck.

Windbreaks have been planted on a few farms in the county, mainly to protect the farmstead from winds in winter and early in spring. These windbreaks also add beauty to the landscape. If planted in the proper places,

TABLE 2.—*Representative potential woodland yields*

Soil series	Species of trees	Number of plots sampled	Site index [1]	Potential yield
				Board feet per acre per year
Brookston.	Swamp white oak	2	77	290
Celina.	Upland oaks	2	90	420
	Tulip-poplar	1	110	800
Crosby.	Upland oaks	3	72	250
	Tulip-poplar	1	92	550
Fox.	Upland oaks	3	81	330
Miamian.	Upland oaks	7	79	310
	Tulip-poplar	4	94	565
	White pine	1	83	880

[1] An expression of site quality based on the average height, in feet, of the dominant trees at 50 years of age.

they prevent drifting snow from blocking the roads. By reducing the velocity of the wind near the ground and holding snow where it falls, windbreaks also conserve soil and moisture.

Evergreens are suitable for planting in windbreaks, and they are more effective in winter than deciduous trees. Norway spruce, Austrian pine, white pine, and arborvitae grow on most of the soils in this county.

Detailed information about the potential of individual soils for producing wood fibre and about the major management limitations of the soils for woodland production is available from the county office of the Soil Conservation Service.

Information on general forest management is available from the County Agricultural Extension Agent, the Ohio Department of Natural Resources, Division of Forestry, the Agricultural Stabilization and Conservation Service, and the Soil Conservation Service.

Wildlife

Wildlife is an important natural resource in Union County. Since the early days of settlement and clearing of the land, the wildlife in the county has changed in kind, distribution, and numbers. Because of changes in land use and the resulting changes in wildlife distribution, it is difficult to correlate the kinds and numbers of wildlife with specific soils.

All of the soils, however, have some potential for producing the elements of habitat necessary to wildlife survival. Table 3 shows the potential of each soil in the county for eight selected elements of wildlife habitat and for openland, woodland, and wetland wildlife.

The ratings in table 3 are expressed numerically. The numeral 1 indicates well suited; 2, suited; 3, poorly suited; and 4, not suited. Soils that are *well suited* have few limitations, those that are *suited* have moderate limitations, and those that are *poorly suited* have severe limitations. Not considered in the rating are present land use, the location of a soil in relation to other soils, and the mobility of wildlife. Ratings are based on the natural drainage of the soil. Artificial drainage can change the ratings indicated on table 3. Drained areas of very poorly drained soils are seldom used as habitat. The information that follows can be used in—

1. Broad-scale planning of the use of soils for parks, wildlife refuges, nature-study areas, and other recreational developments.
2. Selecting the better sites for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the degree of management intensity required for individual habitat elements.
4. Eliminating sites on which management for specific kinds of wildlife is difficult or not feasible.
5. Determining areas suitable for acquisition for wildlife use.

The headings in table 3 are explained in the following paragraphs (*1*).

Grain and seed crops include corn, sorghum, soybeans, wheat, barley, oats, rye and other seed-producing annuals. Ragweed, smartweed, foxtail, and other annual weeds that occur with grain crops benefit both game and songbirds.

Grasses and legumes are domestic grasses and legumes that are established by planting. Among the plants are bluegrass, fescue, smooth brome, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil and alfalfa. On soils that are rated *well suited* many kinds of plants suited to the climate can be maintained in adequate stands for at least 10 years. These soils have slopes of 0 to 12 percent, are well drained or moderately well drained, and have moderately high or high available moisture capacity. Occasional flooding and stones in the surface layer are not serious concerns, because the soils are seldom tilled.

Wild herbaceous upland plants are perennial grasses and weeds that generally are established naturally. They include switchgrass, milkweed, thistles, daisies, goldenrod, nightshade, and dandelion. Soils that are well suited to these plants vary widely in texture, drainage, and slope. If drainage ranges between good and somewhat poor, slope is not limiting. Stoniness and occasional flooding are not serious concerns.

Hardwoods and woody plants are nonconiferous trees, shrubs, and woody vines that produce nuts, fruits, buds, catkins, twigs, or foliage that wildlife eat. They generally are established naturally, but they are planted in some places. Among the native trees and other plants are oak, beech, cherry, maple, hickory, poplar, aspen, walnut, dogwood, roses and briers. Soils well suited to these plants are deep or moderately deep, medium textured or moderately fine textured, and moderately well drained to somewhat excessively drained. Slope and stones on the surface and in the surface layer are of little significance.

Also in this group are several varieties of fruiting shrubs that are grown commercially for planting. Autumn-olive, Amur honeysuckle, Tartarian honeyshuckle, crabapple, multiflora rose, viburnum, and dogwood are some of the shrubs that generally are available and can be planted on soils that are rated well suited to hardwood

TABLE 3.—*Suitability of soils for elements of wildlife habitat and kinds of wildlife*

[The numeral 1 denotes well suited; 2, suited; 3, poorly suited; and 4, not suited. No rating is given Cu, Gp, and Qu]

Soil series and map symbols	Wildlife habitat elements								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Ponds	Openland	Woodland	Wetland
Algiers: Ag	3	2	2	1	2	2	2	4	2	1	2
Blount:											
BoA	2	2	2	2	3	2	2	2	2	2	2
BoB, BoB2	2	2	2	2	3	3	4	4	2	2	4
Brookston: Bs	4	3	3	1	1	1	1	1	3	2	1
Celina:											
CeA	1	1	1	1	3	3	3	3	1	1	3
CeB	1	1	1	1	3	4	4	4	1	1	4
Crosby:											
CrA	2	2	1	1	3	2	2	2	1	2	2
CrB	2	2	1	1	3	3	3	4	1	2	4
Eel: Ee	2	1	1	1	3	3	3	3	1	1	3
Fox:											
FoA	1	1	1	1	3	4	4	4	1	1	4
FoB, FoB2	2	1	1	1	3	4	4	4	1	1	4
FoC2	2	1	1	1	3	4	4	4	2	2	4
Genesee: Gn	1	1	1	1	3	4	4	4	1	1	4
Henshaw: HeA	2	2	1	1	3	2	2	2	1	2	2
Homer: Ho	2	2	1	1	3	2	2	4	1	2	3
Kane: Ka	2	2	1	1	3	2	2	4	1	2	3
Kendallville: KeA, KeB	1	1	1	1	3	4	4	4	1	1	4
Lippincott: Lc	4	3	3	1	1	1	1	3	3	1	2
Miamian:											
MlB	1	1	1	1	2	4	4	4	1	1	4
MlC2	2	1	1	1	3	4	4	4	1	1	4
MlD2, MlF2	3	2	1	1	3	4	4	4	2	2	4
Montgomery: Mn	4	3	3	1	1	1	1	1	3	1	1
Morley:											
MrB, MrB2	2	1	1	1	3	3	3	3	1	1	3
MrC, MrC2	2	1	1	1	3	4	4	4	1	1	4
MrD2, MrE2, MrF2	3	2	1	1	3	4	4	4	2	2	4
Muskego: Mu	4	4	4	4	4	3	1	1	4	4	2
Nappanee:											
NpA	2	2	2	1	3	2	2	2	2	2	2
NpB	2	2	2	1	3	3	4	4	2	2	4
Odell: OdA	2	2	1	1	3	2	2	2	1	2	2
Paulding: Pa	3	3	3	1	1	3	1	1	3	1	2
Pewamo: Pm	4	3	3	1	1	1	1	1	3	2	1
Ross: Ro	2	1	1	1	3	4	4	4	1	1	4
St. Clair:											
ScB, ScB2	2	2	2	2	3	4	4	4	2	3	4
ScC, ScC2	2	2	2	2	3	4	4	4	2	3	4

TABLE 3.—*Suitability of soils for elements of wildlife habitat and kinds of wildlife*—Continued

Soil series and map symbols	Wildlife habitat elements								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Ponds	Openland	Woodland	Wetland
Shoals: Sh	2	2	1	1	3	2	2	3	1	2	2
Sleeth: SlA	2	2	1	1	3	2	2	4	1	2	3
Sloan: So	4	3	3	1	1	1	1	3	3	2	1
Warsaw: WaB	2	1	1	1	3	4	4	4	1	1	4
Westland: Wc	4	3	3	1	1	1	1	1	3	1	1
Wetzel: We	4	3	3	1	1	1	1	1	3	2	1

woody plants. Hardwoods that are not available commercially commonly can be transplanted successfully.

Coniferous woody plants are cone-bearing evergreen trees and shrubs that are used by wildlife primarily as cover, though they also provide browse and seeds. Among these are Norway spruce, white pine, arborvitae, redcedar, and juniper. The plants generally are established naturally in areas where the cover of weeds and sod is thin. The soils that are well suited to coniferous wildlife habitat are those on which plants grow slowly and closure of the canopy is delayed. It is important that branches are kept close to the ground so that food and cover are readily available to rabbits, pheasants, and other birds and small animals. If the trees quickly form a dense canopy that shuts out the light, the lower branches die.

On soils rated poorly suited to coniferous wildlife habitat, widely spaced plants may quickly but temporarily produce desired growth characteristics. The establishment or maintenance, however, is difficult because these soils are well suited to competing hardwoods. Unless the stand is carefully managed, hardwoods invade and commonly overtop the conifers.

Wetland food and cover plants are wild, herbaceous, annual and perennial plants that grow on moist to wet sites They include smartweed, wild millet, rush, bulrush, spikerush, sedges, burreed, buttonbush, rice cutgrass, and cattails. Soils that are well suited to these plants are nearly level and poorly drained or very poorly drained. Soils that are suited are nearly level and are somewhat poorly drained or frequently flooded. Depth, stoniness, and texture of the surface layer are of little concern.

Shallow water developments are impoundments or excavations that provide areas of shallow water near food and cover for wetland wildlife. Examples of such developments are shallow dugouts, level ditches, blasted potholes, and devices that keep the water 6 to 24 inches deep in marshes. Plants suited to these sites are water lilies, spatterdock, and such submerged aquatic plants as pondweed, water mulfoil, najas, and filamentous algae. Soils that are rated well suited to this use are nearly level, more than 36 inches deep over bedrock, and poorly drained or very poorly drained. Soils rated suited are nearly level and somewhat poorly drained and are only 20 to 36 inches deep over bedrock in places.

Ponds are dug-out areas, or a combination of these and impoundments behind low dikes, in which the water is at a depth suitable for the production of fish or wildlife. If fish are produced, part of the pond should be at least 8 feet deep. Soils that are rated well suited are nearly level, more than 96 inches deep, and poorly drained or very poorly drained. In constructing an excavated impoundment, the difficulty or degree of limitation increases as slope increases, and this increase reduces the feasible size of a pond.

Openland wildlife includes pheasant, quail, redwing blackbirds, meadowlarks, field sparrows, grasshopper sparrows, mourning doves, cottontail rabbits, red foxes, and woodchucks. These birds and mammals normally make their home in areas of cropland, pasture, meadow, and lawns and in areas overgrown with grasses, herbs, and shrubs. They are also found along the fencerows and borders associated with open land.

Woodland wildlife are birds and mammals that prefer woodland habitat. Examples in Union County are woodcock, thrushes, vireos, tanagers, gray squirrels, fox squirrels, gray foxes, white-tailed deer, racoons, opossum, and woodpeckers. They obtain food and cover in stands of hardwoods, coniferous trees, shrubs, or a mixture of these plants. They occasionally use openland or wetland near the woodland.

Wetland wildlife are ducks, geese, rails, herons, shore birds, mink, and muskrats. These birds and mammals normally make their home in wet areas, such as ponds, marshes, and swamps.

Each rating under "Kinds of wildlife" in table 3 is based on the ratings listed for the habitat elements in the first part of the table. For openland wildlife, the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood plants, and coniferous woody plants. The rating for woodland wildlife is based on the ratings listed for all the elements except grain and seed crops. For wetland wildlife, the rating is based on the ratings shown for wetland food and cover plants, shallow water developments, and ponds.

Engineering Uses of the Soils [2]

Some soil properties are of interest to engineers, because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, irrigation and drainage systems, and sewage disposal systems. Among the soil properties important to engineers are permeability, shear strength, compaction characteristics, drainage, shrink-swell potential, dispersion, grain size, plasticity, and soil reaction. Depth to the water table, depth to bedrock, available water capacity, and topography are also important. Results of tests on soil samples from Union County are given in table 4; estimates of the soil properties significant in engineering are given in table 5; and interpretations relating to engineering uses of the soils are shown in table 6. The estimates and interpretations of soil properties in these tables can be used in—

1. Planning of agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.
3. Locating probable sources of sand, gravel, or rock suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.

The engineering interpretations, along with the use of the soil map to identify the soils, give information useful in planning more detailed field investigations and in indicating the kinds of problems that can be expected. They do not eliminate the need for sampling and testing at the site of specific engineering works.

Some of the terms used by soil scientists have a special meaning in soil science that may not be familiar to engineers. These terms are defined in the Glossary.

Engineering classification systems

Two systems of classifying soils are in general use among engineers.

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (AASHO) (*2*). This system of classification is based on grain-size gradation, liquid limit, plasticity index, and field performance of highways. In the AASHO system, soil materials are classified in seven principal groups. The groups range from A–1, which consists of soils that have the highest bearing strength and are the best soils for subgrade, to A–7, which consists of soils that have the lowest strength when wet. Within each group, the relative engineering value of a soil is indicated by group index numbers that range from 0 for the best material to 20 for the poorest. The group index number is given in parentheses after the soil group symbol, for example, A–7–5(17), in table 4.

Some engineers prefer to use the Unified soil classification system established by the U.S. Department of Defense (*14*). In this system the soils are identified according to texture and plasticity and are grouped according to their performance as engineering construction materials. Soil materials are identified as coarse grained (eight classes), fine grained (six classes), and highly organic.

Engineering test data

To help evaluate the soils for engineering purposes, samples from 10 profiles representing eight of the principal soil series in Union County were tested in accordance with standard specifications of the American Society for Testing and Materials (ASTM). Only selected layers of each soil were tested. The results of these tests are shown in table 4. The engineering classifications in this table are based on data obtained by mechanical analysis and by tests to determine the liquid limit and the plastic limit.

Table 4 gives the moisture-density data for the tested soils. If a soil material is compacted at successively higher moisture content, and the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases as the moisture content increases. The highest dry density obtained in the compaction test is termed maximum dry density, and the corresponding moisture content is the optimum moisture.

The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from semisolid to plastic. As the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content, expressed as a percentage of the ovendry weight of the soil, at which the soil material passes from semisolid to plastic. The liquid limit is the moisture content at which the material passes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is plastic. Some silty and sandy soils are nonplastic; that is, they do not become plastic at any moisture content.

Estimated soil properties

Table 5 shows estimates of some of the soil properties that affect engineering work. The data are based on laboratory tests, on field experience with the same kind of soils in other counties, and on information in other parts of this soil survey. Some of the column headings in table 5 are explained briefly in the following paragraphs.

The seasonal high water table, which may be a perched water table, is the highest level at which the soil is saturated in winter and early in spring. The water table is lower if precipitation has been less than normal during

[2] LLOYD E. GILLOGLY, construction engineer, State office of Soil Conservation Service, assisted in preparing this section.

TABLE 4.—*Engineering*

[Tests performed by the Ohio Department of Highways in accordance with standard

Soil name and location	Parent material	Ohio Highway Department laboratory number	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			Inches	*Lbs per cu ft*	*Percent*
Blount silt loam: Allen Township; 1 mile SW. of Allen Center; 825 feet NW. of County Road 148-B; 2,900 feet NE. of County Road 160. Modal.	Wisconsin-age clay loam glacial till.	42061 42062 42063	0–6 12–22 31–54	101. 8 101. 0 109. 9	21. 0 21. 5 17. 2
Washington Township; 19 miles N. of Marysville; 490 feet N. of County Road 286; 2,310 feet W. of County Road 299. Slightly finer textured than modal.	Wisconsin-age clay loam glacial till.	60433 60434 60435	0–7 11–16 48–60	102. 4 104. 7 119. 3	20. 3 19. 2 12. 7
Crosby silt loam: Union Township; 9 miles S. of Marysville; 1 mile S. of Pennsylvania Railroad crossing on State Route 38; 330 feet SE. of State Route 38.	Wisconsin-age loam glacial till.	82660 82661 82662	0–7 11–25 25–35	92. 1 94. 6 124. 2	25. 8 24. 4 11. 2
Fox silt loam: Darby Township; 3 miles SE. of Milford Center; 1,400 feet SE. of intersecting State Route 38 and County Road 67; 70 feet N. of State Route 38.	Wisconsin-age glacial outwash.	60430 60431 60432	0–7 21½–26½ 60–72	107. 1 97. 4 131. 5	19. 2 22. 7 8. 8
Lippincott silty clay loam: Darby Township; 5½ miles S. of Marysville; 1,585 feet S. of intersecting State Route 38 and County Road 67; 528 feet SE. of County Road 67.	Wisconsin-age glacial outwash.	60436 60437 60438	0–9 15–22 50–62	92. 1 99. 9 135. 9	25. 8 21. 5 7. 5
Morley silt loam: Taylor Township; 3⅔ miles NW. of Marysville; 1,980 feet NW. of intersecting State Route 31 and County Road 128; 743 feet SW. of State Route 31.	Wisconsin-age clay loam glacial till.	9066 9067 9068	0–7 17–24 38–50	102. 4 102. 4 109. 6	20. 3 20. 3 16. 9
Nappanee silt loam: Liberty Township; 3 miles W. of Raymond; 1,080 feet NE. of County Road 229; 175 feet SE. of County Road 252.	Wave-modified clayey glacial till.	9048 9049 9050	0–6 14–20 32–42	102. 4 97. 4 104. 7	20. 3 22. 7 19. 2
Paulding silty clay: Liberty Township; 3 miles W. of Raymond; 180 feet NE. of County Road 229; 2,178 feet E. of County Road 252.	Clayey lacustrine sediment.	9051 9052 9053	0–7 7–14 52–62	87. 5 89. 9 97. 4	29. 5 27. 4 22. 7
Pewamo silty clay loam: Paris Township; 1¼ miles SE. of Marysville; 1,320 feet E. of U.S. Route 33; 125 feet W. of New York Central Railroad. Slightly finer textured than modal.	Wisconsin-age clay loam glacial till.	42064 42065 42066	0–10 21–32 73–83	93. 2 98. 8 114. 2	24. 6 19. 8 14. 5
Jackson Township; 17.6 miles N. of Marysville; 1,992 feet W. of County Road 332; 2,620 feet N. of State Route 739. Modal.	Wisconsin-age clay loam glacial till.	60439 60440 60441	0–7 16–32 52–60	94. 6 102. 4 114. 6	24. 4 20. 3 14, 6

[1] Based on AASHO Designation T 99-57, Method A (*2*).

[2] Mechanical analysis according to the AASHO Designation: T 88-57 (*2*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming textural classes for soil.

test data

ASTM Specifications adopted by the American Association of State Highway Officials]

Mechanical analysis [2]					Liquid limit	Plasticity index	Classification		
Percentage passing sieve—				Percentage smaller than—			AASHO [3]	Ohio [4]	Unified [5]
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.005 mm					
------------	100	97	83	37	37	11	A-6(9)	A-6a	ML-CL
------------	100	98	90	61	45	21	A-7-6(14)	A-7-6	CL
97	90	84	75	40	32	13	A-6(9)	A-6a	CL
99	97	93	81	39	[6] NP	NP	A-4(8)	A-4a	ML
100	98	96	89	65	48	19	A-7-6(14)	A-7-6	ML-CL
98	92	87	76	51	32	11	A-6(8)	A-6a	CL
------------	100	96	89	36	44	12	A-7-5(10)	A-7-5	ML
------------	100	97	94	55	41	18	A-7-6(11)	A-7-6	CL
96	84	78	69	30	24	6	A-4(3)	A-4a	CL-ML
------------	100	96	78	39	NP	NP	A-4(8)	A-4a	ML
72	57	50	40	33	50	13	A-7-5(2)	A-7-5	SM
43	29	10	5	0	NP	NP	A-1-a(0)	A-1-a	GP-GM
------------	100	96	86	51	54	17	A-7-5(14)	A-7-5	MH
96	87	84	76	47	49	21	A-7-6(15)	A-7-6	ML-CL
43	31	14	6	0	NP	NP	A-1-a(0)	A-1-a	GW-GM
98	96	93	83	39	34	11	A-6(8)	A-6a	ML-CL
------------	100	98	92	65	50	26	A-7-6(16)	A-7-6	CL or CH
98	96	93	85	48	34	14	A-6(10)	A-6a	CL
------------	100	98	88	45	35	11	A-6(8)	A-6a	ML-CL
------------	100	99	94	69	52	30	A-7-6(18)	A-7-6	CH
------------	100	98	92	62	40	21	A-6(12)	A-6b	CL
------------	------------	100	98	70	62	27	A-7-5(19)	A-7-5	MH
------------	------------	100	99	63	63	31	A-7-5(20)	A-7-5	MH-CH
------------	------------	100	99	77	52	27	A-7-6(17)	A-7-6	CH
------------	100	99	95	61	56	25	A-7-5(17)	A-7-5	MH-CH
------------	------------	100	96	61	52	28	A-7-6(18)	A-7-6	CH
95	87	80	70	42	31	11	A-6(8)	A-6a	CL
99	97	96	88	58	47	16	A-7-5(12)	A-7-5	ML
98	92	91	81	54	47	22	A-7-6(14)	A-7-6	CL
97	94	91	81	49	30	11	A-6(8)	A-6a	CL

[3] Based on AASHO Designation M 145-49 (*2*).
[4] Based on Classification of Soils, Ohio State Highway Testing Laboratory, February 1, 1955.
[5] Based on Classification of Soils for Engineering Purposes, ASTM Designation: D-2487. See American Society for Testing and Materials (*3*).
[6] Nonplastic.

TABLE 5.—*Estimates of soil properties*

[The symbol > means more than;

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	USDA texture	Engineering classification	
				Unified	AASHO
	Feet	*Inches*			
Algiers: Ag	[1] 0	0–19	Silt loam	ML or ML–CL	A–4
		19–47	Silty clay loam	CL or CH	A–6 or A–7
		47–60	Clay loam	ML–CL, CL	A–6
Blount: BoA, BoB, BoB2	½–1½	0–10	Silt loam to silty clay loam	ML–CL or ML	A–4 or A–6
		10–22	Silty clay	ML–CL or CL or CH	A–7
		22–60	Silty clay loam or clay loam	CL	A–6
Brookston: Bs	0	0–34	Silty clay loam	ML–CL, MH, CH	A–6 or A–7
		34–60	Silt loam and loam	ML or CL	A–4 or A–6
Celina: CeA, CeB	1–2	0–13	Silt loam	ML or ML–CL	A–4
		13–32	Silty clay loam to silty clay	CL or ML–CL	A–6 or A–7
		32–60	Silt loam	CL or ML–CL	A–4
Crosby: CrA, CrB	½–1½	0–7	Silt loam	ML	A–4, A–7
		7–17	Silty clay loam	ML–CL or CL	A–6
		17–25	Silty clay	CL or CH	A–7
		25–60	Silt loam	CL or ML–CL	A–4
Cut and fill land: Cu. No valid estimates can be made.					
Eel: Ee	[1] 1–3	0–18	Silt loam	ML	A–4 or A–6
		18–60	Silty clay loam	ML–CL or CL	A–6
Fox: FoA, FoB, FoB2, FoC2	>4	0–12	Silt loam	ML or ML–CL	A–4
		12–30	Clay loam to gravelly clay	CL, SC or SM	A–6 or A–7
		30–60	Gravelly loam to sand and gravel.	GP, GM, SW or SM	A–1
Genesee: Gn	[1] >3	0–60	Silt loam	ML or ML–CL	A–4 or A–6
Gravel pits: Gp. No valid estimates can be made.					
Henshaw: HeA	½–1½	0–8	Silt loam	ML or ML–CL	A–4
		8–60	Silty clay loam	ML–CL, CL	A–6
Homer: Ho	½–1½	0–12	Silt loam	ML or ML–CL	A–4
		12–34	Clay or gravelly clay loam	CL or SC	A–6
		34–60	Sand and gravel	GW, GM, SW, or SM	A–1
Kane: Ka	½–1½	0–13	Silt loam	ML or ML–CL	A–4
		13–31	Silty clay loam, clay loam, or clay.	ML–CL or CL	A–6
		31–39	Gravelly silt loam	SM or ML	A–6
		39–60	Sand and gravel	GW, GW–GM, SW or SW–SM	A–1
Kendallville: KeA, KeB	>4	0–9	Silt loam	ML or ML–CL	A–4
		9–20	Clay loam	CL	A–6
		20–29	Gravelly clay	CL or SC	A–6
		29–60	Clay loam	CL or ML–CL	A–6

See footnotes at end of table.

significant in engineering

the symbol <means less than]

Percentage passing sieve— No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosion potential — Steel	Corrosion potential — Concrete
				Inches per hour	*Inches per inch of soil*				
--------	100	90–100	75–95	0. 63–2. 0	0. 15–0. 24	6. 6–7. 8	Moderate	----------------	Low.
--------	100	85–100	80–95	0. 06–0. 2	0. 15–0. 24	6. 6–7. 8	High	High	Low.
95–100	95–100	90–100	80–90	0. 06–0. 2	0. 10–0. 14	[2] 7. 4–8. 4	Moderate	High	Low.
95–100	95–100	85–100	70–95	0. 63–2. 0	0. 18–0. 22	4. 6–5. 5	Low	----------------	Moderate to high.
95–100	95–100	90–100	85–95	0. 20–0. 63	0. 15–0. 18	4. 6–6. 1	High	High	Moderate to high.
95–100	80–100	75–95	70–85	0. 06–0. 2	0. 08–0. 12	[2] 6. 1–7. 8	Moderate	High	Low
100	95–100	95–100	85–95	0. 63–2. 0	0. 18–0. 24	6. 1–7. 4	High	High	Low.
80–100	75–95	75–90	65–75	0. 06–0. 2	0. 08–0. 14	[2] 7. 4–8. 4	Moderate	High	Low.
95–100	90–100	85–95	70–80	0. 63–2. 0	0. 18–0. 22	4. 6–6. 5	Low	----------------	Moderate.
95–100	85–100	80–95	70–85	0. 2–0. 63	0. 14–0. 17	4. 6–7. 3	High	High	Moderate to low.
80–90	65–80	60–70	50–60	0. 2–0. 63	0. 06–0. 10	[2] 7. 4–8. 4	Low	Moderate	Low.
95–100	90–100	90–100	70–95	0. 63–2. 0	0. 18–0. 22	5. 1–5. 5	Low	----------------	Moderate to high.
95–100	85–100	80–100	70–95	0. 2–0. 63	0. 10–0. 16	5. 1–6. 3	Moderate	High	Moderate.
95–100	90–100	90–100	80–95	0. 2–0. 63	0. 08–0. 14	5. 1–7. 3	High	High	Moderate to low.
80–100	70–90	60–85	55–75	0. 06–0. 2	0. 06–0. 10	[2] 7. 4–8. 4	Low	High	Low.
--------	100	80–100	80–100	0. 63–2. 0	0. 18–0. 23	6. 6–7. 4	Low	----------------	Low.
95–100	95–100	90–100	80–95	0. 63–2. 0	0. 15–0. 19	7. 4–8. 4	Moderate	Moderate	Low.
85–100	75–100	65–100	55–95	0. 63–2. 0	0. 16–0. 21	5. 1–7. 3	Low	----------------	Moderate to low.
70–100	55–100	50–95	40–80	0. 63–2. 0	0. 10–0. 15	5. 1–6. 5	Moderate	Moderate	Moderate to low.
25–60	20–35	5–15	2–15	6. 3–12. 0	<0. 05	[2] 7. 4–8. 4	Low	Low	Low.
95–100	95–100	90–100	70–90	0. 63–2. 0	0. 17–0. 22	6. 6–7. 4	Low to moderate.	Moderate	Low.
100	95–100	90–100	80–90	0. 63–2. 0	0. 17–0. 22	5. 6–7. 3	Low	----------------	Low.
100	95–100	90–100	80–95	0. 2–0. 63	0. 16–0. 19	6. 1–7. 8	Low to moderate.	High	Low.
85–100	75–100	65–100	55–95	0. 63–2. 0	0. 18–0. 22	5. 6–6. 5	Low	----------------	Moderate to low.
70–100	55–100	50–95	40–80	0. 63–2. 0	0. 12–0. 17	5. 6–7. 4	Moderate	High	Moderate to low.
25–60	20–35	5–15	2–15	6. 3–12. 0	<0. 05	[2] 7. 4–8. 4	Low	High	Low.
85–100	75–100	65–100	55–95	0. 63–2. 0	0. 18–0. 22	6. 1–7. 3	Low	----------------	Low.
90–100	80–100	75–90	70–90	0. 63–2. 0	0. 12–0. 17	5. 6–6. 5	Moderate	High	Moderate.
60–85	55–75	45–70	40–65	0. 63–2. 0	0. 17–0. 22	6. 1–7. 3	Low	High	Low.
25–60	20–35	5–15	2–15	6. 3–12. 0	<0. 05	[2] 7. 4–8. 4			
90–100	90–100	70–90	65–80	0. 63–2. 0	0. 16–0. 19	6. 1–7. 3	Low	----------------	Low.
90–100	90–100	80–95	70–85	0. 63–2. 0	0. 12–0. 17	4. 6–5. 5	Moderate	Moderate	Moderate.
80–90	60–75	50–70	40–65	0. 63–2. 0	0. 10–0. 15	4. 6–6. 5	Moderate to high.	High	Moderate.
95–100	90–100	80–95	70–85	0. 2–0. 63	0. 06–0. 10	[2] 7. 4–8. 4	Moderate	Moderate	Low.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	USDA texture	Engineering classification	
				Unified	AASHO
	Feet	*Inches*			
Lippincott: Lc	0	0–11	Silty clay loam	CL, ML–CL or MH	A–6 or A–7
		11–25	Silty clay and silty clay loam	CL or ML–CL	A–6 or A–7
		25–36	Very gravelly loam	GM or SM	A–1
		36–60	Sand and gravel	GW, GM, SW, or SM	A–1
Miamian: MIB, MIC2, MID2, MIF2	>4	0–11	Silt loam	ML or ML–CL	A–4
		11–24	Clay	CL	A–6 or A–7
		24–60	Loam	CL or ML–CL	A–4
Montgomery: Mn	0	0–9	Silty clay loam	CL or ML–CL	A–6 or A–7
		9–70	Silty clay	CH	A–7
Morley: MrB, MrB2, MrC, MrC2, MrD2, MrE2, MrF2.	2–3	0–10	Silt loam	ML or ML–CL	A–4 or A–6
		10–24	Clay	CL or CH	A–6 or A–7
		24–60	Silty clay loam	CL	A–6
Muskego: Mu	0	0–36	Muck	Pt	
		36–60	Coprogenous material		
Nappanee: NpA, NpB	½–1	0–7	Silt loam	ML or ML–CL	A–6
		7–25	Silty clay	CL or CH	A–7
		25–60	Silty clay	CL	A–6
Odell: OdA	½–1	0–10	Silt loam to silty clay loam	ML or ML–CL	A–4
		10–18	Silty clay loam	CL or ML–CL	A–6
		18–60	Loam	CL or ML–CL	A–4 or A–6
Paulding: Pa	0	0–7	Silty clay	MH	A–7
		7–42	Clay	MH–CH or CH	A–7
		42–62	Silty clay	CH	A–7
Pewamo: Pm	0–½	0–6	Silty clay loam	ML or MH–CH	A–7
		6–35	Silty clay	CL, CH or ML–CL	A–7
		35–60	Silty clay loam	CL	A–6
Quarries: Qu. No valid estimates can be made.					
Ross: Ro	[1] >3	0–25	Silt loam	ML or ML–CL	A–4
		25–38	Silty clay loam	CL or ML–CL	A–6
		38–60	Silty clay	CL or CH	A–6 or A–7
St. Clair: ScB, ScB2, ScC, ScC2	2–3	0–8	Silt loam	ML or ML–CL	A–6
		8–28	Clay and silty clay	CL or CH	A–7
		28–60	Silty clay	CL	A–7 or A–6
Shoals: Sh	[1] 0	0–14	Silt loam	ML or ML–CL	A–4 or A–6
		14–38	Silty clay loam	CL or ML–CL	A–6
		38–60	Silty clay	ML–CL or CH	A–7
Sleeth: SlA	½–1	0–15	Silt loam	ML or ML–CL	A–4
		15–54	Silty clay loam to silty clay	CL or ML–CL	A–6
		54–65	Very gravelly sand	GW, GM, SW, or SM	A–1
Sloan: So	[1] 0	0–60	Silty clay loam	CL or ML–CL	A–6

See footnotes at end of table.

significant in engineering

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)					Steel	Concrete
				Inches per hour	*Inches per inch of soil*				
100	90–100	85–100	85–95	0.63–2.0	0.16–0.28	6.1–6.5	Moderate		Low.
95–100	85–100	80–90	70–85	0.63–2.0	0.14–0.18	6.1–7.3	Moderate to high.	High	Low.
60–90	40–60	30–50	20–30	2.0–6.3	0.10–0.14	6.6–7.8	Low	High	Low.
25–60	20–35	5–15	2–15	6.3–12.0	0.02–0.05	[2] 7.4–8.4	Low	High	Low.
95–100	95–100	90–100	75–90	0.63–2.0	0.18–0.22	5.6–7.3	Low		Moderate to low.
95–100	85–95	80–95	70–85	0.2–0.63	0.10–0.16	5.1–6.5	Moderate	High	Moderate.
75–95	70–90	60–75	50–60	0.2–0.63	0.06–0.10	[2] 7.4–8.4	Low	Low	Low.
	100	90–100	85–95	0.2–0.63	0.18–0.22	6.1–7.3	Moderate		Low.
	100	90–100	80–95	<0.2	0.10–0.14	6.1–7.8	High	High	Low.
95–100	95–100	90–100	75–85	0.63–2.0	0.18–0.22	6.1–7.3	Low		Low.
95–100	95–100	90–100	80–95	0.2–0.63	0.15–0.18	5.1–7.3	High	High	Moderate to low.
95–100	95–100	80–95	70–85	0.06–0.2	0.08–0.12	[2] 7.4–8.4	Moderate	High	Low.
				0.63–2.0	0.20–0.30	6.1–7.3	Varies	High	Low.
	100	100	90–100	0.06–0.2	0.15–0.20	6.6–7.3	Varies	High	Low.
	100	90–100	80–90	0.2–2.0	0.16–0.20	5.6–7.3	Low		Moderate to low.
	100	90–100	85–100	<0.06	0.13–0.17	5.1–7.3	High	High	Moderate to low.
	100	90–100	80–95	<0.06	0.08–0.12	[2] 7.4–7.8	Moderate to high.	High	Low.
95–100	95–100	85–100	75–90	0.63–0.2	0.14–0.22	5.6–6.5	Low		Moderate to low
95–100	85–100	80–100	70–85	0.2–0.63	0.10–0.16	5.6–7.3	Moderate to high.	High	Moderate to low.
80–90	65–85	60–80	55–75	0.2–0.63	0.06–0.10	[2] 7.4–8.4	Low	High	Low.
	100	95–100	90–100	0.2–0.63	0.11–0.15	6.1–7.3	High		Low.
	100	90–100	90–100	0.06–0.2	0.11–0.15	6.1–7.3	High	High	Low.
	100	95–100	90–100	<0.06	0.05–0.10	[2] 7.4–7.8	High	High	Low.
95–100	95–100	95–100	80–95	0.63–2.0	0.18–0.22	6.1–7.3	Moderate		Low.
95–100	90–100	90–100	80–95	0.2–0.63	0.15–0.18	6.1–7.8	High	High	Low.
90–100	80–100	80–90	70–85	0.2–0.63	0.08–0.14	[2] 7.4–8.4	Moderate	High	Low.
95–100	95–100	90–100	75–95	0.63–2.0	0.18–0.24	6.6–7.8	Moderate		Low.
95–100	95–100	90–100	80–95	0.63–2.0	0.18–0.22	6.6–7.8	Moderate	Moderate	Low.
95–100	95–100	90–100	85–100	0.63–2.0	0.15–0.18	6.6–7.8	Moderate to high.	Moderate	Low.
95–100	95–100	90–100	80–90	0.2–2.0	0.16–0.20	5.6–6.5	Low		Moderate to low.
	100	90–100	85–100	<0.06	0.13–0.17	5.0–6.5	High	High	Moderate.
	100	90–100	85–95	<0.06	0.08–0.12	[2] 7.4–7.8	Moderate to high.	High	Low.
95–100	95–100	90–100	75–95	0.63–2.0	0.18–0.22	6.1–7.3	Low		Low.
95–100	95–100	90–100	80–95	0.63–2.0	0.18–0.20	6.1–7.3	Moderate	High	Low.
95–100	95–100	80–95	75–90	0.63–2.0	0.14–0.18	[2] 6.6–7.8	High	High	Low.
95–100	95–100	85–95	75–90	0.63–2.0	0.18–0.22	6.1–7.3	Low		Low.
95–100	95–100	90–100	80–95	0.63–2.0	0.16–0.20	5.1–7.8	Moderate	High	Low.
50–60	15–45	10–35	2–20	6.3–12.0	0.02–0.05	[2] 7.4–8.4	Low	High	Low.
95–100	95–100	90–100	80–95	0.2–0.63	0.16–0.20	6.6–7.8	Moderate	High	Low.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	USDA texture	Engineering classification	
				Unified	AASHO
	Feet	*Inches*			
Warsaw: WaB	>3	0–15	Silt loam	ML or ML–CL	A–4
		15–26	Silty clay loam to clay loam	ML or CL	A–6 or A–4
		26–33	Sandy clay loam	SC or CL	A–4 or A–6
		33–60	Sand and gravel	GW, GM, SW, or SM	A–1
Westland: Wc	0	0–33	Silty clay loam	CL or ML–CL	A–6
		33–57	Loam to gravelly loam	SM or ML	A–4
		57–65	Sand and gravel	GW, GM, SW, or SM	A–1
Wetzel: We	0–½	0–9	Silty clay loam	ML or MH	A–7
		9–32	Silty clay	CL, ML or CH	A–7
		32–60	Silty clay loam	CL	A–6

[1] Subject to flooding.
[2] Calcareous.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as a source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Algiers: Ag	Poor: wet; clayey and loamy material.	High: seasonal high water table; high silt content.	Good to a depth of 1½ to 2 feet; seasonally wet.	Not suitable	Poor: seasonal high water table; high shrink-swell potential.	Seasonal high water table; subject to flooding and ponding; slow permeability; soft when wet.
Blount: BoA, BoB, BoB2.	Poor: wet; clayey material.	High: seasonal high water table; high silt content.	Fair: low in organic matter; thin suitable material.	Not suitable	Poor to moderate: high shrink-swell potential; seasonal high water table; poor workability.	Seasonal high water table; susceptible to frost action; clayey subsoil.
Brookston: Bs	Poor: seasonally wet; loamy texture.	High: seasonal high water table; high silt content.	Good to a depth of 1½ to 2 feet.	Not suitable	Poor to moderate: poor workability.	Poor natural drainage; seasonal high water table; surface ponding in low areas; plastic subsoil.

See footnote at end of table.

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Steel	Concrete
				Inches per hour	*Inches per inch of soil*				
100	90–100	75–95	75–90	0.63–2.0	0.16–0.26	6.1–7.3	Low		Low.
90–100	80–100	65–90	60–85	0.63–2.0	0.14–0.18	5.1–6.5	Moderate	Moderate	Moderate.
80–90	60–75	50–70	40–55	0.63–2.0	0.08–0.14	5.1–6.5	Moderate to low	Low	Moderate.
25–60	20–35	5–15	2–15	6.3–12.0	0.02–0.05	[2] 7.4–8.4	Low	Low	Low.
95–100	95–100	90–100	80–95	0.63–2.0	0.14–0.18	6.1–7.3	Moderate	High	Low.
80–95	60–75	50–70	40–55	0.63–2.0	0.12–0.16	6.1–7.8	Low	High	Low.
25–60	15–40	5–15	2–15	6.3–12.0	0.02–0.05	[2] 7.4–8.4	Low	High	Low.
95–100	95–100	95–100	80–95	0.63–0.2	0.18–0.22	6.1–7.3	Moderate		Low.
95–100	90–100	90–100	80–95	0.06–0.2	0.15–0.18	6.1–7.8	High	High	Low.
90–100	80–100	80–90	70–85	0.06–0.2	0.10–0.14	[2] 7.4–8.4	Moderate	High	Low.

interpretations

Soil features affecting—Continued						
Pipeline construction and maintenance	Ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoirs	Dikes, levees, and embankments [1]				
Seasonal high water table; subject to flooding and ponding; subject to caving.	Possibility of seepage if excavated below a depth of 5 feet; subject to flooding.	Fair stability; slow permeability; poor to fair compaction; medium to high compressibility; fair resistance to piping.	Slow permeability; somewhat poor natural drainage; subject to flooding; high water table.	Seasonal high water table; medium infiltration rate; high available moisture capacity; subject to flooding or ponding.	Nearly level; seasonally wet.	Somewhat poor natural drainage; subject to flooding or ponding.
Seasonal high water table; clayey subsoil; substratum is compact glacial till.	Very slow seepage; seasonal high water table.	Fair stability; slow permeability; fair compaction; medium to high compressibility; good resistance to piping.	Somewhat poor natural drainage; slow permeability; seasonal high water table.	Seasonal high water table; medium to slow infiltration rate; medium available moisture capacity.	Nearly level to gently sloping; moderately erodible channels.	Susceptible to erosion; clayey material; somewhat poor drainage.
Seasonal high water table; subject to ponding in low areas; loamy subsoil.	Very slow seepage; seasonal high water table.	Fair stability; slow permeability; fair to poor compaction; medium to high compressibility; good resistance to piping.	Slow permeability; poor natural drainage; high water table.	Seasonal high water table; high available moisture capacity; slow permeability.	Nearly level; seasonally wet.	Seasonal high water table; susceptible to erosion; very poor drainage.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as a source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Celina: CeA, CeB	Poor: clayey and loamy subsoil; generally wet in winter.	Moderate	Fair: low in organic matter.	Not suitable	Poor in subsoil: high shrink-swell potential; poor workability. Fair in substratum.	Seasonal high water table; plastic subsoil; susceptible to frost action.
Crosby: CrA, CrB	Poor: wet in winter; clayey subsoil.	High: seasonal high water table; high silt content.	Fair: low in organic matter.	Not suitable	Poor in subsoil: high shrink-swell potential; poor workability. Fair in substratum.	Seasonal high water table; plastic subsoil; slow permeability.
Cut and fill land: Cu. No interpretations. Material too variable						
Eel: Ee	Poor: subject to flooding.	Moderate: seasonal high water table; high silt content.	Good to a depth of 2 to 4 feet.	Not suitable	Poor: poor compaction; low stability.	Seasonal high water table; subject to flooding; susceptible to frost action.
Fox: FoA, FoB, FoB2, FoC2.	Fair: high silt and clay content to a depth of 30 to 40 inches. Good in sandy gravelly substratum.	Low: good drainage.	Fair: low in organic matter; limited suitable material.	Good below a depth of 2 to 3 feet; well graded; stratified and calcareous.	Fair in subsoil: moderate shrink-swell. Good in substratum.	Good drainage; low susceptibility to frost action; cut slopes droughty.
Genesee: Gn	Fair: good drainage; subject to occasional flooding.	Moderate: subject to occasional flooding.	Good to a depth of 2 to 4 feet.	Not suitable	Poor: poor compaction; low stability.	Good drainage; subject to occasional flooding; slightly erodible.
Gravel pits: Gp. No interpretations. Material too variable.						

interpretations—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoirs	Dikes, levees, and embankments [1]				
Seasonal high water table; clayey and loamy subsoil; substratum is loamy glacial till.	Slow seepage; seasonal high water table.	Fair stability; slow permeability; fair compaction; medium compressibility; good resistance to piping.	Moderately slow permeability; good natural drainage.	Seasonal high water table; medium infiltration rate; medium available moisture capacity.	Gently to moderately sloping; moderately erodible.	Susceptible to erosion.
Seasonal high water table; clayey subsoil; compact loamy glacial till substratum.	Slow seepage; seasonal high water table.	Fair stability; slow permeability; fair compaction; medium compressibility; good resistance to piping.	Slow permeability; somewhat poor natural drainage; seasonal high water table.	Seasonal high water table; medium infiltration rate; medium available moisture capacity.	Nearly level to gently sloping; seasonal high water table.	Susceptible to erosion; somewhat poor drainage.
Seasonal high water table; subject to flooding; subject to caving.	Medium seepage; subject to flooding.	Poor stability; moderate permeability; poor compaction; medium compressibility; poor resistance to piping.	Moderate perbility; fair natural drainage; subject to flooding.	Medium infiltration rate; seasonal high water table; high available moisture capacity; subject to flooding.	Diversions needed adjacent to higher areas in places; subject to flooding.	Subject to flooding; highly erodible.
Good drainage; sand and gravel below a depth of 2 to 3 feet; subject to caving.	Excessive seepage in substratum.	Upper 2 to 3 feet has good stability; fair to good compaction; moderate permeability; medium compressibility; good resistance to piping. Substratum has good stability; good compaction; rapid permeability; slight compressibility; good resistance to piping.	Not needed; good drainage.	Medium infiltration rate; generally medium to low available moisture capacity.	Not needed; short slopes; moderate permeability.	Susceptible to erosion; gravelly in cut areas; droughty.
Subject to occasional flooding; subject to caving.	Medium seepage; subject to occasional flooding.	Poor stability; moderate permeability; poor compaction; medium compressibility; poor resistance to piping.	Moderate permeability; good natural drainage; drainage generally not needed; subject to occasional flooding.	Medium infiltration rate; high water holding capacity; subject to occasional flooding.	Terraces generally not needed; nearly level; diversions needed to remove runoff from adjacent higher areas in places.	Subject to occasional flooding; highly erodible.

See footnote at end of table.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as a source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Henshaw: HeA	Poor: seasonal high water table; loamy texture.	High: seasonal high water table; high silt content.	Fair: low in organic matter.	Not suitable	Poor: moderate shrink-swell potential; poor workability.	Seasonal high water table; highly compressible; unstable.
Homer: Ho	Poor: seasonal high water table; clayey and loamy subsoil; wet in winter.	High: seasonal high water table; high silt content.	Fair: low in organic matter.	Good for sand and gravel below a depth of 2 to 3 feet; well graded; stratified and calcareous; seasonal high water table.	Fair in subsoil: moderate shrink-swell potential. Good in substratum.	Seasonal high water table; somewhat poor drainage; sand and gravel below a depth of 2 to 3 feet.
Kane: Ka	Poor: seasonal high water table; loamy and clayey subsoil; wet in winter.	High: seasonal high water table; high silt content.	Fair to a depth of 1 to 2 feet.	Good for sand and gravel below a depth of 2 to 3 feet; well graded; stratified and calcareous; seasonal high water table.	Fair in subsoil: moderate shrink-swell potential. Good in substratum.	Seasonal high water table; somewhat poor drainage; sand and gravel below a depth of 2 to 3 feet.
Kendallville: KeA, KeB.	Poor: loamy and clayey texture.	Moderate to low; good drainage.	Fair: low in organic matter; limited suitable material.	Not suitable	Fair: moderate shrink-swell potential; loamy substratum.	Good natural drainage; sloping.

See footnote at end of table.

interpretations—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Ponds: Reservoirs	Ponds: Dikes, levees, and embankments [1]	Agricultural drainage	Irrigation	Terraces or diversions	Waterways
Seasonal high water table; soft silty material subject to caving.	Slow rate of seepage; seasonal high water table.	Poor stability; fair compaction; slow permeability; medium to high compressibility; fair resistance to piping.	Somewhat poor natural drainage; moderately slow permeability; seasonal high water table.	Medium infiltration rate; high available moisture capacity; seasonal high water table.	Terraces generally not needed; nearly level; diversions needed to remove runoff from adjacent high areas in places.	Susceptible to erosion; somewhat poor drainage.
Seasonal high water table; sand and gravel below a depth of 2 to 3 feet; subject to caving.	Excessive seepage in substratum.	Upper 2 to 3 feet has fair to good stability; fair to good compaction; moderate permeability; medium to high compressibility; good resistance to piping. Substratum has good stability; good compaction; high permeability; very slight compressibility; good resistance to piping.	Seasonal high water table; moderate permeability; somewhat poor natural drainage.	Medium infiltration rate; medium available moisture capacity; seasonal high water table.	Not needed; nearly level.	Susceptible to erosion; somewhat poor drainage.
Seasonal high water table; sand and gravel below a depth of 2 to 3 feet; subject to caving.	Excessive seepage in substratum.	Upper 2 to 3 feet has fair to good stability; fair compaction; slow permeability; medium compressibility; good resistance to piping. Substratum has good stability; good compaction; rapid permeability; very slight compressibility; good resistance to piping.	Seasonal high water table; moderate permeability; somewhat poor natural drainage.	Medium water intake rate; medium available water capacity; seasonal high water table.	Generally not needed; nearly level topography.	Susceptible to erosion; somewhat poor drainage.
Good drainage; compact loamy glacial till substratum.	Moderate to slow seepage; rapid permeability in places.	Fair stability; fair to good compaction; slow permeability; medium compressibility; good resistance to piping.	Not needed; good natural drainage.	Medium infiltration rate; medium available moisture capacity.	Good natural drainage; slopes short in most places; moderately erodible.	Susceptible to erosion.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as a source of— Topsoil	Suitability as a source of— Sand and gravel	Suitability as a source of— Road fill	Soil features affecting— Highway location
Lippincott: Lc	Poor: seasonal high water table; clayey and loamy subsoil.	High: seasonal high water table; high silt and clay content.	Good to a depth of 1 to 2 feet.	Good below a depth of 2 to 3 feet; well graded; stratified and calcareous.	Fair in subsoil: plastic; moderate shrink-swell potential; seasonal high water table. Good in substratum.	Seasonal high water table; high susceptibility to frost action; subject to ponding in places.
Miamian: MlB, MlC2, MlD2, MlF2.	Poor: clayey subsoil.	Moderate: high silt content.	Fair: low in organic matter; limited suitable material.	Not suitable	Poor in subsoil: plastic; moderate shrink-swell potential. Fair in substratum.	Good natural drainage; moderate susceptibility to frost action; steep slopes in places.
Montgomery: Mn	Poor: seasonal high water table; clayey material.	High: high silt and clay content; seasonal high water table.	Fair: clayey material high in organic matter.	Not suitable	Poor: very plastic; high shrink-swell potential.	Very poor natural drainage; seasonal high water table; subject to flooding or ponding; high compressibility.
Morley: MrB, MrB2, MrC, MrC2, MrD2, MrE2, MrF2.	Poor: clayey material; generally wet in winter.	High: seasonal high water table; high silt and clay content.	Fair: low in organic matter; limited suitable material.	Not suitable	Poor: high to moderate shrink-swell potential; highly plastic subsoil.	Slow permeability; highly susceptible to frost action; slope.
Muskego: Mu	Poor: high water table; unstable organic soil.	High: high water table.	Poor if used alone; good if mixed with mineral soil.	Not suitable	Not suitable; peat and muck.	High water table; unstable organic material; removal necessary for roadbed; soft and compressible.

See footnote at end of table.

interpretations—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoirs	Dikes, levees, and embankments [1]				
Seasonal high water table; sand and gravel below a depth of 2 to 3 feet; subject to caving.	Excessive seepage in substratum; seasonal high water table.	Upper 2½ to 3 feet has fair to good stability; fair compaction; slow permeability; medium compressibility; good resistance to piping. Substratum has good stability and compaction; rapid permeability; very slight compressibility; good resistance to piping.	Seasonal high water table; moderate permeability; very poor natural drainage; outlets are difficult to obtain in places.	Medium infiltration rate; medium available moisture capacity; seasonal high water table.	Terraces not needed; nearly level; diversions needed to remove runoff from adjacent higher areas in places.	Susceptible to erosion; high water table; very poor drainage.
Good drainage; compact loamy glacial till substratum.	Slow seepage; steep slopes in places.	Fair to good stability and compaction; slow permeability; medium compressibility; good resistance to piping.	Not needed; good natural drainage.	Medium infiltration rate; medium available moisture capacity; steep slopes in places.	Gently to strongly sloping; erodible.	Susceptible to erosion; droughty where eroded.
Seasonal high water table; poor roadability; soft clayey soil.	Very slow seepage; seasonal high water table.	Poor stability; poor compaction; slow permeability; high compressibility; good resistance to piping; cracks as it dries.	Very slow permeability; seasonal high water table; very poor natural drainage; outlets difficult to obtain in places.	Medium infiltration rate; high available moisture capacity; seasonal high water table.	Nearly level; very poor drainage.	Seasonal high water table; nearly level.
Clayey material; moderately good drainage; compact glacial till.	Very slow seepage; steep slopes.	Fair compaction; fair stability; slow permeability; medium compressibility; good resistance to piping.	Good natural drainage; slow permeability; seasonal high water table for short periods.	Medium infiltration rate; steep slopes in places; medium available moisture capacity.	Rolling; moderately erodible channels.	Steep slopes in places; moderately erodible; clayey channels.
Trench walls and bottom unstable; high water table; muck and peat.	High water table; rapid seepage; suited for dug ponds.	Unstable organic material; high seepage.	High water table; unstable organic material; outlets difficult to obtain in places.	High available water capacity; high water table; high infiltration rate.	Nearly level; organic soil; diversions needed to remove runoff from adjacent higher areas in places.	High water table; organic soil; nearly level.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as a source of— Topsoil	Suitability as a source of— Sand and gravel	Suitability as a source of— Road fill	Soil features affecting— Highway location
Nappanee: NpA, NpB.	Poor: clayey material; seasonal high water table; wet in winter.	High: seasonal high water table; high clay content.	Fair to poor: low in organic matter; thin.	Not suitable	Poor: very plastic; high shrink-swell potential; clayey material.	Seasonal high water table; plastic soil material; highly susceptible to frost action; high clay content.
Odell: OdA	Poor: clayey subsoil; wet in winter.	High: seasonal high water table and high silt content.	Good: high in organic matter.	Not suitable	Poor in subsoil; high shrink-swell potential; poor workability. Fair in substratum.	Seasonal high water table; clayey subsoil; moderately slow permeability.
Paulding: Pa	Poor: clayey material; wet.	Moderate: seasonal high water table; high clay content.	Poor: clayey	Not suitable	Poor: very plastic; high shrink-swell potential.	Seasonal high water table; subject to ponding in low areas; highly plastic; high compressibility.
Pewamo: Pm	Poor: clayey material; wet.	High: seasonal high water table; high silt and clay content.	Good: high in organic matter to a depth of 1 to 1½ feet.	Not suitable	Poor: highly plastic; high shrink-swell potential in subsoil; clayey material.	Very poor natural drainage; seasonal high water table; subject to ponding in low areas; clayey material.
Quarries: Qu. No interpretations. Material too variable.						
Ross: Ro	Poor: loamy material; subject to flooding.	High: high silt content.	Good to a depth of 2 to 3 feet.	Not suitable	Poor: subject to flooding; generally clayey.	Subject to flooding; high susceptibility to frost action.
St. Clair: ScB, ScB2, ScC, ScC2.	Poor: clayey material; generally wet in winter.	High: high clay content.	Fair to poor: low in organic matter; thin.	Not suitable	Poor: very plastic; high shrink-swell potential; clayey material.	Moderately good drainage; plastic; clayey soil material; highly susceptible to frost action; slope.

See footnote at end of table.

interpretations—Continued

Soil features affecting—Continued							
Pipeline construction and maintenance	Ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoirs	Dikes, levees, and embankments [1]				
Seasonal high water table; clayey plastic material.	Very slow rate of seepage; seasonal high water table.	Poor stability and compaction; slow permeability; high compressibility; good resistance to piping; cracks when dry.	Somewhat poor natural drainage; very slow permeability; seasonal water table.	Slow infiltration rate; medium available moisture capacity; seasonal high water table; very slow permeability.	Nearly level to gently rolling; moderately erodible; slopes generally short.	Susceptible to erosion; clayey channels.
Seasonal high water table; compact loamy glacial till substratum.	Slow seepage; seasonal high water table.	Fair stability; good compaction; slow permeability; medium compressibility; good resistance to piping.	Moderately slow permeability; seasonal high water table; somewhat poor natural drainage.	Medium infiltration rate; medium available moisture capacity; seasonal high water table.	Not needed; nearly level.	Susceptible to erosion; seasonal high water table.
Seasonal high water table; subject to ponding in low areas; clayey soil.	Very slow seepage; seasonal high water table.	Poor stability and compaction; slow permeability; high compressibility; good resistance to piping.	Very slow permeability; seasonal high water table; very poor natural drainage.	Slow infiltration rate; medium available moisture capacity; seasonal high water table.	Nearly level; very poor drainage.	Wet clayey soil; seasonal high water table.
Seasonal high water table; subject to ponding in low areas; compact glacial till substratum.	Very slow seepage; seasonal high water table.	Fair stability and compaction; slow permeability; medium compressibility; good resistance to piping.	Very poor natural drainage; slow permeability; seasonal high water table.	Medium infiltration rate; high available moisture capacity; seasonal high water table.	Nearly level; very poor natural drainage.	Seasonal high water table; moderately erodible channel.
Subject to flooding; subject to caving.	Excessive seepage in substratum in some areas, subject to flooding.	Fair to good stability and compaction; slow permeability; medium compressibility; good resistance to piping.	Moderately good natural drainage; moderate permeability; seasonal high water table; subject to flooding.	Medium infiltration rate; high available moisture capacity; subject to flooding.	Nearly level; diversions needed to collect runoff from higher adjacent areas in places.	Susceptible to erosion; subject to flooding.
Plastic; clayey material; compact clayey glacial till in substratum.	Very slow seepage; seasonal high water table for short periods.	Poor stability and compaction; slow permeability; high compressibility; good resistance to piping; cracks as it dries.	Moderately good drainage; a few seepage areas; very slow permeability; seasonal high water table for short periods.	Slow infiltration rate; medium available moisture capacity; seasonal high water table; slopes.	Clayey subsoil at a shallow depth; slope.	Clayey channels; susceptible to erosion; slope.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as a source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Shoals: Sh	Poor: seasonal high water table; subject to flooding; wet in winter.	High: seasonal high water table; high silt content.	Good to a depth of 2 to 3 feet; medium in organic matter.	Not suitable	Poor: poor compaction and stability; subject to flooding.	Seasonal high water table; subject to flooding; highly susceptible to frost action; compressible; silty material.
Sleeth: SlA	Poor: silty material; generally wet in winter.	High: seasonal high water table; high silt content.	Fair: low in organic matter.	Good for sand and gravel below a depth of 3½ feet; well graded; stratified and calcareous; seasonal high water table.	Fair in subsoil; moderate shrink-swell potential. Good in substratum.	Seasonal high water table; somewhat poorly drained; high susceptibility to frost action; sand and gravel below a depth of 3½ feet.
Sloan: So	Poor: seasonal high water table; subject to flooding; wet.	High: seasonal high water table; high silt content.	Good to a depth of 1½ to 3½ feet; high in organic matter.	Not suitable	Poor: seasonal high water table; moderate shrink-swell potential; subject to flooding.	Seasonal high water table; subject to flooding; high susceptibility to frost action; compressible; silty material.
Warsaw: WaB	Fair: high silt and clay content to a depth of 30 to 40 inches; good in substratum.	Low: good drainage.	Good to a depth of 1 to 1½ feet.	Good for gravel and sand in substratum; well graded; stratified and calcareous.	Fair in subsoil; moderate shrink-swell potential; good in substratum.	Good natural drainage; low susceptibility to frost action; cut slopes are droughty.

See footnote at end of table.

interpretations—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoirs	Dikes, levees, and embankments [5]				
Seasonal high water table; subject to flooding; soft silty material; subject to caving.	Subject to flooding; slow seepage; permeable sandy strata in places.	Poor stability and compaction; slow permeability; high compressibility; poor resistance to piping.	Seasonal high water table; moderate permeability; somewhat poor natural drainage; outlets difficult to obtain; subject to flooding.	Medium infiltration rate; seasonal high water table; high available moisture capacity; subject to flooding.	Nearly level; subject to flooding; diversions needed adjacent to higher areas in places.	Highly erodible; subject to flooding; fertile soil.
Seasonal high water table; sand and gravel below a depth of 3½ feet; subject to caving.	Excessive seepage in substratum.	Upper 2½ to 3 feet has fair to good stability and compaction; slow permeability; medium compressibility; good resistance to piping. Substratum has good stability and compaction; moderate permeability; slight compressibility; good resistance to piping.	Seasonal high water table; moderate permeability; somewhat poor natural drainage.	Medium infiltration rate; medium to high available moisture capacity; seasonal high water table.	Not needed; nearly level.	Susceptible to erosion; somewhat poor drainage.
Seasonal high water table; subject to flooding; soft silty material; subject to caving.	Subject to flooding; slow seepage; permeable sandy strata in places.	Poor stability and compaction; slow permeability; high compressibility; poor resistance to piping.	Seasonal high water table for long periods; moderately slow permeability; poor natural drainage; outlets are difficult to obtain; subject to flooding.	Medium infiltration rate; high available moisture capacity; seasonal high water table; subject to flooding.	Nearly level; subject to flooding.	Nearly level; subject to flooding; fertile soil; erodible.
Good drainage; sand and gravel below a depth of 30 to 40 inches; trench walls subject to caving.	Excessive seepage.	Upper 2½ to 3½ feet has good stability and compaction; slow permeability; medium compressibility; good resistance to piping. Substratum has good stability and compaction; rapid permeability; very slight compressibility; good resistance to piping.	Not needed; good natural drainage.	Rapid infiltration rate; medium to low available moisture capacity.	Generally not needed; moderate permeability; short slopes.	Gravelly and droughty in channels; susceptible to erosion.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as a source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Westland: Wc	Poor: seasonal high water table; wet in winter; loamy subsoil.	High: seasonal high water table and high in silt.	Good to a depth of 1 to 2 feet.	Good for gravel and sand below a depth of 2 to 3 feet; well graded; stratified and calcareous.	Fair in subsoil; plastic; moderate shrink-swell potential; good in substratum.	Seasonal high water table; high susceptibility to frost action; subject to ponding.
Wetzel: We	Poor: clayey material; wet.	High: seasonal high water table; high silt and clay content.	Medium to fair: loamy and clayey texture.	Not suitable	Poor: plastic; high shrink-swell potential in subsoil; clayey material.	Poor natural drainage; seasonal high water table; subject to ponding in low areas; clayey material.

[1] Permeability, as stated in this column, refers to the permeability of the soil material after it has been compacted. Statements in

interpretations—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoirs	Dikes, levees, and embankments [1]				
Seasonal high water table; sand and gravel below a depth of 2 to 3 feet; trench walls subject to caving.	Excessive seepage; seasonal high water table.	Upper 2½ to 3½ feet has fair to good compaction and stability; slow permeability; medium compressibility; good resistance to piping. Substratum has good compaction and stability; rapid permeability; good resistance to piping.	Seasonal high water table; moderate permeability; very poor natural drainage; subject to ponding for short periods.	Medium infiltration rate; high available moisture capacity; seasonal high water table.	Nearly level; diversions needed to remove runoff from adjacent higher areas in places.	Seasonal water table; very poor drainage.
Seasonal high water table; subject to ponding in low areas; compact glacial till substratum.	Very slow seepage; seasonal high water table.	Fair stability and compaction; slow permeability; medium compressibility; good resistance to piping.	Poor natural drainage; slow permeability; seasonal high water table.	Medium infiltration rate; high available moisture capacity; seasonal high water table.	Nearly level; poor natural drainage.	Seasonal high water table; moderately erodible; clayey channel.

other columns and elsewhere in the text refer to permeability of the undisturbed soil material.

the wet season. From late in spring through fall, the water table is lower than is shown in table 5, particularly in sloping soils and in soils on uplands.

The estimated rates of permeability, expressed in inches per hour, are based on the movement of water through saturated, undisturbed soils. The rate of permeability depends largely on texture and structure. In soils that contain a large amount of clay or organic matter, the rates are considerably higher when soils are unsaturated.

Available moisture capacity, expressed as inches of water per inch of soil, is the capacity of soils to hold water available for use by most plants. It is the difference between the amount of soil water at field capacity and the amount at wilting point. The factors considered in making the estimates are texture, structure, and organic-matter content.

Shrink-swell potential indicates the volume change to be expected when moisture content changes in the soil. Generally soils classified as CH and A–7 contain a large proportion of plastic fines and have a high shrink-swell potential. Those classified as SM or A–2 have low shrink-swell potential.

The corrosion potential estimated for uncoated steel is based on soil texture, soil drainage, and total acidity. Electrical resistivity is not considered in this rating. The corrosion potential for concrete is based on soil texture and pH value. The rating given is for average concrete. Ratings do not apply to concrete mixed specifically for corrosion resistance.

All of the soils in the county are more than 5 feet over bedrock. Hence, bedrock does not affect their use.

Engineering interpretations

Table 6 lists interpretations of features that affect the suitability of each soil in the county for specific engineering purposes. These interpretations are based on the soil test data in table 4, on estimates of properties in table 5, on mechanical analysis of other soils in the county, and on experience in the field. The column headings are defined briefly in the following paragraphs.

Suitability for winter grading depends on features that affect the ease with which the soil can be moved by construction equipment. The features considered are texture, moisture content, and stability upon thawing. The rating for poorly drained soils is poor, and that for well-drained sandy and gravelly soils is good.

Susceptibility to frost action depends on texture, depth to water table, permeability, and drainage. The degree of frost heaving is determined by the rate of upward capillary flow. The rate of upward capillary flow is determined by the depth to the free water table and the size of connecting vertical pores through which the water must rise. Soils that have moderately slow to moderately rapid permeability have the highest rate of capillary flow. Somewhat poorly drained and poorly drained soils that have moderately slow to moderately rapid permeability are highly susceptible to frost heaving, and so are those that are moderately well drained and have a very fine sandy loam or silt loam texture.

Suitability as a source of topsoil depends on thickness, texture, fertility, stoniness, and organic-matter content of the surface layer.

Suitability as a source of sand and gravel depends on the presence and quality of coarse-grained material. Some areas in the county have been developed commercially and are important sources of building aggregate and highway subgrade material.

Suitability ratings for sources of road fill are based on the estimated AASHO classifications given in table 5. The ratings for well-graded, coarse-grained soils are good. Those for highly plastic, clayey soils and poorly graded silty soils that are difficult to compact and low in stability are poor. Other features considered are depth to bedrock and erodibility.

Highway location refers to both vertical alinement and geographic position. The features considered are drainage, depth to a seasonal high water table, depth to bedrock, and the hazard of flooding. The evaluation is based on the entire profile of an undisturbed soil that has not been artificially drained.

Pipeline construction and maintenance are affected by depth to a seasonal high water table, drainage, depth to bedrock, and stability of soil material in vertical walls.

Pond reservoir areas are affected mainly by the rate of seepage. Depth to bedrock and hazard of flooding also are important. Pond embankments, dikes, and levees are affected by stability, permeability of compacted materials, resistance to piping, and shrink-swell potential. The estimated Unified classification given in table 4 was used to evaluate the features of each soil for use in the embankments.

Agricultural drainage is affected by natural drainage, permeability, depth to water table, and depth to bedrock. Drainage is needed for maximum crop yields on all soils that are somewhat poorly drained to very poorly drained. Both tile and surface drains generally are required for adequate drainage of soils that have moderately slow to very slow permeability. Surface drains are needed where good outlets for subsurface drains are not available and where rock is near enough to the surface to interfere with installation of subsurface drains.

Irrigation is affected by natural drainage, permeability, infiltration rate, available moisture capacity, and fertility. Soils suitable for irrigation take in water at the rate of half an inch to an inch an hour. Steepness or poor soil structure causes water to run off rather than soak in. Adequate drainage is essential. Excess water must be removed and waterlogging prevented to allow aeration of plant roots and good growth of plants.

Terraces and diversions are affected mainly by the slope and erodibility of the soil. Terraces are not necessary on nearly level soils and are not suitable if the slope is more than 12 percent. Terraces shorten slopes, slow runoff, and reduce the hazard of erosion. Diversions are used to intercept runoff from adjacent areas. They are difficult to construct if the slope is more than 12 percent.

Waterways are affected by the slope and erodibility of the soil. Grassed waterways are used to prevent the formation of gullies in natural drainageways and to remove excess surface water from sloping areas.

Town and Country Planning

Land use in Union County is diversified. Most of the land has been used for farming, but the acreage used for residential, commercial, industrial, and recreational purposes is increasing. New development is most rapid in

Paris, Mill Creek, and Jerome Townships adjacent to Franklin County and the Columbus area.

Table 7 shows estimates of the degree and kind of limitation of each of the soils in the county for farming and other specified uses. The degree of limitation is based on soil properties. A rating of *slight* indicates that the limitation is not important and is easily overcome. A rating of *moderate* indicates that overcoming the limitation is generally feasible. A rating of *severe* indicates that the limitation is difficult and costly to overcome and that the use of the soil for the particular purpose is questionable although not impossible.

The column headings in table 7 are explained in the following paragraphs.

Farming.—The degree of limitation for farming is based on the land capability classification system, which is explained in the section "Capability Grouping."

Onsite disposal of sewage effluent.—Many homes built in areas that have no public sewage disposal systems must have individual septic tanks and filter fields. The degree of limitation for this use depends largely on depth to the water table, hazard of flooding, permeability, and slope.

A high water table that persists for an extended period interferes with the functioning of a filter field, because effluent discharged below the water table does not seep away. In slowly permeable soils, the seepage of effluent is very slow. If the soils have a sandy or gravelly substratum, effluent may seep away without adequate filtration and pollute nearby streams and other water sources. If a filter field has a steep slope, effluent may seep to the surface in the lower part of the slope.

Sewage lagoons.—Shallow ponds built to impound and treat sewage are used in some areas where septic tanks or a central sewage system is not practical. Among the features that control the degree of limitation are the hazard of flooding, degree of slope, permeability of the soil, and depth to seasonal high water table.

Homesite location.—The degrees of limitation for homesite location also apply to commercial, institutional, and light industrial buildings that have basements and are no more than three stories high. They depend largely on slope, natural drainage, and the hazard of flooding. Methods of sewage disposal are not considered.

Basements in poorly drained and somewhat poorly drained soils are likely to be wet unless foundations are drained. By means of extensive systems of tile drains and open ditches, large areas of the wet soils in Union County have been made suitable for farming. Excavations for building are apt to disrupt artificial drainage systems. A combination of poor natural drainage and silty texture makes soils soft and compressible, and consequently, the soils are unfavorable for foundations. Heaving and cracking of foundations can be expected if the soils have a high shrink-swell potential. Flooding, even if infrequent, causes severe damage.

Lawns, landscaping, golf fairways.—The degree of limitation for these uses depends on natural drainage, slope, depth to bedrock, texture of surface layer, stoniness, hazard of flooding, and available moisture capacity. Generally, the original surface layer in an area is better for growing lawn grasses and ornamentals than either fill brought from other areas or soil material taken from excavations. The surface layer can be scalped before construction is begun, stored away from the construction site and then replaced after construction and grading are finished. The natural surface layer removed in grading for streets also can be used for lawns.

The amount of supplemental watering that will be needed to maintain a lawn depends largely on the depth and kind of soil. This is important in parts of the county where water is scarce. Grading of steep slopes can cause erosion.

Streets and parking lots.—The degree of limitation for streets and parking lots is based on depth to the water table, slope, and hazard of flooding. It applies only to residential streets that carry a minimum of heavy-duty traffic. Soils that have severe limitations can be located on the soil map and avoided if possible. If they cannot be avoided, the problems associated with their use can be identified.

Estimates of soil properties important in highway construction and maintenance also are given in the section "Engineering Uses of the Soils."

Athletic fields.—The degree of limitation for athletic fields and other intensive play areas depends largely on natural drainage, slope, permeability, texture of the surface layer, and the hazard of flooding. It is assumed that no fill is to be used. Well-drained, medium-textured soils have only slight limitations. Soils that are wet, steep, very sandy, very clayey, or very shallow have severe limitations. Flooding is a severe limitation. The degree of limitation for athletic fields can be slight or moderate, depending on the frequency and duration of flooding.

Parks and play areas.—Parks and play areas can be located on many kinds of soils that provide a variety of wildlife and natural vegetation. Considered in rating the soils for this use are natural drainage, slope, and the hazard of flooding. Paths in these areas should be constructed and maintained in a way that helps to control erosion.

Campsites.—Campsites have to be suitable, without surfacing, for parking cars and trailers and for outdoor living during the camping season. The degree of limitation depends largely on the drainage and the hazard of flooding. Permeability, slope, and soil texture also are important. Well drained and moderately well drained soils have the fewest limitations. Poorly drained and very poorly drained soils, soils in depressions, and soils subject to flooding have the most limitations. Permeable soils are less limited than impermeable ones, because they dry more quickly. A slope of less than 12 percent is best for tent sites. Slope is more critical for trailer sites than it is for tent sites. Medium-textured soils have less severe limitations than either coarse-textured or fine-textured soils.

Sanitary landfill.—Among the properties that affect the degrees of limitation for sanitary landfill are drainage, hazard of flooding, slope, texture, and permeability. Natural drainage is a critical factor. Soils that are subject to flooding are severely limited. Slope is important, because heavy equipment is used, and erosion is a hazard on bare slopes. Coarse-textured soils have less severe limitations than medium-textured soils and fine-textured soils, because they are easier to move. The risk of contaminating ground water limits the use of permeable soils.

TABLE 7.—*Estimated degree and kinds of limitations of*

Soil series and map symbols	Farming (cultivated crops only)	Onsite disposal of sewage effluent	Sewage lagoons	Homesite location[1] (three stories or less)	Lawns, landscaping, golf fairways
Algiers: Ag	Slight: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding or ponding.	Severe: subject to flooding.	Severe: subject to flooding; seasonal high water table.
Blount:					
BoA	Slight	Severe: slow permeability.	Slight	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; slow permeability.
BoB	Slight	Severe: slow permeability.	Moderate: slope.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; slow permeability.
BoB2	Moderate: slope.	Severe: slow permeability.	Moderate: slope.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; slow permeability.
Brookston: Bs	Slight	Severe: slow permeability; seasonal high water table; subject to ponding.	Slight	Severe: very poorly drained.	Severe: very poorly drained.
Celina:					
CeA	Slight	Severe: moderately slow permeability.	Slight	Slight	Slight
CeB	Slight	Severe: moderately slow permeability.	Moderate: slope.	Slight	Slight
Crosby:					
CrA	Slight	Severe: slow permeability.	Slight	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
CrB	Slight	Severe: slow permeability.	Moderate: slope	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Cut and fill land: Cu. Material too variable. Onsite investigation required.					
Eel: Ee	Slight	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.

See footnotes at end of table.

soils to be considered in town and country planning

Streets and parking lots	Athletic fields	Parks and play areas	Campsites		Sanitary land-fill	Cemeteries
			Tents	Trailers		
Severe: subject to flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained; slow permeability.	Severe: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained; clay loam texture.	Severe: somewhat poorly drained; slow permeability.
Moderate: somewhat poorly drained; slope.	Moderate: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained; slow permeability.	Severe: somewhat poorly drained; slow permeability; slope.	Moderate: somewhat poorly drained; slow permeability.	Severe: somewhat poorly drained; slow permeability.
Moderate: somewhat poorly drained; slope.	Moderate: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained; slow permeability.	Severe: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained; clay loam texture.	Severe: somewhat poorly drained; slow permeability.
Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.
Slight	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability; moderately well drained.
Moderate: slope.	Moderate: slope; moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Moderate: slope; moderately slow permeability.	Slight	Moderate: moderately slow permeability; moderately well drained.
Moderate: somewhat poorly drained.	Severe: slow permeability.	Moderate: somewhat poorly drained.	Severe: slow permeability.	Severe: slow permeability.	Severe: seasonal high water table.	Severe: slow permeability.
Moderate: somewhat poorly drained.	Severe: slow permeability.	Moderate: somewhat poorly drained.	Severe: slow permeability.	Severe: slow permeability.	Severe: seasonal high water table.	Severe: slow permeability.
Severe: subject to flooding.	Slight: subject to flooding.	Slight: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.

TABLE 7.—*Estimated degree and kinds of limitations of*

Soil series and map symbols	Farming (cultivated crops only)	Onsite disposal of sewage effluent	Sewage lagoons	Homesite location[1] (three stories or less)	Lawns, landscaping, golf fairways
Fox:					
FoA	Slight	Slight [2]	Severe: rapid permeability in substratum.[2]	Slight	Moderate: low to medium available moisture capacity.
FoB, FoB2	Slight	Slight [2]	Severe: rapid permeability in substratum.[2]	Slight	Moderate: low to medium available moisture capacity.
FoC2	Moderate: erosion hazard.	Moderate: slope.[2]	Severe: rapid permeability in substratum.[2]	Moderate: slope.	Moderate: available moisture capacity is low to medium; slope.
Genesee: Gn	Slight	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Gravel pits: Gp. Material too variable. Onsite investigation required.					
Henshaw: HeA	Slight	Severe: moderately slow permeability.	Slight	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; moderately slow permeability.
Homer: Ho	Slight	Moderate: somewhat poorly drained.[2]	Severe: rapid permeability in substratum.[2]	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Kane: Ka	Slight	Moderate: somewhat poorly drained.[2]	Severe: rapid permeability in the substratum.[2]	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Kendallville:					
KeA	Slight	Severe: moderately slow permeability.	Slight	Slight	Slight
KeB	Slight	Severe: moderately slow permeability.	Moderate: slope.	Slight	Slight
Lippincott: Lc	Slight	Severe: very poorly drained.[2]	Severe: rapid permeability in substratum.[2]	Severe: very poorly drained.	Severe: very poorly drained.
Miamian:					
MlB	Slight	Severe: moderately slow permeability.	Moderate: slope.	Slight	Slight
MlC2	Moderate: slope; erosion hazard.	Severe: moderately slow permeability.	Severe: slope	Moderate: slope	Moderate: slope
MlD2, MlF2	Severe: slope; erosion hazard.	Severe: slope; moderately slow permeability.	Severe: slope	Severe: slope	Severe: slope

See footnotes at end of table.

soils to be considered in town and country planning—Continued

Streets and parking lots	Athletic fields	Parks and play areas	Campsites: Tents	Campsites: Trailers	Sanitary landfill	Cemeteries
Slight	Slight	Slight	Slight	Slight	Severe: rapid permeability in substratum.[2]	Slight.
Moderate: slope.	Moderate: slope.	Slight	Slight	Moderate: slope.	Severe: rapid permeability in substratum.[2]	Slight.
Severe: slope	Severe: slope	Moderate: slope.	Moderate: slope.	Severe: slope	Moderate: rapid permeability in substratum.[2]	Moderate: slope.
Severe: subject to flooding.	Slight: subject to flooding.	Slight: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; moderately slow permeability.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; moderately slow permeability.	Moderate: somewhat poorly drained; moderately slow permeability.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: rapid permeability in substratum.[2]	Moderate: somewhat poorly drained.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: rapid permeability in substratum.[2]	Moderate: somewhat poorly drained.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Moderate: slope.	Moderate: slope.	Slight	Slight	Moderate: slope.	Slight	Slight.
Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained; rapid permeability in substratum.[2]	Severe: very poorly drained.
Moderate: slope.	Moderate: slope; modately slow permeability.	Slight	Moderate: moderately slow permeability.	Moderate: slope; moderately slow permeability.	Slight	Moderate: moderately slow permeability.
Severe: slope	Severe: slope	Moderate: slope.	Moderate: slope; moderately slow permeability.	Severe: slope	Moderate: slope.	Moderate: slope; modately slow permeability.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

TABLE 7.—*Estimated degree and kinds of limitations of*

Soil series and map symbols	Farming (cultivated crops only)	Onsite disposal of sewage effluent	Sewage lagoons	Homesite location [1] (three stories or less)	Lawns, landscaping, golf fairways
Montgomery: Mn	Moderate: wetness.	Severe: slow permeability; very poorly drained.	Slight	Severe: very poorly drained.	Severe: very poorly drained.
Morley:					
MrB	Slight	Severe: slow permeability.	Moderate: slope.	Slight	Slight
MrB2	Moderate: erosion hazard.	Severe: slow permeability.	Moderate: slope.	Slight	Slight
MrC, MrC2	Moderate: erosion hazard.	Severe: slow permeability.	Severe: slope	Moderate: slope.	Moderate: medium available water capacity; slope.
MrD2, MrE2, MrF2	Severe: slope; erosion hazard.	Severe: slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope
Muskego: Mu	Moderate: high water table.	Severe: high water table.	Severe: organic soil.	Severe: very poorly drained; soft and unstable.	Severe: very poorly drained.
Nappanee:					
NpA	Moderate: wetness.	Severe: very slow permeability.	Slight	Moderate: somewhat poorly drained.	Severe: very slow permeability.
NpB	Moderate: wetness.	Severe: very slow permeability.	Moderate: slope.	Moderate: somewhat poorly drained.	Severe: very slow permeability.
Odell: OdA	Slight	Moderate: somewhat poorly drained.	Slight	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Paulding: Pa	Moderate: wetness.	Severe: very slow permeability; very poorly drained.	Slight	Severe: very poorly drained.	Severe: very poorly drained; very slow permeability; clayey surface layer.
Pewamo: Pm	Slight	Severe: moderately slow permeability; very poorly drained.	Slight	Severe: very poorly drained.	Severe: very poorly drained; some ponding; moderately slow permeability.
Quarries: Qu. Material too variable. Onsite investigation required.					
Ross: Ro	Slight	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.

See footnotes at end of table.

soils to be considered in town and country planning—Continued

Streets and parking lots	Athletic fields	Parks and play areas	Campsites: Tents	Campsites: Trailers	Sanitary land-fill	Cemeteries
Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.
Moderate: slope.	Severe: slow permeability.	Slight	Severe: slow permeability.	Severe: slow permeability.	Slight	Severe: slow permeability.
Moderate: slope.	Severe: slow permeability.	Slight	Severe: slow permeability.	Severe: slow permeability.	Slight	Severe: slow permeability.
Severe: slope	Severe: slope; slow permeability.	Moderate: slope.	Severe: slow permeability; slope.	Severe: slope; slow permeability.	Moderate: slope.	Moderate: slope.
Severe: slope	Severe: slope; slow permeability.	Severe: slope	Severe: slope; slow permeability.	Severe: slope; slow permeability.	Severe: slope	Severe: slope.
Severe: very poorly drained; soft and unstable.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.
Moderate: somewhat poorly drained.	Severe: very slow permeability.	Moderate: somewhat poorly drained.	Severe: very slow permeability.	Severe: very slow permeability.	Severe: clayey layer.	Severe: very slow permeability; somewhat poorly drained; clayey layer.
Moderate: somewhat poorly drained; slope.	Severe: very slow permeability.	Moderate: somewhat poorly drained.	Severe: very slow permeability.	Severe: very slow permeability.	Severe: clayey layer.	Severe: very slow permeability; somewhat poorly drained; clayey layer.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: very poorly drained.	Severe: very poorly drained; very slow permeability; clayey surface layer.	Severe: very poorly drained; clayey surface layer.	Severe: very poorly drained; very slow permeability; clayey surface layer.	Severe: very poorly drained; very slow permeability; clayey surface layer.	Severe: very poorly drained; clayey layer.	Severe: very poorly drained; clayey layer.
Severe: very poorly drained.	Severe: very poorly drained; moderately slow permeability.	Severe: very poorly drained.	Severe: very poorly drained; moderately slow permeability.	Severe: very poorly drained; moderately slow permeability.	Severe: very poorly drained.	Severe: very poorly drained; moderately slow permeability.
Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.

TABLE 7.—*Estimated degree and kind of limitation of*

Soil series and map symbols	Farming (cultivated crops only)	Onsite disposal of sewage effluent	Sewage lagoons	Homesite location [1] (three stories or less)	Lawns, landscaping, golf fairways
St. Clair:					
ScB, ScB2	Moderate: erosion hazard.	Severe: very slow permeability.	Moderate: slope.	Slight	Severe: very slow permeability.
ScC, ScC2	Severe: erosion hazard.	Severe: very slow permeability; slope.	Severe: slope	Moderate: slope.	Severe: very slow permeability; slope.
Shoals: Sh	Slight	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Sleeth: SlA	Slight	Moderate: somewhat poorly drained.[2]	Severe: rapid permeability in substratum.[2]	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Sloan: So	Moderate: wetness.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Warsaw: WaB	Slight	Slight [2]	Severe: rapid permeability in substratum.[2]	Slight	Slight
Westland: Wc	Slight	Severe: very poorly drained.[2]	Severe: rapid permeability in substratum.[2]	Severe: very poorly drained.	Severe: very poorly drained.
Wetzel: We	Slight	Severe: very poorly drained; slow permeability.	Slight	Severe: very poorly drained.	Severe: very poorly drained.

[1] Small industrial, institutional, and commercial buildings of three stories or less and a basement.
[2] Possible pollution hazard to nearby wells, springs, lakes, or ponds because filtration is inadequate.

the soils for town and country planning—Continued

Streets and parking lots	Athletic fields	Parks and play areas	Campsites		Sanitary land-fill	Cemeteries
			Tents	Trailers		
Moderate: slope.	Severe: very slow permeability.	Slight	Severe: very slow permeability.	Severe: very slow permeability.	Severe: clayey layer.	Severe: very slow permeability; clayey layer.
Severe: slope	Severe: slope; very slow permeability.	Moderate: slope.	Severe: very slow permeability; slope.	Severe: slope; very slow permeability.	Severe: clayey layer.	Severe: very slow permeability; clayey layer.
Severe: subject to flooding.	Severe: subject to flooding; somewhat poorly drained.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: rapid permeability in substratum.[2]	Moderate: somewhat poorly drained.
Severe: subject to flooding.	Severe: subject to flooding; very poorly drained.	Severe: subject to flooding; very poorly drained.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Moderate: slope.	Moderate: slope.	Slight	Slight	Slight	Severe: rapid permeability in substratum.[2]	Slight.
Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.
Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained; slow permeability; clayey surface layer.	Severe: very poorly drained; slow permeability; clayey surface layer.	Severe: very poorly drained; slow permeability; clayey layer.	Severe: very poorly drained; clayey layer.	Severe: very poorly drained; clayey layer.

Cemeteries.—The principal soil property that affects the degree of limitation for cemeteries is natural drainage. Others are flooding, texture, and slope. The limitation is *slight* if drainage is good, *moderate* if it is moderately good, and *severe* if it is poor or somewhat poor. All soils that are subject to flooding are severely limited. If graves are dug below the water table, they will fill with water. Medium-textured soils have fewer limitations than coarse-textured soils or fine-textured soils. Slope is important because it affects trafficability.

Descriptions of the Soils

This section describes the soil series and mapping units in Union County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a moist soil.

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

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 8. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*12*).

Algiers Series

The Algiers series consists of level, somewhat poorly drained soils on flood plains throughout the county. These soils formed in a layer of recent loamy alluvium 14 to 22 inches thick and the underlying dark-colored, loamy to clayey alluvium. The alluvium was washed from areas where the soils formed mainly in calcareous glacial till.

In a representative profile in a cultivated area the plow layer is dark grayish-brown silt loam 11 inches thick. Beneath the plow layer is 8 inches of dark grayish-brown silt loam, 11 inches of very dark grayish-brown silty clay loam, 8 inches of dark-gray light silty clay mottled with yellowish brown, 9 inches of gray silty clay loam mottled with yellowish brown and very dark gray, and 13 inches or more of grayish-brown clay loam mottled with yellowish brown and gray.

The water table is high during wet periods, and flooding is a hazard. If drainage is adequate, the root zone is deep and has high available water capacity. It is slightly acid to neutral. Permeability is moderate to a depth of about 19 inches and slow below that depth.

These soils are used mostly for crops and pasture. In adequately drained areas, corn and soybeans are the principal crops. Bluegrass is the main pasture plant.

Representative profile of Algiers silt loam in a cultivated field in Leesburg Township, 5½ miles northeast of Marysville, 1,387 feet northwest of intersection of County Road 196 and State Route 4, adjacent to a tributary of Blues Creek:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary.

C—11 to 19 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; slightly acid; clear, wavy boundary.

IIAb—19 to 30 inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, medium, granular structure; firm; a few continuous black (10YR 2/1) organic coatings; moderately alkaline; clear, smooth boundary.

IIB21b—30 to 38 inches, dark-gray (10YR 4/1) light silty clay; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm, plastic when wet; thin, patchy; black (10YR 2/1) clay films; moderately alkaline; clear, wavy boundary.

IIB22bg—38 to 47 inches, gray (10YR 5/1) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/4) and very dark gray (10YR 3/1) mottles; moderate, medium, subangular blocky structure; firm, plastic when wet; thin, patchy, very dark gray (10YR 3/1) clay films; moderately alkaline; clear, wavy boundary.

IIB3bg—47 to 60 inches, grayish-brown (10YR 5/2) clay loam; common, fine, faint, yellowish-brown (10YR 5/4) and gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; firm, plastic when wet; a few thin gray (10YR 5/1) clay films on vertical ped faces; moderately alkaline.

The Ap and C horizons are neutral to slightly acid. The Ap horizon is dominantly dark grayish brown (10YR 4/2) or dark brown (10YR 4/3) when rubbed. The IIAb and IIB21b horizons range from black (N 2/0) to very dark gray (10YR 3/1) and are dark brown (10YR 3/3) when rubbed.

Algiers soils are adjacent to the moderately well drained Eel soils, the somewhat poorly drained Shoals soils, and the very poorly drained Sloan soils. They have an A horizon similar to that of Eel and Shoals soils, but they are underlain by very dark grayish brown instead of brown material. They are more poorly drained than Eel soils. They have a lighter colored A horizon than Sloan soils.

Algiers silt loam (Ag).—Most areas of this soil are along the major streams and are 10 to 20 acres in size. Areas along the smaller streams are long, narrow, and winding.

Included in mapping are small areas of very poorly drained, dark-colored Sloan soils.

TABLE 8.—*Acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Algiers silt loam	343	0.1
Blount silt loam, 0 to 2 percent slopes	72,305	26.0
Blount silt loam, 2 to 6 percent slopes	43,715	15.7
Blount silt loam, 2 to 6 percent slopes, moderately eroded	407	.1
Brookston silty clay loam	17,459	6.3
Celina silt loam, 0 to 2 percent slopes	67	(1)
Celina silt loam, 2 to 6 percent slopes	1,181	.4
Crosby silt loam, 0 to 2 percent slopes	9,718	3.5
Crosby silt loam, 2 to 6 percent slopes	1,040	.4
Cut and fill land	176	.1
Eel silt loam	1,721	.6
Fox silt loam, 0 to 2 percent slopes	2,362	.8
Fox silt loam, 2 to 6 percent slopes	1,314	.5
Fox silt loam, 2 to 6 percent slopes, moderately eroded	166	.1
Fox silt loam, 6 to 12 percent slopes, moderately eroded	64	(1)
Genesee silt loam	3,006	1.1
Gravel pits	147	.1
Henshaw silt loam, 0 to 2 percent slopes	455	.2
Homer silt loam	339	.1
Kane silt loam	81	(1)
Kendallville silt loam, 0 to 2 percent slopes	106	(1)
Kendallville silt loam, 2 to 6 percent slopes	299	.1
Lippincott silty clay loam	1,641	.6
Miamian silt loam, 2 to 6 percent slopes	566	.2
Miamian silt loam, 6 to 12 percent slopes, moderately eroded	150	.1
Miamian silt loam, 12 to 18 percent slopes, moderately eroded	54	(1)
Miamian silt loam, 18 to 35 percent slopes, moderately eroded	49	(1)
Montgomery silty clay loam	2,093	.8
Morley silt loam, 2 to 6 percent slopes	18,899	6.8
Morley silt loam, 2 to 6 percent slopes, moderately eroded	2,489	0.9
Morley silt loam, 6 to 12 percent slopes	652	.2
Morley silt loam, 6 to 12 percent slopes, moderately eroded	5,920	2.1
Morley silt loam, 12 to 18 percent slopes, moderately eroded	850	.3
Morley silt loam, 18 to 25 percent slopes, moderately eroded	90	(1)
Morley silt loam, 25 to 50 percent slopes, moderately eroded	53	(1)
Muskego muck	135	(1)
Nappanee silt loam, 0 to 2 percent slopes	7,570	2.7
Nappanee silt loam, 2 to 6 percent slopes	8,980	3.2
Odell silt loam, 0 to 2 percent slopes	142	.1
Paulding silty clay	7,936	2.9
Pewamo silty clay loam	25,209	9.1
Quarries	77	(1)
Ross silt loam	831	.3
St. Clair silt loam, 2 to 6 percent slopes	3,049	1.1
St. Clair silt loam, 2 to 6 percent slopes, moderately eroded	725	.3
St. Clair silt loam, 6 to 12 percent slopes	114	(1)
St. Clair silt loam, 6 to 12 percent slopes, moderately eroded	706	.3
Shoals silt loam	1,538	.6
Sleeth silt loam, 0 to 2 percent slopes	322	.1
Sloan silty clay loam	2,610	1.0
Warsaw silt loam, 1 to 4 percent slopes	94	(1)
Westland silty clay loam	1,450	.5
Wetzel silty clay loam	25,979	9.4
Subtotal	277,444	
Water areas	316	.1
Total	277,760	100.0

1 Less than 0.1 percent.

Natural wetness is a moderate limitation to all farm uses. Flooding is a severe limitation to most nonfarm uses. Capability unit IIw–2.

Blount Series

The Blount series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in calcareous glacial till of silty clay loam or clay loam texture. They are on uplands north of Big Darby Creek.

In a representative profile in a cultivated area the plow layer is dark grayish-brown silt loam about 6 inches thick. The subsoil is 25 inches thick. In sequence from the top, it is 4 inches of grayish-brown to brown silty clay loam mottled with yellowish brown; 12 inches of grayish-brown and yellowish-brown silty clay that has grayish-brown coatings on structure faces; and 9 inches of gray and yellowish-brown silty clay loam. The underlying material, reaching to a depth of 60 inches or more, is gray and yellowish-brown, calcareous, clay loam till.

Blount soils have a seasonal high water table. The gray mottling in the subsoil indicates natural wetness. Permeability is slow. The fine-textured subsoil and the compact underlying till tend to limit the depth of root penetration. The root zone is moderately deep if the soil is adequately drained. It is slightly acid and has medium available moisture capacity.

These soils are well suited to the crops commonly grown in the county. The main crops are corn, soybeans, small grain, and hay.

Representative profile of Blount silt loam, 0 to 2 percent slopes, in a cultivated field in Allen Township, 1 mile southwest of Allen Center, 825 feet northwest of County Road 148–B, and 2,900 feet northeast of County Road 160 (Sample UN–16 in Laboratory data).

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; common roots; neutral; abrupt, smooth boundary.

B1t—6 to 10 inches, grayish-brown (10YR 5/2) to brown (10YR 5/3) silty clay loam; common, fine, faint, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; thin, patchy, pale-brown (10YR 6/3) clay films on ped faces; few roots; slightly acid; clear, smooth boundary.

B21t—10 to 12 inches, grayish-brown (10YR 5/2) silty clay; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium and coarse, subangular blocky structure; firm; thin, patchy, pale-brown (10YR 6/3) clay films on ped faces; few roots; slightly acid; clear, smooth boundary.

B22t—12 to 22 inches, yellowish-brown (10YR 5/4) silty clay; moderate, medium, subangular blocky structure; very firm; few roots; medium, continuous, grayish-brown (2.5Y 5/2) clay films on ped faces; slightly acid; clear, irregular boundary.

B3t—22 to 31 inches, gray (10YR 5/1) and yellowish-brown (10YR 5/4) silty clay loam; weak, coarse, subangular blocky structure; very firm; thin, patchy, light brownish-gray (10YR 6/2) clay films on ped faces; moderately alkaline and calcareous; gradual, wavy boundary.

C—31 to 60 inches, gray (5Y 5/1) and yellowish-brown (10YR 5/8) clay loam till; massive; very firm; mildly alkaline and calcareous.

In wooded areas the A1 horizon is very dark grayish brown (10YR 3/2), is 2 to 5 inches thick, and is underlain by 3 to 7 inches of A2 material. The B2t horizon ranges from grayish brown (10YR 5/2) to yellowish brown (10YR 5/4) and has films of pale brown (10YR 6/3), grayish brown (2.5Y 5/2), and dark grayish brown (2.5Y 4/2). The B2t horizon is silty clay or clay, is very strongly acid to neutral, and ranges from 10 to 16 inches in thickness. The lower part in places has coarse prismatic structure that parts to subangular blocky. A B3t horizon is present in most places below a depth of 20 to 40 inches. Depth to the B3t horizon and to calcareous material averages about 28 inches. The C horizon is glacial till of clay loam and silty clay loam texture. In some places the soil has a silt capping as much as 14 inches thick.

Blount soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Morley soils and the darker colored, very poorly drained Pewamo and Wetzel soils. Their B horizon is less clayey than that of Nappanee soils and is more compact and somewhat more clayey than that of Crosby soils.

Blount silt loam, 0 to 2 percent slopes (BoA).—This soil has the profile described as representative of the series. Most areas are oval and about 5 to 25 acres in size. Included in mapping are spots of the very poorly drained Pewamo and Wetzel soils in depressions and swales.

Seasonal wetness is a moderate limitation if this soil is used for cultivated crops. Runoff is slow. Wetness also limits most nonfarm uses. Capability unit IIw–5.

Blount silt loam, 2 to 6 percent slopes (BoB).—This gently sloping soil is in broad areas about 5 to 30 acres in size. Included in mapping are small areas of Morley soils on small, oval knolls; and a few small areas of Pewamo and Wetzel soils in depressions and drainageways.

Seasonal wetness is a moderate limitation if this soil is used for crops. Runoff is moderate. Erosion is a hazard on long slopes in cultivated areas. Wetness limits most nonfarm uses. Capability unit IIw–5.

Blount silt loam, 2 to 6 percent slopes, moderately eroded (BoB2).—The plow layer of this soil is a mixture of the original surface layer and the upper part of the subsoil. Absorption and release of moisture are slower than in the uneroded Blount soils. Included in mapping are small areas of Morley soils on oval knolls and spots of Pewamo and Wetzel soils in depressions and drainageways.

The hazard of erosion is severe if this soil is used for row crops. Runoff is moderate. Wetness limits all farm and most nonfarm uses. Capability unit IIIe–2.

Brookston Series

The Brookston series consists of dark-colored, level to nearly level soils that are very poorly drained. These soils formed in calcareous, loamy glacial till. They are on uplands in the Darby Plain region in the southern part of the county.

In a representative profile in a cultivated area the plow layer is black silty clay loam 11 inches thick. The subsoil is 39 inches thick. In sequence from the top, it is 4 inches of black silty clay loam mottled with grayish brown; 7 inches of dark-gray silty clay loam mottled with light olive brown; 12 inches of grayish-brown silty clay loam mottled with yellowish brown; and 16 inches of olive-gray silt loam mottled with yellowish brown. The underlying material at a depth of 50 inches is gray loam glacial till mottled with yellowish brown.

Brookston soils have a seasonal high water table. The gray mottling in the subsoil indicates natural wetness.

Permeability is slow. The root zone is deep if drainage is adequate. It is only slightly acid in the most acid horizon. Available moisture capacity is high.

These soils are well suited to the crops commonly grown in the county. Corn, soybeans, small grain, and hay are the main crops.

Representative profile of Brookston silty clay loam in a cultivated area in Darby Township, 1 mile southwest of Unionville Center, 2,640 feet east of County Road 44, 1,200 feet south of the Penn-Central Railroad tracks:

Ap1—0 to 4 inches, black (10YR 2/1) silty clay loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

Ap2—4 to 11 inches, black (10YR 2/1) silty clay loam; weak, medium, granular structure; firm; neutral; abrupt, smooth boundary.

B21tg—11 to 15 inches (10YR 2/1) silty clay loam; few, fine, faint, dark grayish-brown (2.5Y 4/2) mottles; strong, fine and medium, angular blocky structure; firm; thin, patchy, very dark grayish-brown (10YR 3/2) clay films on vertical ped faces; slightly acid; clear, wavy boundary.

B22tg—15 to 22 inches, dark-gray (N 4/0) silty clay loam; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; moderate, medium, prismatic structure parting to strong, medium, angular blocky; very firm; thin, continuous, dark grayish-brown (2.5Y 4/2) clay films on vertical and many horizontal ped faces; neutral; clear, smooth boundary.

B23tg—22 to 34 inches, grayish-brown (2.5Y 5/2) silty clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; strong, medium, prismatic structure; very firm; thin, patchy, dark grayish-brown (2.5Y 4/2) clay films on vertical ped faces; few, fine, distinct, very dark brown (10YR 2/2) oxide concretions; 2 percent coarse fragments; few black (10YR 2/1) krotovina channels; mildly alkaline; clear, irregular boundary.

B3tg—34 to 50 inches, olive-gray (5Y 5/2) silt loam; many, fine and medium, prominent, yellowish-brown (10YR 5/8) mottles; massive; firm; thin, patchy, gray (5Y 5/1) clay films in cracks; a few black (10YR 2/1) krotovina channels; 2 percent coarse fragments of dolomite; mildly alkaline and calcareous; clear, wavy boundary.

C—50 to 60 inches, gray (5Y 5/1) loam; many, medium, prominent, yellowish-brown (10YR 5/8) mottles; massive; firm; mildly alkaline and calcareous.

The A horizon is slightly acid to neutral, ranges from 11 to 17 inches in thickness, and in black (10YR 2/1) or very dark gray (10YR 3/1). The B21tg horizon is black (10YR 2/1) or very dark gray (10YR 3/1). The B22tg horizon is neutral. It has hues of 10YR, 2.5Y, or 5Y; values of 4 or 5; and chromas of 1 or 2. The B2 horizon is silty clay loam or clay loam and is slightly acid to mildly alkaline. Depth to calcareous material ranges from 21 to 45 inches but is typically 27 to 38 inches. The C horizon is loam or silt loam. In some places the soil has a silt capping as much as 14 inches thick.

Brookston soils are the dark-colored, very poorly drained members of a drainage sequence that includes the somewhat poorly drained Crosby soils, the moderately well drained Celina soils, and the well drained Miamian soils. They have a lower content of clay than Pewamo and Wetzel soils.

Brookston silty clay loam (Bs).—The surface layer of this level or nearly level soil is high in content of organic matter. If this soil is cultivated at the optimum moisture content it has good structure. Tilth generally is good. Ponding is likely in undrained areas. Included in mapping are many spots of the somewhat poorly drained Crosby and Odell soils on small, low knolls.

Seasonal wetness is a moderate limitation to all farm and nonfarm uses. Capability unit IIw-6.

Celina Series

The Celina series consists of nearly level to gently sloping soils that are moderately well drained. These soils formed in calcareous, loamy glacial till. They are in the Darby Plain region in the southern part of the county.

In a representative profile the plow layer is dark grayish-brown silt loam 8 inches thick. The subsurface layer is brown silt loam 2 inches thick. The subsoil is 22 inches thick. In sequence from the top, it is 3 inches of dark-brown silt loam; 4 inches of yellowish-brown silty clay loam; 4 inches of dark-brown light silty clay mottled with yellowish brown and grayish brown; and 7 inches of yellowish-brown and brown light silty clay and silty clay loam mottled with grayish brown. The substratum to a depth of 60 inches or more is brown, calcareous silt loam till.

Celina soils are saturated for short periods, mostly in spring, and tillage is delayed. Permeability is moderately slow. The underlying compact glacial till limits root penetration. The root zone is moderately deep, is medium acid, and has medium available water capacity.

These soils are used mainly for field crops, chiefly corn, soybeans, small grain, and hay.

Representative profile of Celina silt loam, 2 to 6 percent slopes, in a cultivated field in Union Township, 1½ miles south of Milford Center, one-half mile east of State Route 4 and U.S. Route 36, 450 feet north of County Road 65:

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

A2—8 to 10 inches, brown (10YR 5/3) silt loam; weak, fine, subangular blocky structure; friable; thin, dark grayish-brown (10YR 4/2) coatings on ped faces;

B1—10 to 13 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, subangular blocky structure; friable; dark grayish-brown (10YR 4/2) coatings on ped faces; medium acid; clear, smooth boundary.

IIB21t—13 to 17 inches, yellowish-brown (10YR 5/4) silty clay loam; strong, medium, subangular blocky structure; firm; thin, continuous, dark-brown (10YR 4/3) clay films on ped faces; 2 percent coarse fragments; medium acid; gradual, smooth boundary.

IIB22t—17 to 21 inches, brown (10YR 5/3) heavy silty clay loam; common, fine, faint, grayish-brown (10YR 5/2) mottles; strong, medium, subangular and angular blocky structure; firm; thin, continuous, dark-brown (10YR 4/3) clay films on ped faces; 5 percent coarse fragments; medium acid; clear, smooth boundary.

IIB23t—21 to 25 inches, dark-brown (10YR 4/3) light silty clay; many, fine, distinct, yellowish-brown (10YR 5/4) mottles and common, fine, faint, grayish-brown (10YR 5/2) mottles; strong, coarse, angular blocky structure; very firm; medium, continuous, dark grayish-brown (10YR 4/2) clay films on ped faces; 5 percent coarse fragments; slightly acid; clear, smooth boundary.

IIB24t—25 to 30 inches, yellowish-brown (10YR 5/4) light silty clay; common, fine, faint, grayish-brown (10YR 5/2 mottles; strong, coarse, angular blocky structure; firm; medium, continuous, dark grayish-brown (10YR 4/2) clay films on ped faces; 5 percent coarse fragments; silty acid; abrupt, wavy boundary.

IIB3t—30 to 32 inches, brown (10YR 5/3) silty clay loam; very weak, coarse, subangular blocky structure; firm; thin, dark grayish-brown (10YR 4/2) clay films on vertical ped faces; 5 percent coarse fragments; mildly alkaline and calcareous; clear, wavy boundary.

IIC—32 to 60 inches, brown (10YR 5/3) silt loam till; massive; firm; 10 percent coarse fragments consisting of dolomitic and igneous material; moderately alkaline and calcareous.

The Ap horizon is grayish brown (10YR 5/2) or dark grayish brown (10YR 4/2) and ranges from medium acid to neutral. The B2t horizon ranges from dark brown (10YR 4/3) to dark brown (7.5YR 4/4). It is silty clay loam to light clay or light silty clay and is strongly acid to slightly acid. Depth to carbonates ranges from 22 to 35 inches. In some places the soil has a silt capping as much as 14 inches thick.

Celina soils are the moderately well drained members of a drainage sequence that includes the well drained Miamian soils, the somewhat poorly drained Crosby soils, and the dark-colored, very poorly drained Brookston soils. Their B and C horizons are less clayey than those of Morley soils.

Celina silt loam, 0 to 2 percent slopes (CeA).—The surface layer of this soil is slightly thicker and is in better tilth than that in the profile described as representative of the series. Included in mapping are small, low areas of the somewhat poorly drained Crosby soils.

Surface runoff is slow. There are few if any limitations to farm use. Moderately slow permeability limits many nonfarm uses. Capability unit I–1.

Celina silt loam, 2 to 6 percent slopes (CeB).—This soil has the profile described as representative of the series. It is in long narrow strips and on knolls. Slopes are short and convex. Included in mapping are small areas of Miamian soils on knolls.

Surface runoff is rapid. Erosion is a moderate hazard in cultivated areas. Moderately slow permeability limits many nonfarm uses. Capability unit IIe–1.

Crosby Series

The Crosby series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in loamy, calcareous glacial till on the uplands. They are in the Darby Plain region in the southern part of the county.

In a representative profile in a wooded area, the surface layer is dark grayish-brown silt loam about 3 inches thick. The subsurface layer is 4 inches of light brownish-gray silt loam mottled with yellowish brown. The subsoil is 18 inches thick. In sequence from the top, it is 4 inches of brown silty clay loam mottled with gray and yellowish brown; 6 inches of yellowish-brown silty clay loam mottled with gray and yellowish brown; and 8 inches of yellowish-brown light silty clay mottled with dark grayish brown, yellowish brown, and gray. The substratum extends to a depth of 60 inches or more. The upper 10 inches is brown and yellowish-brown silt loam mottled with yellowish brown, and the lower part is brown silt loam glacial till.

Crosby soils have a seasonal high water table. The gray mottling in the subsoil indicates natural wetness. Permeability is slow. The root zone is strongly acid. It is moderately deep in adequately drained areas or in summer when the water table is low. Available moisture capacity is medium.

If adequately drained, these soils are well suited to the crops commonly grown in the county. The principal crops are corn, soybeans, small grain, and hay.

Representative profile of Crosby silt loam, 0 to 2 percent slopes, in a wooded area in Union Township, 7½ miles south of Marysville, 1 mile south of Penn-Central Railroad tracks on State Route 38, 400 feet southeast of State Route 38 (Sample UN–19 in Laboratory data):

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

A2—3 to 7 inches, light brownish-gray (10YR 6/2) silt loam; few, fine, faint, yellowish-brown (10YR 5/6 and 5/8) mottles; moderate, medium, platy structure; friable; strongly acid; clear, smooth boundary.

B1—7 to 11 inches, brown (10YR 5/3) silty clay loam; common, fine, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; firm; strongly acid; clear, smooth boundary.

IIB21t—11 to 17 inches, yellowish-brown (10YR 5/4) silty clay loam; common, fine, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; thin dark-brown (10YR 3/3) and dark-gray (10YR 4/1) clay films on vertical ped faces and on many horizontal faces; 8 percent coarse fragments; strongly acid; clear, wavy boundary.

IIB22t—17 to 25 inches, yellowish-brown (10YR 5/4) light silty clay; common, fine, distinct, dark grayish-brown (10YR 4/2), yellowish-brown (10YR 5/6), and gray (10YR 5/1) mottles; moderate and strong, coarse, subangular blocky structure; very firm, medium, continuous, very dark grayish-brown (10YR 3/2) and grayish-brown (2.5Y 5/2) clay films on ped faces; a few tongues of this horizon extend into the upper part of the C horizon; 8 percent coarse fragments; strongly acid; clear, wavy boundary.

IIC1—25 to 35 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; massive; firm; common coarse fragments consisting of weathered limestone pebbles and cobblestones; mildly alkaline and calcareous.

IIC2—35 to 60 inches, brown (10YR 5/3) silt loam; common coarse fragments consisting of weathered limestone pebbles and cobblestones and shale material; mildly alkaline and calcareous.

The A1 horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2) and dark gray (10YR 4/1), is 2 to 3 inches thick, and is medium acid or slightly acid. In cultivated areas, the Ap horizon is dark grayish brown (10YR 4/2) and is medium acid to neutral. The Bt horizon is dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) light silty clay, light clay, silty clay loam, and clay loam. It ranges from strongly acid to medium acid in the upper part and becomes less acid with increasing depth. A B3 horizon is present in some places. The C horizon is silt loam and loam. Depth to carbonates ranges from 20 to 30 inches. In some places the soil has a silt capping as much as 14 inches thick.

Crosby soils are the somewhat poorly drained members of a drainage sequence that includes the darker colored very poorly drained Brookston soils and the moderately well drained Celina soils. Their B and C horizons are less clayey and less compact than those of Blount soils. They have a lighter colored A horizon than the somewhat poorly drained Odell soils.

Crosby silt loam, 0 to 2 percent slopes (CrA).—This soil has the profile described as representative of the series. Included in mapping are small areas of very poorly drained Brookston soils in drainageways and areas of darker colored Odell soils.

Seasonal wetness is a moderate limitation to all farm uses and limits most nonfarm uses. Runoff is slow. Capability unit IIw–5.

Crosby silt loam, 2 to 6 percent slopes (CrB).—This soil has more rapid runoff than Crosby silt loam, 0 to 2 percent slopes. Areas vary in size and shape. Included in mapping are areas of better drained Celina soils on small rounded knolls, areas of Brookston soils in drainageways, and small spots of eroded soils.

Seasonal wetness is a moderate limitation to all farm uses. Where slopes are long, this soil is likely to erode if it is cultivated. Wetness also limits most nonfarm uses. Capability unit IIw-5.

Cut and Fill Land

Cut and fill land (Cu) consists of areas of material that have been deposited as fill, or areas from which the soil material has been removed for construction purposes or the disposal of debris. The material is similar to that of adjacent or nearby soils, unless it is a fill area. Most of the areas are 3 to 5 acres in size. Fill areas used for disposal of debris are continually being enlarged.

In areas where soil material has been removed, the material generally is similar to that of the substratum of adjacent soils. In fill or disposal areas, characteristics vary because the material consists of varying amounts from the subsoil and substratum material of nearby soils.

This soil material is generally poor for plant growth. It is normally calcareous, especially in areas where material has been removed from areas of soils underlain by till. Both the available moisture capacity and the content of organic matter are low. Unprotected areas are susceptible to erosion. Instability of the soil material causes gullying and siltation.

Where a cover of plants is to be established and maintained, resurfacing areas with favorable soil material provides a more suitable root zone. Grasses and trees that are tolerant of the adverse characteristics of this soil material can be grown. Most areas are suitable as wildlife habitat and for recreational development. Not assigned to a capability unit.

Eel Series

The Eel series consists of nearly level, moderately well drained soils on flood plains along the major streams in the county. These soils formed in recent loamy alluvium washed from soils derived from calcareous glacial till.

In a representative profile in a pasture the surface layer is dark grayish-brown silt loam 6 inches thick. The subsoil is 34 inches thick. In sequence from the top, it is 7 inches of dark grayish-brown silt loam; 5 inches of brown silt loam; 7 inches of dark-brown light silty clay loam mottled with gray and dark yellowish brown; and 15 inches of brown silty clay loam mottled with gray. The substratum to a depth of 60 inches or more is dark-gray light silty clay loam mottled with dark yellowish brown and yellowish brown.

Eel soils are subject to flooding. Runoff is slow and permeability is moderate. The surface layer is mildly alkaline. The root zone is deep and has high available moisture capacity.

Eel soils are used for pasture and cultivated crops. Bluegrass is the common pasture grass. Corn and soybeans are the principal cultivated crops.

Representative profile of Eel silt loam in a pasture in Paris Township, 3¼ miles northwest of Marysville, three-fourths mile northwest of the intersection of County Roads 191 and 139, adjacent to Otter Run:

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; very dark grayish-brown (10YR 3/2) coatings; mildly alkaline; abrupt, smooth boundary.

B1—6 to 13 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, subangular blocky structure; friable; very dark grayish-brown (10YR 3/2) coatings; mildly alkaline; abrupt, smooth boundary.

B21—13 to 18 inches, brown (10YR 5/3) silt loam; moderate, medium, subangular blocky structure; friable; dark grayish-brown (10YR 4/2) coatings; mildly alkaline; clear, smooth boundary.

B22—18 to 25 inches, dark-brown (10YR 4/3) light silty clay loam; common, medium, distinct, gray (5YR 5/1) and dark yellowish-brown (10YR 4/4) mottles; moderate, coarse, subangular blocky structure; firm; slightly acid; clear, smooth boundary.

B23—25 to 40 inches, brown (10YR 4/3) light silty clay loam; common, fine, distinct, gray (10YR 5/1) mottles, and few, fine, faint, dark-brown (10YR 4/3) mottles; moderate, coarse, subangular blocky structure; firm: grayish-brown (2.5Y 5/2) coatings; slightly acid; clear, smooth boundary.

C—40 to 60 inches, dark-gray (10YR 4/1) light silty clay loam; moderate, medium, distinct, dark yellowish-brown (10YR 4/4) mottles, and few, medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; massive; firm; charcoal fragments and a few pebbles; mildly alkaline, calcareous.

The A1 horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), and dark brown (10YR 4/3) and ranges from neutral to mildly alkaline. The B horizon is silt loam or light silty clay loam and ranges from neutral to slightly acid. The C horizon is light silty clay loam or gravelly loam.

Eel soils are adjacent to the well-drained Genesee soils, the somewhat poorly drained Shoals soils, and the dark-colored, very poorly drained Sloan soils. They are better drained than the Algiers soils. They are lighter colored than the well-drained Ross soils.

Eel silt loam (Ee).—This soil is on flood plains along the major streams in the county. Included in mapping are spots of Shoals and Genesee soils too small to map separately.

Wetness is a moderate limitation to the use of this soil for farming. Flooding is a severe limitation for most nonfarm uses. Capability unit IIw-1.

Fox Series

The Fox series consists of nearly level to gently sloping soils that are well drained. These soils formed in loamy material 24 to 42 inches thick over stratified gravel and sand. They are mostly on glacial outwash terraces of Wisconsin age along the major streams in the county.

In a representative profile the plow layer is dark-brown silt loam 9 inches thick. The subsoil is 25 inches thick. In sequence from the top, it is 3 inches of dark-brown silty clay loam; 5 inches of dark-brown light clay loam; and 17 inches of dark-brown material that is for the most part gravelly clay. The substratum to a depth of 60 inches or more is stratified, calcareous, loose gravel and sand.

Fox soils are moderately permeable to a depth of 34 inches and rapidly permeable in the gravel and sand material below. They warm up early in spring. The underlying gravel and sand limits root penetration. The root zone is moderately deep and is strongly acid in the upper part. The gravelly underlying material is medium acid to mildly alkaline. Available moisture capacity is medium to low, and droughtiness is a hazard, especially for crops that mature late in summer.

Fox soils are used mainly for farming. Corn, soybeans, small grain, and hay are the main crops. A small acreage is pasture and woodland. These soils are suited to irrigation if erosion is controlled.

Representative profile of Fox silt loam, 0 to 2 percent slopes, in a cultivated field in Allen Township, 3½ miles northwest of Milford Center, 1¼ miles northwest of intersection of County Roads 75 and 78:

Ap—0 to 9 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; many roots; thin, continuous, dark-brown (10YR 3/3) coatings; neutral; abrupt, smooth boundary.

B1—9 to 12 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; friable; many roots; thin, continuous, dark-brown (10YR 3/3) coatings; medium acid; clear, wavy boundary.

B21t—12 to 17 inches, dark-brown (7.5YR 4/4) light clay loam; moderate, medium, subangular blocky structure; firm; many roots; thin, continuous, dark yellowish-brown (10YR 3/4) clay films on vertical ped faces, and patchy on the horizontal faces; strongly acid; clear, wavy boundary.

B22t—17 to 22 inches, dark-brown (7.5YR 4/2 and 7.5YR 4/4) clay; moderate, medium, subangular blocky structure; firm; thin, continuous, dark yellowish-brown (10YR 3/4) clay films on all ped surfaces; 15 percent coarse fragments; medium acid; gradual, wavy boundary.

IIB23t—22 to 28 inches, dark-brown (7.5YR 4/2) gravelly clay; weak, medium, prismatic structure parting to weak, medium, subangular blocky; firm; thin, continuous, dark yellowish-brown (10YR 3/4) clay films; 20 percent coarse fragments; medium acid; gradual, wavy boundary.

IIB24t—28 to 30 inches, dark-brown (7.5 YR 4/2) clay; weak, medium, subangular blocky structure; very firm; thin, continuous, very dark brown (10YR 2/2) clay films; less than 10 percent coarse fragments; slightly acid; gradual, wavy boundary.

IIB3t—30 to 34 inches, dark-brown (10YR 3/3) gravelly loam; weak, medium and coarse, subangular blocky structure; friable; thin, patchy, very dark brown (10YR 2/2) clay films on gravel; 40 percent coarse fragments; mildly alkaline and calcareous; diffuse, irregular boundary.

IIC—34 to 60 inches, brown (10YR 5/3) and grayish-brown (10YR 5/2) stratified sand and fine gravel; single grained; loose; moderately alkaline and calcareous.

The AP horizon is dark brown (10YR 4/3) or dark grayish brown (10YR 4/2) and is 6 to 9 inches thick. The B1 horizon is silty clay loam or fine silt loam. The IIB2t horizon is dark brown (7.5YR 4/4), brown (7.5YR 4/2), and dark reddish brown (5YR 3/3) and dominantly is clay loam, gravelly clay loam, gravelly clay, or clay. Irregular tongues from the IIB2t horizon (fig. 6) commonly extend about 2 feet into the IIB3 and IIC horizons. The IIB2t horizon ranges from slightly acid to strongly acid. Depth to calcareous gravel and sand ranges from 24 to 42 inches.

The Fox soils in this county have a higher content of clay in the upper 20 inches of the B horizon than is defined as the range for the series. This slight difference does not greatly influence the usefulness or behavior of the soils.

Fox soils commonly are adjacent to Homer and Lippincott soils. They are well drained, but Homer soils are somewhat poorly drained. They are lighter colored than Lippincott soils.

Fox silt loam, 0 to 2 percent slopes (FoA).—This soil has the profile described as representative of the series. It is in areas about 5 to 15 acres in size on broad terraces.

***Figure 6.*—Downward tonguing of subsoil into substratum in profile of Fox silt loam.**

Runoff is slow. Drought is a moderate limitation for farm uses. Limitations are no more than slight for most nonfarm uses. Capability unit IIs–1.

Fox silt loam, 2 to 6 percent slopes (FoB).—This soil is mainly on broad terraces. Areas are commonly long and narrow and range from 5 to 15 acres in size.

Runoff is medium. Erosion is a moderate hazard if this soil is cultivated. Limitations are no more than slight for most nonfarm uses. Capability unit IIe–3.

Fox silt loam, 2 to 6 percent slopes, moderately eroded (FoB2).—This soil is on broad terraces. Areas are generally oval in shape and 5 to 15 acres in size. Erosion has removed part of the original surface layer, and the plow layer is a mixture of the original surface layer and brownish material from the upper part of the subsoil. Slopes are generally long, which increases the hazard of erosion.

The hazard of erosion is a moderate limitation if this soil is used for cultivated crops. This soil is more droughty than the uneroded Fox soils. It has slight or no limitations for most nonfarm uses. Capability unit IIe–3.

Fox silt loam, 6 to 12 percent slopes, moderately eroded (FoC2).—This soil is in long narrow areas 5 to 15 acres in size. Part of the original surface layer has been lost through erosion, and the plow layer is a mixture of the original surface layer and brownish material from the upper part of the subsoil. Included in mapping are a few areas of Kendallville soils.

The soil is more droughty than the uneroded Fox soils. The hazard of erosion and rapid runoff are severe limitations to farm uses. Slope is a limitation to many nonfarm uses. Capability unit IIIe–1.

Genesee Series

The Genesee series consists of nearly level, well-drained soils on flood plains along the major streams in the county. These soils formed in recent loamy alluvium washed from areas where the soils were derived mainly from calcareous glacial till.

In a representative profile in a pasture, the surface layer is very dark grayish-brown silt loam 13 inches thick. The subsoil is 31 inches thick. In sequence from the top, it is 16 inches of very dark grayish-brown silt loam and 15 inches of dark grayish-brown silt loam. The substratum to a depth of 60 inches or more is brown silt loam.

Genesee soils are subject to flooding. Runoff is slow. The root zone is deep. It is neutral, has high available moisture capacity, and is moderately permeable.

These soils are used for pasture and crops. Bluegrass is the common pasture grass. Corn and soybeans are the principal cultivated crops.

Representative profile of Genesee silt loam in a pasture in Liberty Township, 1 mile northwest of Raymond, 1,700 feet east of County Road 238-A. along south bank of Mill Creek:

A1—0 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) rubbed; weak, fine, granular structure; friable; neutral; gradual, smooth boundary.

B1—13 to 29 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) rubbed; moderate, medium, granular structure; friable; neutral; gradual, smooth boundary.

B2—29 to 44 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, coarse, granular structure; friable; mildly alkaline; gradual, smooth boundary.

C—44 to 60 inches, brown (10YR 4/3) silt loam; massive; friable; mildly alkaline, calcareous.

The A horizon is neutral to mildly alkaline. The B horizon is dominantly silt loam but ranges to light silty clay loam. It is neutral to mildly alkaline. The C horizon typically is silt loam, but in some places it is gravelly silt loam that has sandy layers. This horizon is mildly alkaline or calcareous.

The Genesee soils in this county generally do not have carbonates within a depth of 40 inches, which is outside the range defined for the series. This slight difference does not greatly influence the use or behavior of these soils.

Genesee soils are adjacent to the moderately well drained Eel soils, the somewhat poorly drained Shoals soils, and the dark-colored, very poorly drained Sloan soils. They are better drained than Algiers soils, and lighter colored than Ross soils.

Genesee silt loam (Gn).—This soil is on flood plains along the major streams in the county. Included in mapping are small spots of Eel soils.

Flooding is a limitation to all farm and many nonfarm uses. Capability unit IIw–1.

Gravel Pits

Gravel pits (Gp) consists of areas from which gravel is excavated for use in construction. The pits generally are in areas underlain by glacial outwash. They are associated with Fox, Lippincott, Westland, and other soils underlain by gravelly and sandy outwash. Areas are 10 to 60 acres in size. Some pits are actively mined and are being enlarged.

The material in Gravel pits consists of layers of gravel and sand that vary in thickness and in orientation. The kinds of aggregates and the sizes of grains are fairly uniform within a layer, but are likely to differ considerably from material in an adjacent layer. Some layers contain an appreciable amount of silt and sand. Selective mining is practiced so that desirable kinds of aggregate can be obtained.

Nearly all of the large aggregates are rounded. Quartz, granite, and other siliceous materials are common. Dolomitic material also is present. The amount varies from place to place. In some places a weakly bonded conglomerate has formed through cementation by calcareous material. Limestone and shale materials in these pits are generally of local origin.

The soil material in spoil banks varies within short distances. As a rule, the stripped soil material is low in content of organic matter and available moisture capacity, and it is poorly suited to the growth of plants. Because this material is unstable, it is subject to erosion and is a potential source of siltation.

Establishing vegetation in areas that are no longer mined reduces the hazard of erosion. Only grasses and trees that tolerate the low available moisture capacity and the unfavorable soil properties should be selected for seeding and planting.

Ponded areas generally can be developed for wildlife and recreation. Not assigned to a capability unit.

Henshaw Series

The Henshaw series consists of nearly level soils that are somewhat poorly drained. These soils formed in silty lacustrine material on low terraces along the major streams in the county.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown silt loam 8 inches thick. The subsoil is 36 inches of yellowish-brown silty clay loam mottled with gray, grayish brown, and light olive brown. The substratum to a depth of 60 inches or more is gray silty clay loam mottled with yellowish brown.

Henshaw soils have a seasonal high water table. Grayness and mottling in the subsoil indicate natural wetness. Permeability is moderately slow, and available moisture capacity is medium. Reaction is neutral. The root zone is deep if the soils are adequately drained.

These soils are used for crops commonly grown in the county. Corn, soybeans, small grain, and hay are the main crops.

Representative profile of Henshaw silt loam, 0 to 2 percent slopes, in a cultivated area in Jackson Township, 2½ miles west of Essex, 1,452 feet south of State Route 739, and 1,518 feet east of County Road 338:

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

B1t—8 to 13 inches, yellowish-brown (10YR 5/4) silty clay loam; medium, distinct, gray (10YR 5/1) and grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky and plastic when wet; thin, patchy, gray (10 YR 5/1) clay films; neutral; clear, wavy boundary.

B21tg—13 to 23 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, light olive-brown (2.5Y 5/4) and gray (10YR 5/1) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic when wet; medium, continuous, gray (10YR 5/1) clay films; common, medium, distinct, very dark grayish-brown (10YR 3/2) oxide stains; neutral; clear, wavy boundary.

B22tg—23 to 30 inches, yellowish-brown (10YR 5/6) silty clay loam; common, medium, distinct, gray (10YR 5/1) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic when wet; medium, distinct, very dark grayish-brown (10YR 3/2) oxide stains; mildly alkaline; clear, wavy boundary.

B3t—30 to 44 inches, yellowish-brown (10YR 5/6) silty clay loam; common, medium, distinct, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic when wet; medium discontinuous gray (10YR 5/1) clay films; common, medium, distinct, very dark grayish-brown (10YR 3/2) oxide stains; ½- and 1-inch layers of silty clay; mildly alkaline; gradual, smooth boundary.

C—44 to 60 inches, gray (10YR 5/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; massive; firm; mildly alkaline.

The Ap horizon is dark grayish brown (10YR 4/2 and 2.5Y 4/2). The B1 horizon is yellowish brown (10YR 5/4 and 10YR 5/6). The B2t horizon is silty clay loam and ranges from 30 to 35 percent clay. Depth to the C horizon ranges from 35 to 45 inches.

The Henshaw soils in this county differ from Henshaw soils elsewhere in having a few gray mottles directly below the plow layer and a neutral to mildly alkaline B2 horizon, which is outside the range defined for the series. These differences do not greatly influence the usefulness or behavior of these soils in the county.

Henshaw soils commonly are adjacent to the well drained Genesee soils and the moderately well drained Eel soils.

Henshaw silt loam, 0 to 2 percent slopes (HeA).—This soil is in broad areas on low stream terraces that are subject to occasional flooding. Runoff is slow. Wetness is a moderate limitation to farming and limits most nonfarm uses. Capability unit IIw-3.

Homer Series

The Homer series consists of nearly level soils that are somewhat poorly drained. These soils formed in loamy outwash material underlain by sandy and gravelly material at a depth of 30 to 42 inches. They are on outwash terraces along the major streams in the county.

In a representative profile in a cultivated area, the plow layer is grayish-brown silt loam 9 inches thick. The subsoil is 25 inches thick. In sequence from the top, it is 3 inches of grayish-brown silty clay loam mottled with dark yellowish brown and gray; 10 inches of yellowish-brown clay mottled with grayish brown and yellowish brown; and 12 inches of yellowish-brown gravelly clay loam mottled with dark gray. The substratum extends to a depth of 60 inches or more. The upper 4 inches is yellowish-brown gravelly loam, and the lower part is stratified, grayish-brown gravel and sand.

Homer soils have a seasonal high water table. Grayness and mottling in the subsoil indicate natural wetness. Permeability is moderate in the upper part of the profile and rapid in the underlying gravel and sand. The root zone is moderately deep if the soils are adequately drained. It is medium acid in the most acid part.

These soils are used for the crops commonly grown in the county, mainly corn, soybeans, small grain, and hay.

Representative profile of Homer silt loam in a cultivated area in Allen Township, 2½ miles southwest of Allen Center, 3,630 feet north of State Route 245, 530 feet east of County Road 163:

Ap1—0 to 6 inches, grayish-brown (10YR 5/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

Ap2—6 to 9 inches, grayish-brown (10YR 5/2) silt loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; massive; friable; slightly acid; abrupt, smooth boundary.

B1g—9 to 12 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) and gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.

B2tg—12 to 22 inches, yellowish-brown (10YR 5/4) clay; common, fine, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very firm; thin, continuous, dark grayish-brown (2.5Y 4/2) and very dark grayish-brown (2.5Y 3/2) clay films on ped surfaces; slightly acid; clear, irregular boundary.

IIB3tg—22 to 34 inches, yellowish-brown (10YR 5/4) gravelly clay loam; common, fine, distinct, dark-gray (10YR 4/1) mottles; weak, very coarse, subangular blocky structure; firm; thin, continuous, dark grayish-brown (2.5Y 4/2) clay film on gravel and peds; slightly acid in upper part changing to mildly alkaline to calcareous in the lower part; clear, wavy boundary.

IIC1—34 to 38 inches, yellowish-brown (10YR 5/8) gravelly loam; single grained; friable; mildly alkaline and calcareous.

IIC2—38 to 60 inches, grayish-brown (2.5Y 5/2) stratified gravel and sand; loose; mildly alkaline and calcareous.

The Ap horizon is dark gray (10YR 4/1), grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2). The B2tg horizon is grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) mottled with gray (10YR 5/1), grayish brown (10YR 5/2), and yellowish brown (10YR 5/6). It is clay, gravelly clay, and gravelly clay loam and ranges from slightly acid to medium acid. The weighted average clay content of the Bt horizon is 35 to 40 percent. Most gravel in the IIB3 horizon is dolomite.

The Homer soils in this county have a slightly higher content of clay in the B2tg horizon than is typical for the series. This difference does not greatly influence the usefulness or behavior of these soils.

Homer soils are the somewhat poorly drained members of a drainage sequence that includes the well-drained Fox soils and the dark-colored, very poorly drained Lippincott soils. Their A horizon is lighter colored than that of Kane soils.

Homer silt loam (Ho).—This level soil is in broad areas. Some areas are subject to ponding for short periods. Included in mapping are spots of dark-colored, very poorly drained Lippincott soils.

Seasonal wetness is a moderate limitation to farming and limits most nonfarm uses. Capability unit IIw-3.

Kane Series

The Kane series consists of nearly level soils that are somewhat poorly drained. These soils formed in loamy outwash material underlain by stratified sand and gravel at a depth of 35 to 40 inches. They are on low outwash terraces along the major streams iin the county and are subject to occasional flooding.

In a representative profile in a cultivated area the surface layer is very dark grayish-brown silt loam 13 inches thick. The subsoil is 26 inches thick. In sequence from the top, it is 4 inches of dark grayish-brown silty clay loam mottled with yellowish brown; 11 inches of dark grayish-brown clay loam mottled with strong brown; 3 inches of light olive-brown clay; and 8 inches of grayish-brown and olive-yellow gravelly silt loam. The substratum to a depth of 60 inches or more is stratified, grayish-brown sand and gravel.

Kane soils have a seasonal high water table. Grayness and mottling in the subsoil indicate natural wetness. Penetration of roots is restricted by the underlying sand and gravel. The root zone is moderately deep to deep if the soils are adequately drained. Available water capacity is medium. Permeability is moderate in the subsoil and rapid in the underlying sand and gravel.

Kane soils are used for crops commonly grown in the county, mainly corn, soybeans, small grain, and hay.

Representative profile of Kane silt loam in a cultivated field in Allen Township, 2 miles southwest of Allen Center, 2,000 feet southwest of intersection of State Route 245 and County Road 167:

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

A1—8 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular srtucture; friable; very dark grayish-brown (10YR 3/2) organic coatings on granule faces; slightly acid; clear, smooth boundary.

B1g—13 to 17 inches, dark grayish-brown (10YR 4/2) silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; few very dark gray (10YR 3/1) organic coatings on vertical ped faces; medium acid; clear, smooth boundary.

B21tg—17 to 23 inches, dark grayish-brown (10YR 4/2) clay loam; common, fine, distinct, strong-brown (7.5YR 5/6 and 5/8) mottles; moderate, fine and medium, subangular blocky structure; firm; few, thin, patchy dark-gray (10YR 4/1) clay films on vertical ped faces; medium acid; clear, wavy boundary.

B22tg—23 to 28 inches, dark grayish-brown (10YR 4/2) clay loam; common, fine, distinct, strong-brown (7.5YR 5/6 and 5/8) mottles; moderate, medium, subangular blocky structure; firm; thin, continuous, dark-gray (10YR 4/1) clay films on vertical ped faces; strongly acid; clear, wavy boundary.

B23tg—28 to 31 inches, light olive-brown (2.5YR 5/4, 5/6) clay; weak, medium and coarse, subangular blocky structure; very firm; thin, continuous, very dark gray (N 3/9) clay films on vertical and many horizontal ped faces; slightly acid; clear, irregular boundary.

IIB3—31 to 39 inches, grayish-brown (2.5Y 5/2) and olive-yellow (2.5Y 6/6) gravelly silt loam; massive; friable; 25 percent coarse fragments consisting mainly of partly weathered limestone cobblestones and pebbles; mildly alkaline and calcareous; gradual, irregular boundary.

IIC—39 to 60 inches, grayish-brown (2.5Y 5/2) stratified sand and gravel; loose; calcareous.

Depth to stratified sand and gravel ranges from 35 to 40 inches. The A horizon ranges from 10 to 15 inches in thickness and is black (10YR 2/1), very dark gray (10YR 3/1), and very dark grayish brown (10YR 3/2). The B2 horizon ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4 and 5/6). It is silty clay loam, gravelly clay loam, clay loam, and clay and is strongly to slightly acid. The weighted average clay content of the B2 horizon is 28 to 35 percent. The IIB3 horizon ranges from 6 to 12 inches in thicknesses and is 10 to 30 percent coarse fragments.

Kane soils are the somewhat poorly drained members of a drainage sequence that includes the well-drained Warsaw soils. They commonly are adjacent to the lighter colored, somewhat poorly drained Homer soils.

Kane silt loam (Ka).—This level soil is in broad areas. In places it is subject to ponding, generally for short periods.

Seasonal wetness is a moderate limitation to farming and limits most nonfarm uses. Capability unit IIw–3.

Kendallville Series

The Kendallville series consists of nearly level to gently sloping soils that are well drained. These soils formed in loamy outwash material and the underlying, compact, calcareous glacial till. They are on till plains and moraines.

In a representative profile in a cultivated area, the plow layer is dark-brown silt loam 9 inches thick. The subsoil is 26 inches thick. In sequence from the top, it is 11 inches of reddish-brown clay loam; 9 inches of reddish-brown gravelly clay; and 6 inches of yellowish-brown clay loam. The substratum to a depth of 60 inches or more is light olive-brown clay loam glacial till mottled with gray.

Kendallville soils have moderately slow permeability. The underlying compact till restricts root penetration. The root zone is moderately deep and has medium available moisture capacity. The most acid part is very strongly acid.

Kendallville soils are used mainly for field crops. Corn, soybeans, small grain, and hay are the main crops.

Representative profile of Kendallville silt loam, 2 to 6 percent slopes, in a cultivated area in Leesburg Township, 5 miles southwest of Richwood, one-half mile west of intersection of County Roads 199 and 214:

Ap—0 to 9 inches, dark-brown (10YR 4/3) silt loam; moderate, fine and medium, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

B21t—9 to 14 inches, reddish-brown (5YR 4/4) clay loam; moderate, fine and medium, subangular blocky structure; firm, sticky when wet; few roots; thin, patchy, dark reddish-brown (5YR 3/4) clay films; 10 percent fine gravel; very strongly acid; clear, smooth boundary.

B22t—14 to 20 inches, reddish-brown (5YR 4/4) clay loam; moderate, medium and coarse, subangular blocky structure; firm, sticky when wet; few roots; thin, continuous, dark reddish-brown (5YR 3/3) clay films; 10 percent fine gravel; very strongly acid; clear, wavy boundary.

B23t—20 to 25 inches, reddish-brown (5YR 5/4) gravelly clay; weak, coarse, subangular blocky structure; friable, sticky when wet; few roots; thin, continuous, dark reddish-brown (5YR 3/3) clay films; 25 percent fine gravel; very strongly acid; clear, wavy boundary.

B31t—25 to 29 inches, reddish-brown (5YR 5/4) gravelly clay; weak, coarse, subangular blocky structure; friable; sticky when wet; thin, continuous, dark reddish-brown (5YR 3/2) clay films; 25 percent coarse fragments consisting mostly of dolomitic gravel and cobbles; slightly acid; clear, irregular boundary.

IIB32—29 to 35 inches, yellowish-brown (10YR 5/4) clay loam; weak, coarse, subangular blocky structure; friable; 5 percent glacial pebbles; neutral; clear, irregular boundary.

IIC—35 to 60 inches, light olive brown (2.5Y 5/4) clay loam; few, fine, faint, gray (N 5/0) mottles; massive;

firm; 5 percent coarse fragments; calcareous glacial till.

Depth to the IIC horizon ranges from 25 to 40 inches. The Ap horizon is dark grayish brown (10YR 4/2) and dark brown (10YR 4/3). A silty clay loam B1 horizon is present in some profiles. The B2t horizon is medium acid to very strongly acid and is silty clay loam, clay loam, and gravelly clay. The B22t horizon has hues of 10YR to 5YR, values of 4 and 5, and chroma of 4.

In most places Kendallville soils are near Fox soils. They are underlain by compact glacial till, whereas Fox soils are underlain by stratified sand and gravel. Their B horizon is more gravelly than that of Miamian soils.

Kendallville silt loam, 0 to 2 percent slopes (KeA).—This level soil is in broad areas on uplands adjacent to stream terraces. Included in the mapping are spots of Fox soils.

This soil is well suited to irrigation. It is generally in good tilth and is not subject to erosion in cultivated areas. It has few if any limitations to most nonfarm uses. Capability unit I–1.

Kendallville silt loam, 2 to 6 percent slopes (KeB).—This soil has the profile described as representative of the series. It is on uplands bordering stream terraces. Included in mapping are spots of Fox soils.

Erosion is a moderate hazard in cultivated areas. The soil is suited to irrigation if erosion is controlled. It has few limitations to most nonfarm uses. Capability unit IIe–1.

Lippincott Series

The Lippincott series consists of nearly level soils that are very poorly drained. These soils formed in loamy outwash materials underlain by stratified sand and gravel at a depth of 24 to 36 inches. They are on low outwash terraces, mainly along Big Darby Creek.

In a representative profile in a cultivated area, the plow layer is black silty clay loam 7 inches thick. The subsoil is 29 inches thick. In sequence from the top, it is 4 inches of black silty clay loam; 6 inches of very dark gray silty clay mottled with yellowish brown; 8 inches of dark grayish-brown heavy silt loam mottled with yellowish brown; and 11 inches of grayish-brown very gravelly loam mottled with yellowish brown. The substratum to a depth of 60 inches or more is stratified sand and gravel.

Lippincott soils have a seasonal high water table. Grayness and mottling in the subsoil indicate natural wetness. Permeability is moderate. The root zone is moderately deep if drainage is adequate and has high available water capacity. The underlying sand and gravel material restricts root penetration. The upper part is slightly acid, and the lower part is neutral and calcareous.

Lippincott soils are used mainly for corn and soybeans.

Representative profile of Lippincott silty clay loam in a cultivated area in Union Township, 3 miles southwest of Milford Center, 1,050 feet north of U.S. Route 36, 1,360 feet west of Treacle Creek:

Ap—0 to 7 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; friable; common roots; slightly acid; abrupt, smooth boundary.

B21t—7 to 11 inches, black (10YR 2/1) silty clay loam; moderate, medium, angular blocky structure; firm; common roots; thin, patchy, very dark gray (10YR 3/1) clay films on ped vertical faces; slightly acid; clear, wavy boundary.

B22tg—11 to 17 inches, very dark gray (10YR 3/1) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; firm; common roots; thin, continuous, dark-gray (10YR 4/1) clay films on ped vertical faces; slightly acid; clear, irregular boundary.

B23tg—17 to 25 inches, dark grayish-brown (2.5Y 4/2) heavy silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, prismatic structure; very firm; thin, continuous, dark-gray (10YR 4/1) clay films on ped faces and in root channels; neutral; clear, wavy boundary.

IIB3—25 to 36 inches, grayish-brown (2.5Y 5/2) very gravelly loam; many, fine, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; massive; friable; 50 percent coarse fragments consisting of partly weathered dolomitic gravel; mildly alkaline and weakly calcareous; clear, wavy boundary.

IIC—36 to 60 inches, gray (5Y 5/1) stratified fine gravel and sand; single grained; loose; mildly alkaline and calcareous.

Depth to stratified sand and gravel ranges from 24 to 36 inches. The Ap horizon is very dark gray (10YR 3/1) and black (10YR 2/1). The B23tg horizon is dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2). The B2 horizon is silty clay loam, silty clay, and heavy clay loam. The weighted average clay content of the Bt horizon is 35 to 45 percent. The IIB3 horizon ranges from 6 to 12 inches in thickness. It is 25 to 60 percent dolomitic pebbles and cobblestones.

Lippincott soils are the very poorly drained members of a drainage sequence that includes the well-drained Fox soils and the somewhat poorly drained Homer soils. They are shallower over sand and gravel than Westland soils and have a more clayey B horizon.

Lippincott silty clay loam (Lc).—This level soil is in broad areas. In many areas along the larger streams, it is dissected by flood channels. It is subject to occasional flooding and ponding in spots. Included in mapping are spots of the lighter colored, somewhat poorly drained Homer soils, which generally are at slightly higher elevations.

Seasonal wetness is a moderate limitation to farming and limits most nonfarm uses. Capability unit IIw–4.

Miamian Series

The Miamian series consists of gently sloping to very steep soils that are well drained. These soils formed in loamy calcareous glacial till on uplands. They are on the Darby Plain, in the southern part of Union County.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown silt loam 7 inches thick. The subsoil is 23 inches thick. In sequence from the top, it is 4 inches of brown silt loam; 9 inches of dark yellowish-brown clay; 4 inches of yellowish-brown clay; and 6 inches of yellowish-brown loam. The substratum to a depth of 60 inches or more is yellowish-brown loam.

Miamian soils are commonly saturated for short periods, mostly in spring, and tillage is delayed. Permeability is moderately slow. The underlying compact till restricts root penetration. The root zone is moderately deep, has medium available moisture capacity, and is strongly acid in the most acid part.

Miamian soils are used mainly for corn, soybeans, small grain, and hay.

Representative profile of Miamian silt loam, 2 to 6 percent slopes, in a cultivated area in Allen Township, 1 mile northeast of North Lewisburg, one-fourth mile northeast of intersection of County Roads 162 and 164:

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

B1—7 to 11 inches, brown (7.5YR 5/4) silt loam; moderate, fine, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B21t—11 to 15 inches, dark yellowish-brown (10YR 4/4) clay; moderate and strong, fine and medium, subangular blocky structure; firm; thin, continuous, dark-brown (7.5YR 4/4) clay films on all ped surfaces; strongly acid; clear, smooth boundary.

B22t—15 to 20 inches, dark yellowish-brown (10YR 4/4) clay; moderate and strong, medium and coarse, subangular blocky structure; firm; medium, continuous, dark-brown (7.5YR 4/4) clay films on all ped surfaces; strongly acid; clear, wavy boundary.

B23t—20 to 24 inches, yellowish-brown (10YR 5/4) clay; weak, coarse, subangular blocky structure; very firm; medium, continuous, dark-brown (7.5YR 4/4) clay films on all ped surfaces; slightly acid; clear, irregular boundary.

B3t—24 to 30 inches, yellowish-brown (10YR 5/4) loam; weak, coarse, subangular blocky structure; friable; medium, continuous, dark-brown (10YR 4/3) clay films on vertical and many horizontal ped faces; 8 percent cobblestones and pebbles mostly of dolomite; mildly alkaline and calcareous; clear, irregular boundary.

C—30 to 60 inches, yellowish-brown (10YR 5/4) loam; massive; friable; 8 percent cobblestones and pebbles mostly of dolomite; mildly alkaline and calcareous.

Depth to carbonates ranges from 18 to 30 inches. The B2 horizon is yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) and has clay films of dark brown (7.5YR 4/2 and 7.5YR 4/4). It is clay and clay loam and is strongly acid in the upper part and neutral in the lower part. The B3 horizon ranges from 5 to 8 inches in thickness and has hues of 10YR and 7.5YR, values of 4 and 5, and chroma of 4. Depth to the C horizon ranges from 20 to 37 inches.

Miamian soils are the well drained members of a drainage sequence that includes the moderately well drained Celina soils, the somewhat poorly drained Crosby soils, and the very poorly drained Brookston soils. Their B and C horizons are less clayey than those of the Morely soils.

Miamian silt loam, 2 to 6 percent slopes (MlB).—A profile of this soil is described as representative of the series. This soil is on knolls on uplands and in areas along drainageways. Included in the mapping are spots of moderately well drained Celina soils and areas of steeper, moderately eroded soils.

Runoff is rapid. Erosion is a moderate hazard if this soil is cultivated. Moderately slow permeability is a limitation to many nonfarm uses. Capability unit IIe-1.

Miamian silt loam, 6 to 12 percent slopes, moderately eroded (MlC2).—The plow layer of this soil is a mixture of the original surface layer and materials from the upper part of the subsoil. This soil requires more careful management for growing plants than less eroded Miamian soils because it has a lower capacity to absorb and supply moisture to plants. Included in the mapping are spots of slightly eroded soils and spots of severely eroded soils.

Runoff is rapid. The hazard of erosion is severe if this soil is used for cultivated crops. Slope is a limitation to most nonfarm uses. Capability unit IIIe-1.

Miamian silt loam, 12 to 18 percent slopes, moderately eroded (MlD2).—The present surface layer of this soil is a mixture of the original surface layer and material from the upper part of the subsoil. Total thickness of the surface layer and subsoil is less than in uneroded Miamian soils. Included in mapping are spots of slightly eroded soils, spots of severely eroded soils, and a few areas of this soil that are gullied and in which the calcareous glacial till is exposed.

Runoff is very rapid. A very severe erosion hazard is the major limitation of this soil to farm uses. Slope is a limitation to most nonfarm uses. Capability unit IVe-1.

Miamian silt loam, 18 to 35 percent slopes, moderately eroded (MlF2).—The present surface layer of this soil is a mixture of the original surface layer and material from the upper part of the subsoil. Total thickness of the surface layer and subsoil is less than in uneroded Miamian soils. The steeper areas of this soil are gullied, and the underlying calcareous glacial till is exposed.

Runoff is very rapid. Slope and the hazard of erosion are major limitations to all farm uses. Slope is also a major limitation to most nonfarm uses. Capability unit VIe-1.

Montgomery Series

The Montgomery series consists of nearly level soils that are very poorly drained. These soils formed in clayey material on low stream terraces and in depressions on uplands adjacent to Big Swale Creek, north of Richwood.

In a representative profile in a cultivated area, the plow layer is very dark grayish-brown silty clay loam 9 inches thick. The upper part of the subsoil is 50 inches thick. In sequence from the top, it is 8 inches of very dark gray silty clay mottled with dark yellowish brown and 42 inches of dark gray silt loam. The lower part of the subsoil and the substratum, to a depth of 70 inches or more, is gray silty clay mottled with yellowish brown.

Montgomery soils have a seasonal high water table. The gray colors and the mottling in the subsoil indicate natural wetness. Permeability is slow to very slow. The root zone is deep if these soils are adequately drained, has high available moisture capacity, and is only slightly acid.

Montgomery soils are used mostly for corn and soybeans.

Representative profile of Montgomery silty clay loam in a cultivated field in Paris Township, 3 miles north of Marysville, one-half mile southwest of intersection of State Route 31 and County Road 128:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silty clay loam; weak, medium, granular structure in upper part of horizon and massive in lower part; friable; neutral; abrupt, smooth boundary.

B21g—9 to 17 inches, very dark gray (N 3/0) silty clay; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, angular blocky structure; firm; thin, patchy, very dark gray (N 3/0) clay films on vertical ped surfaces; slightly acid; clear, wavy boundary.

B22g—17 to 26 inches, dark-gray (N 4/0) silty clay; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic structure parting to strong, medium, angular blocky; firm; thin, continuous, very dark gray (N 3/0) clay films on vertical ped surfaces; neutral; clear, wavy boundary.

B23g—26 to 38 inches, dark-gray (10YR 4/1) silty clay; many, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure parting to strong, medium, angular blocky; very firm; thin, continuous dark-gray (N 4/0) clay films on vertical ped surfaces; neutral; gradual, wavy boundary.

B24g—38 to 59 inches, dark-gray (10YR 4/1) silty clay; many, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure parting to moderate, coarse, angular blocky; very firm; thin, patchy, dark-gray (N 4/0) clay films which disappear with depth on vertical ped surfaces; mildly alkaline; gradual, wavy boundary.

B3&C—59 to 70 inches, gray (10YR 5/1) silty clay; many, medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; weak, coarse, prismatic structure parting to weak, coarse, angular blocky; very firm; mildly alkaline.

The dark-colored layer ranges from 10 to 18 inches in thickness and is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), and black (10YR 2/1). The B2g horizon is very dark gray (N 3/0), dark gray (N 4/0), and grayish brown (2.5Y 5/2), is silty clay, clay, and heavy silty clay loam, and is slightly acid to mildly alkaline. The C horizon is gray (10YR 6/1, 10YR 5/1) and dark gray (10YR 4/1). It ranges from neutral to mildly alkaline and is calcareous.

The Montgomery soils in this county have a thicker solum and are deeper over carbonates than is typical for the series. These differences do not greatly influence the use or behavior of these soils.

Montgomery soils commonly are near the Pewamo soils. In contrast, they are underlain by lacustrine material, whereas Pewamo soils are underlain by glacial till.

Montgomery silty clay loam (Mn).—This soil is on broad flats. Runoff is slow and is ponded in some areas. Areas on low terraces are commonly subject to backwater flooding. Included in mapping are spots of soils that have a silty clay surface layer. The included soils can be tilled within only a narrow range of moisture content.

Seasonal wetness is a severe limitation to all farm uses and limits most nonfarm uses. Capability unit IIIw-2.

Morley Series

The Morley series consists of gently sloping to very steep soils that are moderately well drained. These soils formed in calcareous glacial till of silty clay loam or clay loam texture. They are on till plains and moraines. They are moderately deep to deep over compact till.

In a representative profile the plow layers is dark grayish-brown silt loam 7 inches thick. The subsoil is 31 inches thick. In sequence from the top, it is 3 inches of yellowish-brown silty clay loam; 14 inches of dark yellowish-brown clay mottled with grayish brown and dark grayish brown; 5 inches of dark-brown silty clay loam mottled with grayish brown; and 9 inches of dark yellowish-brown and dark grayish-brown silty clay loam. The substratum to a depth of 60 inches or more is dark yellowish-brown and dark-gray silty clay loam.

Morley soils are saturated for short periods, mostly in spring, and tillage is delayed. Permeability is slow. The underlying glacial till restricts the depth to which roots can penetrate. The root zone is moderately deep, has medium available moisture capacity, and is slightly acid to strongly acid in the upper part.

These soils are used mainly for corn, soybeans, small grain, hay, and other field crops.

Representative profile of Morley silt loam, 2 to 6 percent slopes, moderately eroded, in a cultivated field in Taylor Township, 3⅔ miles northwest of Marysville, 1,980 feet northwest of intersection of State Route 31 and County Road 128 (Sample UN-26 in Laboratory data):

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

B1t—7 to 10 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; friable; common roots; thin, patchy, brown (10YR 5/3) clay films on ped surfaces; silt coatings can be seen on dried peds; medium acid; clear, smooth boundary.

B21t—10 to 13 inches, dark yellowish-brown (10YR 4/4) light clay; many, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; common roots; thin, continuous, dark-brown (10YR 4/3) clay films on all ped surfaces; strongly acid; clear, smooth boundary.

B22t—13 to 17 inches, dark, yellowish-brown (10YR 4/4) clay; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, medium and coarse, subangular blocky structure; firm; few roots; thin, continuous, dark-brown (10YR 4/3) clay films on all ped faces; few, fine, distinct, black (10YR 2/1) oxide stains on horizontal ped surfaces; a few small fragments of shale; slightly acid; clear, wavy boundary.

B23t—17 to 24 inches, dark yellowish-brown (10YR 4/4) clay; few, fine, distinct, dark grayish-brown (10YR 4/2) mottles; weak, coarse, prismatic structure parting to moderate, coarse, angular blocky; firm; few roots; thin, continuous, dark grayish-brown (10YR 4/2) clay films on all ped surfaces; a few fragments of shale; neutral; gradual, wavy boundary.

B31t—24 to 29 inches, dark-grown (10YR 4/3) silty clay loam; common, fine, distinct, grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure; very firm; few roots; thin, continuous, dark grayish-brown (10YR 4/2) clay films on vertical and some horizontal ped faces; few fragments of shale; mildly alkaline and calcareous; gradual, wavy boundary.

B32t—29 to 38 inches, dark yellowish-brown (10YR 4/4) and dark grayish-brown (10YR 4/2) silty clay loam; weak, coarse, subangular blocky structure; very firm; thin, continuous, grayish-brown (10YR 5/2), calcareous clay films on vertical ped faces; few fragments of shale and limestone pebbles; moderately alkaline and calcareous; gradual, irregular boundary.

C—38 to 60 inches, dark yellowish-brown (10YR 4/4) and dark-gray (10YR 4/1) silty clay loam; weak, thick, platy structure; very firm; thin, continuous, grayish-brown (10YR 5/2) and light brownish-gray (10YR 6/2), calcareous clay films on vertical ped faces and cracks in the till mass; few fragments of shale; mildly alkaline and calcareous.

The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3) and is slightly acid to neutral. In natural wooded areas the A1 horizon is dark gray (10YR 4/1) or very dark gray (10YR 3/1) and is 2 to 6 inches thick. It is commonly underlain by 3 to 5 inches of the A2 horizon. The B2t horizon is dark yellowish brown (10YR 4/4), brown (10YR 5/3), and yellowish brown (10YR 5/4 and 5/6). Clay films on ped faces are dark brown (10YR 4/3 or 3/3) in the upper part of the horizon and dark grayish brown (10YR 4/2) in the lower part. The B2t horizon ranges from 10 to 19 inches in thickness and from very strongly acid in the upper part to neutral in the lower part. Depth to the B3 horizon ranges from 19 to 28 inches. Depth to carbonates mostly coincides with the depth to the B3 horizon, but is typically about 24 inches. The C horizon has hues of 10YR and 2.5YR, values of 4 and 5, and chroma of 4. The calcareous clay films range from gray (10YR 5/1) to light gray (10YR 7/1) and coat most vertical ped faces and cracks. In some places the soil has a silt capping as much as 14 inches thick.

The Morley soils in this county have 2-chroma mottles in the upper 10 inches of the Bt horizon, which is outside the defined range for the series. This slight difference does not greatly influence the usefulness or behavior of these soils.

Morley soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Blount soils and the darker colored, very poorly drained Pewamo and Wetzel soils. They are not so well drained as the well-drained Miamian soils and are underlain by clay loam till containing shale fragments, whereas Miamian soils are underlain by loam textured till. Their B horizon is less clayey than that of the St. Clair soils.

Morley silt loam, 2 to 6 percent slopes (MrB).—This soil is on knolls and slopes adjacent to drainageways. Its surface layer is less eroded than that in the profile described as representative of the series. Included in mapping are small areas of somewhat poorly drained Blount soils and areas of darker colored, very poorly drained Pewamo and Wetzel soils in small drainageways.

Runoff is rapid. Erosion is a moderate hazard if this soil is used for cultivated crops. Slow permeability is a limitation to many nonfarm uses. Capability unit IIe-2.

Morley silt loam, 2 to 6 percent slopes, moderately eroded (MrB2).—This soil has the profile described as representative of the series. On much of the acreage erosion has removed some of the original surface layer and subsequent plowing has mixed some of the subsoil into the plow layer. This moderately eroded soil has a lower capacity to absorb and supply moisture to plants than uneroded Morley soils, and it requires more careful management to obtain satisfactory plant growth. Included in mapping are small areas of the somewhat poorly drained Blount soils and the darker colored, very poorly drained Pewamo and Wetzel soils. These inclusions are generally in small drainageways.

Runoff is rapid. Erosion is a severe hazard if this soil is used for cultivated crops. Slow permeability is a limitation to most nonfarm uses. Capability unit IIIe-2.

Morley silt loam, 6 to 12 percent slopes (MrC).—This soil is on knolls and slopes adjacent to drainageways. It has a thicker surface layer than that in the profile described as representative of the series. Included in mapping are areas of somewhat poorly drained Blount soils.

Runoff is rapid. Erosion is a severe hazard if this soil is used for cultivated crops. Slope and slow permeability are limitations to most nonfarm uses. Capability unit IIIe-3.

Morley silt loam, 6 to 12 percent slopes, moderately eroded (MrC2).—The plow layer of this soil is a mixture of the original surface layer and material from the upper part of the subsoil. This moderately eroded soil has a lower capacity to absorb and supply moisture to plants than the less eroded Morley soils, and it requires more careful management to obtain good plant growth. Included in mapping are areas of somewhat poorly drained Blount soils.

Runoff is rapid. Erosion is a severe hazard if this soil is used for cultivated crops. Slope is a limitation to most nonfarm uses. Capability unit IIIe-3.

Morley silt loam, 12 to 18 percent slopes, moderately eroded (MrD2).—The present surface layer of this soil is a mixture of the original surface layer and material from the upper part of the subsoil. Included in mapping are areas of less eroded Morley soils.

Runoff is very rapid. Erosion is a severe hazard if this soil is used for cultivated crops. Slope is a limitation to most nonfarm uses. Capability unit IVe-1.

Morley silt loam, 18 to 25 percent slopes, moderately eroded (MrE2).—The present surface layer of this soil is a mixture of the original surface layer and material from the upper part of the subsoil. Included in mapping are areas of less eroded Morley soils and areas where a few, scattered, shallow gullies cut into the underlying calcareous material.

Runoff is very rapid. Slope and the hazard of erosion are the major limitations to farm use. Slope is the major limitation to most nonfarm uses. Capability unit VIe-1.

Morley silt loam, 25 to 50 percent slopes, moderately eroded (MrF2).—The present surface layer of this soil is a mixture of the original surface layer and material from the upper part of the subsoil. Included in mapping are areas of less eroded Morley soils and areas where a few shallow gullies cut into the underlying calcareous material.

Runoff is very rapid. Slope is the major limitation to all farm and most nonfarm uses. Capability unit VIIe-1.

Muskego Series

The Muskego series consists of organic soils that are naturally very poorly drained. These soils are saturated most of the year unless artificially drained. They formed in more than 16 inches of organic material accumulated from the partly decomposed remains of trees, fibrous grasses, sedges, and reeds. They are in low-lying, swampy basins in the till plains, mostly in the southern part of the county.

In a representative profile in a pasture, the surface layer is black muck 13 inches thick. Beneath this is 8 inches of dark-brown mucky peat; 15 inches of dark grayish-brown mucky peat; and 24 inches of olive-gray earthy material.

If Muskego soils are drained, the root zone is deep. It is slightly acid to neutral and has very high available moisture capacity. Permeability is moderate to moderately rapid in the upper part of the profile and slow in the lower part. The content of phosphorus and potash is generally low.

These soils are used for crops and pasture. Corn and soybeans are the principal crops.

Representative profile of Muskego muck in a pasture area in Union Township, near village of Irwin, three-fourths mile southwest of intersection of State Route 161 and an abandoned railroad right-of-way in Irwin:

Oa1—0 to 9 inches, black (10YR 2/1) sapric material muck; moderate, fine, granular structure; friable; slightly acid; gradual, smooth boundary.

Oa2—9 to 13 inches, black (10YR 2/1) sapric material muck; weak, fine, subangular blocky structure; friable; slightly acid; gradual, smooth boundary.

Oa3—13 to 21 inches, dark brown (7.5YR 3/2) sapric material mucky peat; breaks out in chunks; friable; slightly acid; gradual, smooth boundary.

Oa4—21 to 36 inches, dark grayish-brown (2.5Y 4/2) sapric material mucky peat that has some woody fragments; massive; friable; neutral; clear, smooth boundary.

Lco—36 to 60 inches, olive-gray (5Y 4/2) coprogenous earth; massive; some herbaceous plants remain visible; neutral.

The Oa3 horizon is dark brown (7.5YR 3/2) or black (10YR 2/1). The sapric material ranges from medium acid to neutral. The coprogenous earth is neutral or mildly alkaline.

Muskego muck (Mu).—This level soil is in circular-shaped areas. Runoff is slow and is ponded after rainy periods. Included in mapping are a few small areas where the sapric material is more than 40 inches thick and small areas where the sapric material is underlain by marl. Thin silty overwash overlies the areas of sapric material in a few places, generally around the edges of the areas.

This soil is subject to subsidence if it is drained. The subsidence is the result of oxidation of the organic material. Controlling the level of the water table prevents excessive subsidence. If this soil is cultivated, it is subject to blowing during dry periods, especially if the surface is bare and exposed to strong winds. When the soil is dry, it is subject to damage from fire.

Wetness is a severe limitation to all farm uses. Wetness and the low strength of the muck material are severe limitations to most nonfarm uses. Capability unit IIIw-2.

Nappanee Series

The Nappanee series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in calcareous, clayey glacial till that has been modified in the upper part by water action at the bottom of former lakes. They are in the western part of the county.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown silt loam 7 inches thick. The subsoil is 18 inches thick. In sequence from the top, it is 2 inches of dark grayish-brown silty clay loam; 4 inches of gray and dark-gray silty clay mottled with yellowish brown; and 12 inches of dark grayish-brown silty clay mottled with gray and dark brown. The substratum is 14 inches of brown and dark grayish-brown silty clay and 21 inches or more of dark grayish-brown silty clay.

Nappanee soils have a seasonal higher water table. The gray colors and the mottling in the subsoil indicate natural wetness. Permeability is very slow. The root zone is moderately deep if these soils are adequately drained, has medium available moisture capacity, and is strongly acid in the most acid part.

Nappanee soils are used mostly for pasture and crops. The main crops are corn, soybeans, small grain, and hay.

Representative profile of Nappanee silt loam, 0 to 2 percent slopes, in a cultivated area in Liberty Township, 4 miles southwest of Raymond, three-fourth mile southwest of intersection of County Roads 179 and 258 (Sample UN-S27 in Laboratory data):

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

B1g—7 to 9 inches, dark grayish-brown (10YR 4/2) silty clay loam; few, medium, distinct, yellowish-brown (10YR 5/6) and gray (10YR 5/1) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic when wet; few, thin, patchy clay films on ped surfaces; common roots; medium acid; clear, wavy boundary.

B21tg—9 to 13 inches, gray (10YR 5/1) and dark-gray (10YR 4/1) silty clay; many, medium, distinct, yellowish-brown (10YR 5/4, 5/6) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic when wet; common roots; thin, continuous clay films on ped surfaces; strongly acid; clear, irregular boundary.

IIB22tg—13 to 20 inches, dark grayish-brown (2.5Y 4/2) silty clay; common, fine, distinct, gray (10YR 5/1) and dark-brown (10YR 4/3) mottles; moderate, medium, prismatic structure parting to weak, coarse, subangular blocky; firm, sticky and plastic when wet; few roots; thin, continuous clay films on ped surfaces; 1 percent pebbles; neutral; clear, irregular boundary.

IIB3t—20 to 25 inches, dark grayish-brown (2.5Y 4/2) silty clay; common, fine distinct, dark-brown (10YR 4/3) and gray (10YR 5/1) mottles; moderate, medium, prismatic structure parting to weak, medium and coarse, subangular blocky; firm, sticky and plastic when wet; thin, continuous clay films on some vertical ped faces; 1 percent pebbles; neutral; clear, irregular boundary.

IIC1—25 to 39 inches, brown (10YR 4/3) and dark grayish-brown (2.5Y 4/2) silty clay; weak, coarse, prismatic structure; very firm, sticky and plastic when wet; thin, patchy, gray (10YR 5/1) clay films on some vertical ped faces; 1 percent pebbles; irregular boundary; mildly alkaline and calcareous.

IIC2—39 to 60 inches, dark grayish-brown (10YR 4/2) and 2.5Y 4/2) silty clay; massive; very firm, sticky and plastic when wet; thin, patchy, gray (10YR 5/1) clay films on some vertical ped faces; 1 percent pebbles; mildly alkaline and calcareous.

The A and B horizons range from 22 to 32 inches in thickness. The Ap horizon is grayish brown (10YR 4/2) and dark grayish brown (2.5Y 4/2). In wooded areas the A1 horizon ranges from dark gray (10YR 4/1) to very dark grayish brown (10YR 3/2 or 2.5Y 3/2) and is 2 or 3 inches thick. The A2 horizon is 3 to 5 inches thick. A B1 horizon 2 or 3 inches thick is present in wooded areas. The B2 horizon is gray (10YR 5/1), dark gray (10YR 4/1), dark grayish brown (2.5Y 4/2 and 10YR 4/2), and light brownish gray (2.5Y 6/2) mottled with gray (10YR 5/1 and 10YR 6/1), yellowish brown (10YR 5/4 and 10YR 5/6), and dark brown (10YR 4/3). More than 40 percent of the mottling has high chroma. The B2 horizon ranges from 11 to 24 inches in thickness and is silty clay and clay. The B horizon ranges from strongly acid in the upper part to neutral in the lower part.

Nappanee soils are the somewhat poorly drained members of a drainage sequence that includes moderately well drained St. Clair soils and the very poorly drained Paulding soils. Their B and C horizons are more clayey than those of Crosby or Blount soils.

Nappanee silt loam, 0 to 2 percent slopes (NpA).—A profile of this soil is described as representative of the series. This soil is in broad areas. Runoff is slow and is ponded in depressions after rainy periods. Included in the mapping are spots of darker colored very poorly drained Paulding soils in strips 10 to 40 feet wide.

Wetness is a severe limitation to all farm uses. Seasonal wetness limits most nonfarm uses. Capability unit IIIw-1.

Nappanee silt loam, 2 to 6 percent slopes (NpB).—This soil has more rapid runoff than Nappanee silt loam, 0 to 2 percent slopes. Included in the mapping are spots of darker colored, very poorly drained Paulding soils in strips about 10 to 40 feet wide.

Wetness is a severe limitation to all farm uses. In cultivated areas erosion is a hazard on long slopes. Seasonal wetness limits most nonfarm uses. Capability unit IIIw-1.

Odell Series

The Odell series consists of nearly level soils that are somewhat poorly drained. These soils formed in a thin silt mantle and the underlying loamy calcareous glacial till on uplands. They are in the Darby Plain region in the southern part of the county.

In a representative profile in a cultivated area, the plow layer is very dark grayish-brown silt loam 6 inches thick. The subsoil is 21 inches thick: In sequence from the top, it is 4 inches of very dark grayish-brown silty clay loam; 6 inches of dark-brown clay loam mottled with yellowish brown; 2 inches of dark-brown silt loam mottled with light olive brown; and 9 inches of olive-gray loam mottled with yellowish brown. The substratum to a depth of 60 inches or more is dark grayish-brown loam mottled with yellowish brown and gray.

Odell soils have a seasonal high water table. The gray colors in the subsoil indicate natural wetness. Permeability is moderately slow. The root zone is moderately deep if the soils are adequately drained, has medium available moisture capacity, and is medium acid in the most acid part.

Odell soils are used for crops commonly grown in the county. Corn, soybeans, small grain, and hay are the main crops.

Representative profile of Odell silt loam, 0 to 2 percent slopes, in a cultivated area in Darby Township, 2 miles southwest of Unionville Center, three-fourths mile northwest of intersection of State Route 161 and County Road 44:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

B21—6 to 10 inches, very dark grayish-brown (10YR 3/2) silty clay loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; strong, fine, subangular blocky structure; firm; medium acid; clear, smooth boundary.

IIB22t—10 to 16 inches, dark-brown (10YR 4/3) heavy silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; strong, fine, subangular blocky structure; very firm; thin, continuous, dark grayish-brown (10YR 4/2) clay films on all ped faces; 3 percent coarse fragments; medium acid; clear, wavy boundary.

IIB23t—16 to 18 inches, dark-brown (10YR 4/3) heavy silt loam; many, medium, distinct, light olive-brown (2.5Y 5/6) mottles; weak, fine, subangular blocky structure; firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on all ped faces; 5 percent coarse fragments; slightly acid; clear, wavy boundary.

IIB3t—18 to 27 inches, olive-gray (5Y 5/2) loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical ped faces; 5 percent coarse fragments; mildly alkaline; clear, wavy boundary.

IIC—27 to 60 inches, dark grayish-brown (10YR 4/2) loam; common, fine, distinct, yellowish-brown (10YR 5/6) and gray (10YR 5/1) mottles; massive; firm; 5 percent coarse fragments; mildly alkaline and calcareous.

Depth to carbonates ranges from 24 to 36 inches. In most places the soil has a silt capping as much as 14 inches thick. The dark-colored layer ranges from 10 to 14 inches in thickness and is black (10YR 2/1), very dark brown (10YR 2/2), and very dark grayish brown (10YR 3/2). The B2t horizon is dark brown (10YR 4/3) or yellowish brown (10YR 5/4) and has mottles that have hues of 10YR and 2.5Y, values of 4 to 6, and chroma of 2. It is medium acid to neutral and is silt loam and silty clay loam.

Odell soils are near Crosby soils. They have a darker colored A horizon than Crosby soils. Both are somewhat poorly drained.

Odell silt loam, 0 to 2 percent slopes (OdA).—This soil is in broad areas. Runoff is slow and is ponded in depressions after rainy periods. Included in the mapping are spots of very poorly drained Brookston soils and light colored, somewhat poorly drained Crosby soils.

Wetness is a moderate limitation to all farm uses. Seasonal wetness limits most nonfarm uses. Capability unit IIw-5.

Paulding Series

The Paulding series consists of nearly level soils that are very poorly drained. These soils formed in clayey glacial till that has been modified to a moderate depth by water action at the bottom of former lakes. They are in depressions in the uplands in the western part of the county.

In a representative profile in a cultivated area, the plow layer is dark-gray and dark grayish-brown silty clay 7 inches thick. The subsoil is 45 inches thick. In sequence from the top, it is 35 inches of dark-gray clay mottled with strong brown and yellowish brown and 10 inches of yellowish-brown and dark yellowish-brown silty clay. The substratum to a depth of 62 inches or more is dark yellowish-brown silty clay.

Paulding soils have a seasonal high water table. Gray colors in the subsoil indicate natural wetness. Permeability is very slow. If adequately drained, these soils have a moderately deep root zone and medium available moisture capacity. The plow layer is medium acid to neutral.

Paulding soils are used mainly for pasture and crops. The principal crops are corn, soybeans, small grain, and hay.

Representative profile of Paulding silty clay in a cultivated area in Liberty Township, 2½ miles west of Raymond, 2,300 feet east of intersection of County Roads 252 and 229 (Sample UN-21 in Laboratory data):

Ap1—0 to 4 inches, dark-gray (10YR 4/1) silty clay; moderate, fine and medium, granular structure; firm; many roots; very dark gray (10YR 3/1) organic coatings on granule surfaces; medium acid; abrupt, smooth boundary.

Ap2—4 to 7 inches, dark grayish-brown (2.5Y 4/2) silty clay; strong, fine, angular blocky structure; very firm; common roots; neutral; clear, smooth boundary.

B21g—7 to 14 inches, dark-gray (N 4/0) clay; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; very firm; few roots; neutral; clear, wavy boundary.

B22g—14 to 28 inches, dark-gray (N 4/0) clay; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, angular blocky structure; very firm; thin, very patchy clay films on ped vertical surfaces; neutral; clear, wavy boundary.

B23g—28 to 42 inches, dark-gray (5Y 4/1) clay; many, medium, distinct, yellowish-brown (10YR 5/4, 5/6) mottles; massive in place parting to weak coarse angular blocky structure; very firm; few, fine, black (10YR 2/1) oxide stains; mildly alkaline; gradual, wavy boundary.

B3g—42 to 52 inches, yellowish-brown (10YR 5/4) and dark yellowish-brown (10YR 4/4) silty clay; massive in place parting to weak, medium, prismatic structure; sticky and plastic when wet, extremely hard when dry; contains a few small limestone pebbles; mildly alkaline; diffuse, irregular boundary.

C—52 to 62 inches, dark yellowish-brown (10YR 4/4) silty clay; massive in place parting to weak, coarse, prismatic structure; sticky and plastic when wet, extremely hard when dry; common lime streaks and splotches on prisms and in cracks; mildly alkaline and calcareous; contains a few small limestone pebbles.

Depth to calcareous material ranges from 40 to 55 inches. The Ap horizon is dark gray (10 YR 4/4) and dark grayish brown (2.5Y 4/2). The B2g horizon is dark gray (5Y 4/1 or N 4/0) and gray (N 5/0). Mottling in the B2g horizon is yellowish brown (10 YR 5/6 and 5/8) and strong brown (1.5YR 5/6), and reaction ranges from neutral to mildly alkaline.

Paulding soils are near St. Clair and Nappanee soils. They commonly are in depressions and are darker colored than slightly higher lying, moderately well drained St. Clair soils and somewhat poorly drained Nappanee soils. They are more clayey than the Pewamo soils.

Paulding silty clay (Pa).—This nearly level soil is in broad areas and in depressions. Runoff is slow and is ponded in depressions after heavy rains. Included in the mapping are spots of lighter colored Nappanee soils and spots of soils that have a silty clay loam surface layer.

Seasonal wetness is a severe limitation to all farm uses. Seasonal wetness and very slow permeability limit most nonfarm uses. Capability unit IIIw-1.

Pewamo Series

The Pewamo series consists of nearly level soils that are very poorly drained. These soils formed in calcareous glacial till of silty clay loam or clay loam texture, mostly in slight depressions in the uplands. They are in the eastern and northern parts of the county.

In a representative profile in a cultivated area, the play lawer is very dark gray silty clay loam 6 inches thick. The subsoil is 43 inches thick. In sequence from the top, it is 5 inches of very dark gray silty clay mottled with yellowish brown; 16 inches of dark-gray silty clay mottled with yellowish brown and gray; and 22 inches of gray silty clay and silty clay loam mottled with yellowish brown. The substratum to a depth of 60 inches or more is gray silty clay loam mottled with yellowish brown.

Pewamo soils have a seasonal high water table. The gray colors in the subsoil indicate natural wetness. Permeability is miderately slow. The root zone is deep in adequately drained areas, has high available moisture capacity, and is only slightly acid in the most acid part.

These soils re well suited to crops sommonly grown in the county. Corn, soybeans, small grain, and hay are the principal crops.

Representative profile of Pewamo silty clay loam in a cultivated area in Paris Township, 1 mile southeast of Marysville, 650 feet east of intersection of old U.S. Route 33 and the Penn-Central Railroad right-of-way:

Ap1—0 to 3 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

Ap2—3 to 6 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, angular blocky structure; firm; neutral; abrupt, smooth boundary.

B21g—6 to 11 inches, very dark gray (10 YR 3/1) silty clay; common, fine, distince, yellowish-brown (10YR 5/8) mottles; strong, medium, angular blocky structure; firm; slightly acid; clear, wavy boundary.

IIB22tg—11 to 18 inches, dark-gray (5Y 4/1) silty clay; common, fine, prominent, yellowish-brown (10YR 5/8) mottles; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; firm; thin, patchy clay films on vertical surfaces of peds; 2 percent glacial pebbles; neutral; clear, wavy boundary.

IIB23tg—18 to 27 inches, dark-gray (5Y 4/1(silty clay; many, fint and medium, prominent, yellowish-brown (10YR 5/6) mottles; massive but breaks to moderate, coarse, prismatic structure; very firm; this, continuous clay films on all ped surfaces; 2 percent glacial pebbles; neuthal; clear, wavy boundary.

IIB24tg—27 to 35 inches, gray (5Y 5/1) silty clay; many, medium, prominent, yellowish-brown (10YR 5/6) mottles; massive in place but breaks to weak, coarse, prismatic structure; very firm; thin, continuous clay films on vertical surfaces o fpeds; 2 percent glacial pebbles; mildly alkaline; clear, wavy boundary.

IIB3g—35 to 49 inches, gray (5Y 5/1) silty clay loam; many medium, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; massive; very firm; few, fine, distinct, black (10YR 2/1) oxide stains; 2 percent glacial pebbles; mildly alkaline; gradual, wavy boundary.

IIC—49 to 60 inches, gray (5Y 5/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; massive; grm; 2 percent glacial pebbles; mildly alkaline and calcareous.

The dark-colored layer ranges from 10 to 16 inches in thickness. It is very dark gray (10 YR 3/1), black (10YR 2/1), or very dark grayish brown (2.5Y 3/2). The B22, B23, and B24 horizons are dark gray (5Y 4/1), gray (5Y 5/1), or dark grayish brown (2.5Y 4/2). The B2 horizon ranges from slightly acid to mildly alkaline. In places these soils are covered with solty clay alluvium up to 14 inches thick.

Pewamo soils are the very poorly drained members of a drainage sequence that includes the moderately well drained Morley soils, the somewhat poorly drained Blount soils, and the poorly drained Wetzel soils. They have a thicker, dark-colored layer than Wetzel soils and are less clayey. They are more clayey than Brookston soils.

Pewamo silty clay loam (Pm).—This nearly level soil is in broad areas in slight depressions. Runoff is slow and is ponded in depressions after rainy periods. Included in mapping are spots of the lighter colored, somewhat poorly drained Blount soils, spots of Wetzel soils, and areas of teh finer textured Montgomery soils. Also included in places where Pewamo soils are covered with local alluvium areas of Algiers soils.

Seasonal wetness is a moderate limitation to all farm uses and limits most nonfarm uses. Capability unit IIw-6.

Quarries

Quarries (Qu) consists of open excavations from which dolomitic limestone has been removed by strip mining. It generally is in areas where the lawer of till is fairly thin over the dolomitic limestone, chiefly within areas of Morley, Blount, and Pewano soils. Areas range from 3 to 50 acres in size.

The soil material in spoil banks varies within short distances. Generally the stripped soil material is low in content of organic matter and in available moisture capacity and is poorly suited to the growth of plants. Because this material is unstable, it is subject to erosion and is a source of siltation.

Establishing vegetation in areas that are no longer mined reduces the hazard of erosion. Only grasses and trees that tolerate the low available moisture capacity and the unfavorable soil properties should be selected for seeding and planting.

Ponded areas can generally be developed for wildlife and for recreational facilities. Not assigned to a capability unit.

Ross Series

The Ross series consists of nearly level soils that are well drained. These soils formed in stratified loamy alluvium. They are on the bottom land mainly along Big Darby Creek in the southern part of the county.

In a representative profile in a pasture, the surface layer is very dark gray silt loam 13 inches thick. The subsoil is 25 inches thick. In sequence from the top, it is 12 inches of black silt loam and 13 inches of black silty clay loam. The substratum to a depth of 60 inches is dark-gray silty clay mottled with yellowish brown.

Ross soils are subject to flooding. They have a deep root zone and high available moisture capacity. They are mildly alkaline and are calcareous. Permeability is moderate.

These soils are used mainly for pasture. Some areas are used for corn and soybeans.

Representative profile of Ross silt loam in a pasture area in Allen Township, 6 miles southwest of Marysville, 2,000 feet south of intersection of County Roads 146 and 75:

A11—0 to 13 inches, very dark gray (10YR 3/1) silt loam, very dark grayish brown (10YR 3/2) rubbed; strong, medium, granular structure; friable; moderately alkaline and calcareous; abrupt, smooth boundary.

A12—13 to 25 inches, black (10YR 2/1) silt loam, very dark brown (10YR 2/2) rubbed; strong, medium, granular structure; friable; moderately alkaline and calcareous; abrupt, smooth boundary.

IIA13—25 to 38 inches, black (10YR 2/1) silty clay loam, very dark brown (10YR 2/2) rubbed; strong, fine, angular blocky structure; firm; neutral; clear, wavy boundary.

IIC—38 to 60 inches, dark-gray (10YR 4/1) silty clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; firm; neutral.

The A1 horizon is very dark gray (10YR 3/1), black (10YR 2/1), and dark brown (10YR 3/3) and is 20 to 30 inches thick. The IIA1 horizon is 6 to 13 inches thick. The IIC horizon is black (10YR 2/1), very dark gray (10YR 3/1), and dark gray (10YR 4/1). In some profiles the lower part is grayish brown (10YR 5/2) and gray (5Y 5/1). The IIC horizon is silty clay and silty clay loam.

The Ross soils in this county have a slightly higher clay content to a depth of 40 inches than is typical for the series. This difference, however, does not greatly influence the use or behavior of these soils.

Ross soils are near Genesee and Eel soils. They are darker colored than either of those soils and are better drained than the Eel soils.

Ross silt loam (Ro).—This nearly level soil is in broad areas on flood plains. It is subject to flooding. Included in the mapping are spots of very poorly drained Lippincott soils and also spots of Warsaw soils that are covered by 10 to 20 inches of alluvium.

Flooding is a moderate limitation to all farm uses and a severe limitation to many nonfarm uses. Capability unit IIw–1.

St. Clair Series

The St. Clair series consists of gently sloping to sloping soils that are moderately well drained. These soils formed in calcareous clayey glacial till that in places has been modified by water action in old glacial lakes. They are in the western part of the county.

In a representative profile in a cultivated area, the plow layer is grayish-brown silt loam 5 inches thick. The subsoil is 23 inches thick. In sequence from the top, it is 3 inches of pale-brown silty clay loam; 8 inches of brown clay; 5 inches of brown clay mottled with yellowish brown; and 7 inches of yellowish-brown silty clay mottled with grayish-brown. The substratum to a depth of 60 inches or more is yellowish-brown silty clay.

St. Clair soils are saturated for short periods, mostly in spring, and tillage is delayed. Permeability is very slow. The clayey subsoil and underlying compact till restrict penetration of roots. The root zone is moderately deep and has medium available moisture capacity. It is medium acid in the most acid part and becomes less acid with increasing depth.

St. Clair soils are used mainly for pasture and crops. Corn, soybeans, small grain, and hay are the principal crops.

Representative profile of St. Clair silt loam, 2 to 6 percent slopes, in a cultivated area in Allen Township, 6 miles northwest of Marysville, 1 mile north of U.S. Route 33, 1,450 feet east of intersection of County Roads 149 and 137 (Sample UN-S31 in Laboratory data):

Ap—0 to 5 inches, grayish-brown (10YR 5/2) silt loam; moderate, medium, granular structure; friable; common roots; very strongly acid; abrupt, smooth boundary.

B1—5 to 8 inches, pale-brown (10YR 6/3) silty clay loam; moderate, medium, subangular blocky structure; firm, some stickiness when wet; common roots; a few glacial pebbles as much as 1 inch in diameter; very strongly acid; clear, wavy boundary.

B21t—8 to 16 inches, brown (10YR 4/3) clay; moderate, medium and coarse, subangular blocky structure; firm, sticky and plastic when wet; common roots; medium continuous clay films; a few glacial pebbles as much as 1 inch in diameter; very strongly acid; clear, wavy boundary.

B22t—16 to 21 inches, brown (10YR 4/3) clay; few, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; firm, sticky when wet; medium continuous clay films; a few glacial pebbles as much as 1 inch in diameter; mildly alkaline; clear, wavy boundary.

B3t—21 to 28 inches, yellowish-brown (10YR 5/4) silty clay; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, coarse, prismatic structure parting to weak, coarse, subangular blocky; firm, sticky and plastic when wet; thin and medium continuous grayish-brown (10YR 5/2) clay films; a few glacial pebbles as much as 1 inch in diameter; mildly alkaline and calcareous; clear, wavy boundary.

C1—28 to 40 inches, yellowish-brown (10YR 5/4) silty clay; moderate, coarse, prismatic structure; firm, sticky and plastic when wet; some thin, very patchy, gray (10YR 5/1) clay coatings; 1 percent coarse fragments; mildly alkaline and calcareous; clear, wavy boundary.

C2—40 to 60 inches, yellowish-brown (10YR 5/4) silty clay; moderate, coarse, prismatic structure; firm, sticky and plastic when wet; gray (10YR 5/1) clay coatings; 1 percent coarse fragments; mildly alkaline and calcareous.

Depth to carbonates ranges from 16 to 28 inches. The Ap horizon is grayish brown (10YR 5/2), and dark grayish-brown (10YR 4/2). The A1 horizon in wooded areas is very dark gray (10YR 3/1) and is 1 to 3 inches thick. The A2 horizon in wooded areas is 3 to 5 inches thick. The B1 horizon is silty clay loam and silty clay 1 to 3 inches thick. The B2 horizon is yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/4), and dark brown (10YR 4/3) clay or silty clay that is 50 to 60 percent clay. The B horizon is very strongly acid to slightly acid in the upper part and grades to mildly alkaline and calcareous in the lower part.

St. Clair soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Nappanee soils and the very poorly drained Paulding soils. Their B and C horizons are more clayey than those of Morley or Miamian soils.

St. Clair silt loam, 2 to 6 percent slopes (ScB).—This soil has the profile described as representative of the series. It is on the higher knolls and along the major drainageways. Included in mapping are spots of somewhat poorly drained Nappanee soils and narrow strips of the darker colored, very poorly drained Paulding soils in drainageways.

If this soil is cultivated, the hazard of erosion is severe. Very slow permeability is a limitation to many nonfarm uses. Capability unit IIIe-2.

St. Clair silt loam, 2 to 6 percent slopes, moderately eroded (ScB2).—This soil is on the higher knolls and along the major drainageways. Its plow layer is a mixture of the original surface layer and the material from the upper part of the subsoil. It requires more careful management for growing plants than the less eroded St. Clair soils, because it has a lower capacity to absorb and supply moisture. Included in mapping are spots of the somewhat poorly drained Nappanee soils and narrow strips of the darker colored, very poorly drained Paulding soils in drainageways.

If this soil is cultivated, the hazard of erosion is severe. Very slow permeability is a limitation to many nonfarm uses. Capability unit IIIe-2.

St. Clair silt loam, 6 to 12 percent slopes (ScC).—This soil is in areas along the major drainageways. Slopes are short. Included in mapping are spots of moderately eroded soils and spots of moderately steep soils.

If this soil is cultivated, the hazard of erosion is very severe. Runoff is rapid. Slope and very slow permeability are limitations to many nonfarm uses. Capability unit IVe-1.

St. Clair silt loam, 6 to 12 percent slopes, moderately eroded (ScC2).—Slopes along the major drainageways are short. The present surface layer is a mixture of the original surface layer and material from the upper part of the subsoil. The combined thickness of the surface layer and subsoil is less than in uneroded St. Clair soils. Included in mapping are spots of severely eroded soils where the subsoil is exposed, areas of gullied soils where the calcareous clayey substratum is exposed, and areas of moderately steep soils.

If this soil is cultivated, the hazard of erosion is very severe. Runoff is rapid. Slope and very slow permeability are limitations to many nonfarm uses. Capability unit IVe-1.

Shoals Series

The Shoals series consists of nearly level soils that are somewhat poorly drained. These soils formed in loamy alluvium along the major streams in the county.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown silt loam 9 inches thick. The subsoil is 29 inches thick. In sequence from the top, it is 5 inches of dark grayish-brown silt loam mottled with light olive brown and 24 inches of dark grayish-brown silty clay loam mottled with light olive brown. The substratum to a depth of 60 inches or more is grayish-brown light silty clay mottled with light olive brown.

Shoals soils have a seasonal high water table and are subject to flooding. The gray colors in the subsoil indicate natural wetness. Permeability is moderate. The root zone is deep if the soils are adequately drained and is mostly slightly acid to neutral. Available moisture capacity is high.

These soils are used for pasture and cultivated crops. The main crops are corn and soybeans.

Representative profile of Shoals silt loam in a cultivated field in Paris Township, north of Marysville; 1 mile north of intersection of County Road 114 and Penn-Central Railroad right-of-way:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; very dark grayish-brown (10YR 3/2) organic coatings on granule faces; sightly acid; abrupt, smooth boundary.

B1g—9 to 14 inches, dark grayish-brown (2.5Y 4/2) silt loam; few, fine, distinct, light olive-brown (2.5Y 5/4) mottles; moderate, medium, angular blocky structure; friable; very dark grayish-brown (2.5Y 3/2) organic coatings on ped faces; slightly acid; clear, smooth boundary.

B21g—14 to 26 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; common, fine, distinct, light olive-brown (2.5Y 5/4) mottles; weak, medium, angular blocky structure; firm; neutral; gradual, wavy boundary.

B22g—26 to 38 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; common, fine, distinct, light olive-brown (2.5Y 5/4 and 5/6) mottles; weak, coarse, angular blocky structure; firm; few, fine, distinct, dark-brown (7.5YR 3/2) oxide concretions; neutral; gradual, wavy boundary.

Cg—38 to 60 inches, grayish-brown (2.5Y 5/2) light silty clay; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; weak, coarse, angular blocky structure; firm; mildly alkaline and calcareous.

The B2g horizon is dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), and gray (5Y 5/1). The B horizon ranges from slightly acid to neutral and is silty clay loam and silt loam. Some profiles have a thin horizon of light silty clay in the lower part.

Shoals soil are somewhat poorly drained members of a drainage sequence that includes the well drained Genesee soils, the moderately well drained Eel soils, and the darker colored, very poorly drained Sloan soils. They are grayer and more mottled than the Eel and Genessee soils. They differ from Algiers soils in that the Algiers soils are underlain by a very poorly drained, darker colored soil.

Shoals silt loam (Sh).—This soil is in low areas and winding flood channels in bottom land. Surface runoff is very slow and tends to pond in depressions. Included in mapping are spots of Algiers and Eel soils.

Wetness is a moderate limitation to all farm uses. Flooding is a severe limitation to most nonfarm uses. Capability unit IIw-2.

Sleeth Series

The Sleeth series consists of nearly level soils that are somewhat poorly drained. These soils formed in loamy outwash material underlain by sandy and gravelly material at a depth of 42 to 60 inches. They are on outwash terraces along the major streams north of Big Darby Creek.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown silt loam 11 inches thick. The subsoil is 43 inches thick. In sequence from the top, it is 4 inches of grayish-brown silt loam mottled with brown and yellowish brown; 7 inches of brown silty clay loam mottled with yellowish brown, grayish brown, and gray; 16 inches of yellowish-brown silty clay loam mottled with gray and yellowish brown; 10 inches of brown silty clay loam mottled with gray, yellowish brown, and dark yellowish brown; and 6 inches of yellowish-brown silty clay mottled with grayish brown and light olive brown. The substratum to a depth of 65 inches or more is olive-yellow very gravelly sand mottled with light brownish gray.

Sleeth soils have a seasonal high water table. The gray colors and the mottles in the subsoil indicate natural wetness. Permeability is moderate. The root zone is deep if these soils are adequately drained, has medium to high available moisture capacity, and is commonly strongly acid in the most acid part. It becomes less acid with increasing depth and grades to mildly alkaline.

Sleeth soils are used mainly for corn, soybeans, small grain, and hay.

Representative profile of Sleeth silt loam, 0 to 2 percent slopes, in a cultivated area in Taylor Township, 6½ miles northwest of Marysville, 1,730 feet south of County Road 205, 2,890 feet east of intersection of County Roads 191 and 205:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

B1—11 to 15 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, brown (10YR 5/3) and yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; 2 percent gravel; neutral; clear, wavy boundary.

B21tg—15 to 22 inches, brown (10YR 5/3) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6), grayish-brown (10YR 5/2), and gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky and plastic when wet; thin, continuous, gray (10YR 6/1) clay films; 3 percent gravel; neutral; clear, wavy boundary.

IIB22tg—22 to 38 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, gray (10YR 6/1) and yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky and plastic when wet; thin, continuous, gray (10YR 6/1) clay films; common, medium, distinct, very dark brown (10YR 2/2) oxide stains; 5 percent gravel; very strongly acid; clear, wavy boundary.

IIB23t—38 to 48 inches, brown (10YR 5/3) silty clay loam; common, medium, distinct, gray (10YR 6/1), yellowish-brown (10YR 5/6), and dark yellowish-brown (10YR 44) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky and plastic when wet; thin, continuous, gray (10YR 6/1) clay films; common, medium, distinct, very dark brown (10YR 2/2) oxide stains; 5 percent gravel; slightly acid; clear, wavy boundary.

IIB3t—48 to 54 inches, yellowish-brown (10YR 5/6) silty clay; common, medium, distinct, grayish-brown (2.5Y 5/2) and light olive-brown (2.5Y 5/4) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and plastic when wet; some gray (10YR 6/1) and light-gray (10YR 7/1) clay flows; 10 percent gravel; mildly alkaline; clear, wavy boundary.

IIIC—54 to 65 inches, olive-yellow (2.5Y 6/6) very gravelly sand; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; single grained; loose; mildly alkaline and calcareous.

The Ap horizon is dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2). The B2 horizon is silty clay loam, clay loam, and sandy clay loam; 15 to 20 percent of the sand content is coarser than very fine sand. The B2 horizon ranges from neutral to very strongly acid. Depth to the very gravelly sand C horizon ranges from 42 to 60 inches.

Sleeth soils are the somewhat poorly drained members of a drainage sequence that includes the darker colored, very poorly drained Westland soils. They are deeper over the stratified sand and gravel C horizon than Homer soils.

Sleeth silt loam, 0 to 2 percent slopes (SlA).—This soil is on broad, low outwash terraces. It is subject to flooding. Included in mapping are spots of darker colored, very poorly drained Westland soils.

Seasonal wetness is a moderate limitation to all farm uses and limits most nonfarm uses. Capabilty unit IIw-3.

Sloan Series

The Sloan series consists of nearly level soils that are very poorly drained. These soils formed in recent loamy alluvium washed from soils that are mostly underlain by calcareous glacial till. They are on the flood plains along most of the streams in the county.

In a representative profile in a cultivated area, the plow layer is very dark gray silty clay loam 10 inches thick. The lower part of the surface layer is 7 inches thick and is very dark gray silty clay loam mottled with yellowish brown. The subsoil is 8 inches thick and is dark-gray silty clay loam mottled with dark brown. The substratum to a depth of 60 inches or more is dark-gray silty clay loam mottled with brown and strong brown and gray silty clay loam mottled with brown.

Sloan soils have a seasonal high water table. The gray colors and the mottling in the subsoil indicate natural wetness. Permeability is moderately slow. The root zone is deep if the soil is adequately drained, has high available moisture capacity, and is commonly neutral in the upper part grading to mildly alkaline in the lower part.

Sloan soils are used for pasture and crops. Corn and soybeans are the principal crops.

Representative profile of Sloan silty clay loam in a cultivated area in Mill Creek Township, three-fourths mile northwest of Watkins, one-third mile west of intersection of County Roads 94 and 100:

Ap—0 to 10 inches, very dark gray (10YR 3/1) silty clay loam; moderate, fine, granular structure; friable; very dark grayish brown (10YR 3/2) rubbed; neutral; abrupt, smooth boundary.

A1—10 to 17 inches, very dark gray (10YR 3/1) silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, granular structure; friable; very dark grayish brown (10YR 3/2) rubbed; neutral; clear, smooth boundary.

B2g—17 to 25 inches, dark-gray (10YR 4/1) silty clay loam; few, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, medium, subangular blocky structure; firm; neutral; gradual, smooth boundary.

C1—25 to 40 inches, dark-gray (10YR 4/1) silty clay loam; common, medium, distinct, brown (7.5YR 5/4) and strong-brown (7.5YR 5/6) mottles; massive; firm; mildly alkaline; gradual, smooth boundary.

C2—40 to 60 inches, gray (10YR 5/1) silty clay loam; common, medium, distinct, brown (7.5YR 5/4) mottles; massive; firm; mildly alkaline.

The Ap and A1 horizons are very dark gray (10YR 3/1), very dark brown (10YR 2/2), and black (10YR 2/1 and N 2/0). The A horizon ranges from 11 to 24 inches in thickness. The Bg horizon is dark gray (10YR 4/1), gray (10YR 5/1), and grayish-brown (10YR 5/2). The content of clay in the Bg and C1 horizons is less than 35 percent. Reaction is neutral to mildly alkaline.

Sloan soils are the very poorly drained members of a drainage sequence that includes the well drained Genesee soils, the moderately well drained Eel soils, and the somewhat poorly drained Shoals soils. They are darker colored than Algiers soils and are not so well drained.

Sloan silty clay loam (So).—This nearly level soil is in broad areas and slight depressions in the flood plains. It is subject to flooding. Included in mapping are spots of lighter colored Algiers soils.

Seasonal wetness is a severe hazard if this soil is used for farming. Seasonal wetness and flooding severely limit most nonfarm uses. Capability unit IIIw–2.

Warsaw Series

The Warsaw series consists of nearly level to gently sloping, dark colored soils that are well drained. These soils formed in loamy material 30 to 40 inches thick over stratified sand and gravel. They are on glacial outwash terraces of Wisconsin age, mainly along Big Darby Creek.

In a representative profile in a cultivated area, the upper 9 inches of the surface layer, or the plow layer, is very dark grayish-brown silt loam. The lower 6 inches is very dark brown silt loam. The subsoil is 23 inches thick. In sequence from the top, it is 6 inches of dark-brown silty clay loam; 5 inches of dark-brown clay loam; 7 inches of dark-brown sandy clay loam; and 5 inches of very dark brown gravelly sandy loam. The substratum to a depth of 60 inches or more is dark grayish-brown and grayish-brown, stratified sand and gravel.

Warsaw soils are moderately permeable to a depth of 30 to 40 inches and rapidly permeable in the sandy and gravelly material below. They warm up early in spring. The sandy and gravelly material restricts roots. The root zone is moderately deep and has medium available moisture capacity. Consequently, the soils tend to be droughty, especially for crops that mature late in summer. The upper part of the root zone commonly ranges from strongly acid to mildly alkaline. The lower part and the underlying sandy and gravelly material are calcareous.

Warsaw soils are used mainly for corn, soybeans, small grain, and hay.

Representative profile of Warsaw silt loam, 1 to 4 percent slopes in a cultivated area in Union Township, 1 mile northwest of Milford Center, 1,325 feet northeast of intersection of County Roads 57 and 76:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine and medium, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

A1—9 to 15 inches, very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) rubbed; weak, medium, granular structure; friable; common roots; medium acid; clear, wavy boundary.

B1—15 to 21 inches, dark-brown (7.5YR 3/2) silty clay loam, dark brown (7.5YR 4/2) rubbed; moderate, fine, subangular blocky structure; friable; common roots; 10 percent gravel; strongly acid; clear, wavy boundary.

IIB21t—21 to 26 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; thin, continuous, dark-brown (7.5YR 4/2) clay films on vertical and some horizontal ped faces; 10 percent gravel; strongly acid; clear, wavy boundary.

IIB22t—26 to 31 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium and coarse, subangular blocky structure; firm; medium, continuous, dark-brown (7.5YR 4/2) clay films on all ped surfaces; 15 percent gravel; strongly acid; gradual, wavy boundary.

IIB23t—31 to 33 inches, dark-brown (7.5YR 4/4) sandy clay loam; weak, medium and coarse, subangular blocky structure; firm; medium, continuous, very dark brown (10YR 2/2) organic clay coatings on all ped surfaces; 15 percent gravel; medium acid; abrupt, irregular boundary.

IIB3—33 to 38 inches, very dark brown (10YR 2/2) gravelly sandy loam, dark brown (10YR 3/3) rubbed; weak, coarse, subangular blocky structure; friable; 20 percent gravel; mildly alkaline and calcareous; diffuse, irregular boundary.

IIC—38 to 60 inches, dark grayish-brown (10YR 4/2) and grayish-brown (10YR 5/2) stratified sand and gravel; loose; mildly alkaline and calcareous.

Thickness of the loamy material overlying stratified calcareous sand and gravel ranges from 30 to 40 inches. The Ap and A1 horizons are very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2). The A horizon ranges from 11 to 15 inches in thickness. The IIB2 horizon is sandy clay loam, clay loam, and silty clay loam. The weighted average clay content of the Bt horizon is less than 35 percent. The B2 horizon ranges from strongly acid to slightly acid in the upper part to slightly acid or neutral in the lower part. The B3 horizon has clay films on the surface of gravel and sand grains in some places.

Warsaw soils are the well-drained members of a drainage sequence that includes the somewhat poorly drained Kane soils and the very poorly drained, dark-colored Lippincott soils. They are commonly near the lighter colored Fox soils.

Warsaw silt loam, 1 to 4 percent slopes (WaB).—This soil is in broad areas. It has a high infiltration rate and little runoff. Included in mapping are a few spots of the light-colored Fox soils.

Erosion is a slight hazard if this soil is cultivated. This soil has no limitations for most nonfarm uses. Capability unit IIe–3.

Westland Series

The Westland series consists of soils that are very poorly drained. These soils formed in loamy material more than 42 inches thick over stratified sand and gravel. They are nearly level or in slight depressions on low outwash terraces along the major streams in the county north of Big Darby Creek.

In a representative profile in a cultivated area, the plow layer and lower part of the surface layer is black silty clay loam 14 inches thick. The subsoil is 43 inches thick. It is 5 inches of dark-gray silty clay mottled with yellowish brown; 14 inches of grayish-brown clay loam mottled with yellowish brown; 12 inches of yellowish-brown and olive gravelly loam. The substratum to a depth of 65 inches or more is stratified sand and gravel.

Westland soils have a seasonal high water table. They are moderately permeable. The gray colors and the mottles in the subsoil indicate natural wetness. The root zone is deep if the soils are adequately drained and has high available moisture capacity. It is commonly slightly acid or neutral. It becomes less acid with increasing depth and grades to moderately alkaline.

Westland soils are used mainly for corn and soybeans.

Representative profile of Westland silty clay loam in a cultivated area in Darby Township, 3¼ miles south of Marysville, 2,000 feet southwest of intersection of State Route 38 and County Road 62:

Ap—0 to 8 inches, black (N 2/0) silty clay loam, black (10YR 2/1) rubbed; moderate, medium, granular structure; friable; common roots; neutral; abrupt, smooth boundary.

A1—8 to 14 inches, black (N 2/0) silty clay loam, black (10YR 2/1) rubbed; strong, fine, subangular blocky structure; firm; common roots; neutral; clear, smooth boundary.

B21tg—14 to 19 inches, dark-gray (10YR 4/1) light silty clay; common, fine, distinct, yellowish-brown (10YR 5/4, 5/6) mottles; moderate, fine, prismatic structure parting to moderate, fine and medium, subangular blocky; firm; few, thin, patchy, very dark grayish-brown (10YR 3/2) clay films on vertical ped surfaces; common roots; neutral; clear, wavy boundary.

B22tg—19 to 25 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure; firm; few roots; thin, continuous, dark grayish-brown (2.5Y 4/2) clay films on vertical and most horizontal ped surfaces; neutral; gradual, wavy boundary.

B23tg—25 to 33 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6, 5/8) mottles; weak, medium, prismatic structure; firm; few, thin, continuous, dark grayish-brown (2.5Y 4/2) clay films on vertical ped surfaces; few, fine and medium, very dark brown (10YR 2/2) oxide stains; 5 percent igneous and dolomitic pebbles; mildly alkaline; gradual, wavy boundary.

IIB31—33 to 45 inches, olive-gray (5Y 5/2) and yellowish-brown (10YR 5/8) loam; massive; friable; 10 percent coarse fragments consisting of shale and partly weathered dolomitic pebbles; mildly alkaline and calcareous; diffuse, irregular boundary.

IIB32—45 to 57 inches, yellowish-brown (10YR 5/8) and olive (5Y 5/4) gravelly loam; massive; friable; 25 percent coarse fragments consisting of dolomitic cobblestones; mildly alkaline and calcareous; diffuse, irregular boundary.

IIIC—57 to 65 inches, brown (10YR 5/3) stratified sand and gravel; loose; mildly alkaline and calcareous.

The depth to sand and gravel is 42 to 60 inches. Depth to carbonates ranges from 32 to 50 inches. The A1 horizon is black (N 2/0) and very dark gray (10YR 3/1). The A horizon ranges from 12 to 16 inches in thickness. The B2 horizon is dark gray (10YR 4/1), grayish brown (2.5Y 5/2), and gray (5Y 5/1), and is silty clay loam, clay loam, and silty clay. The B2 horizon ranges from slightly acid in the upper part to moderately alkaline in the lower part. The B3 horizon is 10 to 30 percent coarse fragments consisting mostly of shale and dolomitic pebbles. In some places the coarse fragments have clay coatings.

The Westland soils in this county have a slightly higher clay content in the upper part of the B horizon than is defined as the range for the series. This difference does not greatly influence the use or behavior of these soils.

Westland soils are the very poorly drained members of a drainage sequence that includes the lighter colored, somewhat poorly drained Sleeth soils. In contrast with Lippincott soils, they have a lower content of clay in the B horizon and are deeper over the stratified sand and gravel C horizon.

Westland silty clay loam (Wc).—This nearly level soil is in broad areas and in slight depressions. Runoff is slow and is ponded in depressions after rainy periods. Included in mapping are spots of the lighter colored, somewhat poorly drained Sleeth soils.

Seasonal wetness is a moderate limitation to all farm uses and limits most nonfarm uses. Capability unit IIw-4.

Wetzel Series

The Wetzel series consists of soils that are very poorly drained. These soils formed in silty clay loam or clay loam glacial till. In many places they formed in areas that were shallow glacial lakes where a thin deposit of smooth, clayey lacustrine material covers the glacial till. They are in nearly level areas and in depressions in uplands in the northern and eastern parts of the county.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown silty clay loam 9 inches thick. The subsoil is 38 inches thick. In sequence from the top, it is 16 inches of dark-gray silty clay mottled with dark brown, strong brown, dark yellowish brown, and yellowish brown; 7 inches of gray silty clay mottled with dark yellowish brown and yellowish brown; and 15 inches of gray heavy silty clay loam mottled with dark yellowish brown and yellowish brown. The substratum to a depth of 60 inches or more is dark yellowish brown and gray heavy silty clay loam.

Wetzel soils have a seasonal high water table. The gray colors in the subsoil indicate natural wetness. Permeability is slow. The root zone is deep if the soils are adequately drained and has medium available moisture capacity. It is commonly neutral and grades to mildly alkaline with increasing depth.

Wetzel soils are used mainly for corn, soybeans, small grain, and hay.

Representative profile of Wetzel silty clay loam in a cultivated area in Leesburg Township, 6 miles northeast of Marysville, 1,475 feet west and 80 feet south of intersection of County Road 176 and State Route 4:

Ap1—0 to 7 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; weak, medium, subangular blocky structure; firm; many roots; neutral; abrupt, smooth boundary.

Ap2—7 to 9 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; strong, fine and medium, angular blocky structure; firm; common roots; slightly acid; clear, smooth boundary.

B1g—9 to 17 inches, dark-gray (N 4/0) silty clay; common, fine, distinct and prominent, dark-brown (7.5YR 4/4) and strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; firm; common fine roots, particularly along vertical ped faces; neutral; clear, smooth boundary.

B21tg—17 to 25 inches, dark-gray (N 4/0) silty clay; common, fine, distinct and prominent, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4, 5/6) mottles; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; firm; thin, patchy, very dark gray (N 3/0) clay films on ped faces; 2 percent pebbles; neutral; clear, smooth boundary.

B22tg—25 to 32 inches, gray (N 5/0) silty clay; common, fine, distinct and prominent, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4, 5/6) mottles; weak, medium, prismatic structure; firm; thin, continuous, dark-gray (N 4/0) clay films on ped faces and in old root channels; few, fine, black (10YR 2/1) concretions; 2 percent pebbles; neutral; gradual, wavy boundary.

B3—32 to 47 inches, gray (10YR 5/1) heavy silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4, 5/6) mottles; weak, coarse, prismatic structure; firm; thin patchy clay films on vertical ped faces; few, fine, black (10YR 2/1) concretions; 2 to 5 percent pebbles; mildly alkaline; gradual, wavy boundary.

C—47 to 60 inches, dark yellowish-brown (10YR 4/4) and gray (10YR 5/1) heavy silty clay loam; massive; firm; 10 percent pebbles; few cobblestones; mildly alkaline and calcareous.

Thickness of the solum and depth to carbonates ranges from 36 to 52 inches. The Ap horizon is dark grayish brown (2.5Y 4/2 or 10YR 4/2) and dark gray (10YR 4/1). The B2 horizon is dark gray (N 4/0), gray (N 5/0), and grayish brown (2.5Y 5/2). The B horizon is neutral in the upper part and mildly alkaline in the lower part.

Wetzel soils are the very poorly drained members of a drainage sequence that includes the moderately well drained Morley soils, the somewhat poorly drained Blount soils, and the very poorly drained Pewamo soils. Their A horizon is lighter colored than that of the Pewamo soils.

Wetzel silty clay loam (We).—This nearly level soil is in broad areas and in narrow areas in depressions along upland drainageways. Runoff is slow and is ponded in depressions after rainy periods. Included in mapping are spots of darker colored Pewamo soils and spots of slightly higher lying lighter colored Blount soils.

Seasonal wetness is a moderate limitation for all farm uses. Seasonal wetness and slow permeability limit most nonfarm uses. Capability unit IIw-6.

Formation and Classification of the Soils

This section describes the major factors of soil formation, tells how these factors have affected the soils in Union County, and explains some of these processes in soil formation. It also defines the current system for classifying soils and classifies the soils according to that system. The soil series in this county and a profile representative of each series are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soils are the product of soil-forming processes acting on material deposited or accumulated by geologic forces. The major factors in soil formation are parent material, climate, relief, living organisms, and time.

Climate and living organisms, particularly vegetation, are the active forces in soil formation. Their effect on the parent material is modified by relief and by the length of time the parent material has been acted upon. The relative importance of each factor differs from place to place. In some places one factor dominates and determines most of the soil properties, but normally the interaction of all five factors determines what kind of soil forms in any given place.

Parent material

The soils of Union County formed in several kinds of parent material: glacial till, outwash material, and loess, or combinations of these materials, lacustrine deposits, recent alluvium, and accumulated organic material.

Glacial till, a general term applied to extensive glacial deposits, is the most extensive of the parent materials in the county. The upland soils formed in glacial till; however, as much as 14 inches of loess capping overlies some of the till areas. In these areas the upper part of the soil formed in loess. Blount, Morley, Celina, and Crosby are the principal soils that are partially capped by loess. The till is fairly homogeneous and uniform in texture, and the soils formed in this parent material have a moderately fine to fine textured subsoil.

Outwash sand and gravel was deposited in the county by melt water along the glacial streams in the county. Much of this fairly well sorted coarse material was covered by finer textured loamy outwash. Fox and Westland soils, for example, formed in these materials. Fox soils are reddish brown because drainage is good. Westland soils are dominantly gray because the water table is high and aeration is poor.

Areas of lacustrine material (lake bottom sediment) are not extensive in the county. The interlayered silty and clayey characteristics of the parent material in these areas are reflected in the fine-textured, plastic subsoil of the Henshaw and Montgomery soils.

Alluvial, or flood water, deposits are the youngest parent materials in the county. These materials are still accumulating as fresh sediment is added by the overflow of streams. The sediment is from the surface layer of the higher lying soils in the county and from exposures of glacial till. Genesee soils, which are deep, fertile, and neutral in reaction, formed in alluvial material.

Accumulated organic material occurs in a few scattered areas in the southwestern part of the county. It consists mainly of decomposed remains of trees, sedges, and grasses that have accumulated in potholes and in drainageways where the water table is high and where seepage water has kept the area permanently wet. This material is slightly acid to neutral in reaction. Muskego soils formed in this material.

Climate

The climate throughout Union County is uniform enough that it has not greatly contributed to differences among the soils. It has been favorable to both physical change and chemical weathering of parent materials and to biological activity.

Rainfall has been adequate for percolating water to leach carbonates to a moderate depth, as in the Morley, Celina, and Blount soils, for example. Frequency of rainfall caused wetting and drying cycles favorable to the translocation of clay minerals and formation of soil structure, as in Morley, Miamian, and Fox soils.

The range of temperature variations has favored both physical change and chemical weathering of parent material. Freezing and thawing aided the formation of soil structure, and warm temperatures in summer favored chemical reactions in the weathering of primary minerals.

Rainfall and temperature have been conducive to plant growth and the accumulation of organic matter in all the soils.

Relief

Relief can account for the formation of different soils from the same kind of parent materials. Morley, Blount, and Pewamo soils all formed in glacial till. The moderately well drained Morley soils have a moderately thick solum. They generally formed where the slope was not steep enough to encourage excessive erosion nor so nearly level to prevent runoff. The somewhat poorly drained

Blount soils are nearly level and formed in areas where runoff is slow. Nearby, the very poorly drained, dark-colored Pewamo soils formed in the swales where organic residues accumulate because the water table is high most of the year. Blount soils and the steep Morley soils are dominant in the morainic areas. The nearly level to gently undulating Blount, Wetzel, and Pewamo soils are dominant on the till plains.

Living organisms

At the time Union County was settled, the vegetation was predominantly hardwood forest, dominantly beech, maple, oak, hickory, and ash. Grassy clearings occurred on the well-drained sites and marshy openings in the poorly drained swales.

Soils that formed in forested areas are acid and moderate in natural fertility. They include the Morley, Blount, and St. Clair soils. In the well-drained grassy clearings are the dark-colored, less acid, and more fertile Odell and Kane soils. In the marshy swales are the very poorly drained, dark-colored, fertile soils, such as Pewamo, Wetzel, and Brookston soils.

Small animals, insects, worms, and roots make the soil more permeable by channeling in it. Animals also mix the soil materials in their life activities and contribute organic matter in the process and after death. Worm channels or casts are plentiful in the highly organic surface layer of Odell and Kane soils. Crawfish channels are prevalent in the more poorly drained Paulding, Wetzel, and Montgomery soils.

The activities of man also affect the course of soil formation. Man plows and plants and introduces vegetative changes. He drains some areas, irrigates some, and removes soil material from others for construction purposes. His use of lime and fertilizer changes the chemistry of the soils. Each of these activities, in its own way, affects the future formation of the soil.

Time

Time is needed for the other soil-forming factors to produce their effects. The age of a soil is indicated, to some extent, by the degree of profile formation. In many places, factors other than time have been responsible for most of the differences in kind and distinctness of horizons in the different soils. If the parent material weathers slowly, the profile forms slowly. If slopes are steep and soil is removed almost as fast as it forms, no distinct horizons form.

Most soils in the county have a well-formed profile. Example are the Morley, Blount, Fox, Celina, and Crosby soils. On the flood plains, frequent deposits of fresh sediment periodically interrupt the soil-forming process. The Genesse and Eel on flood plains are examples of soils in which horizons are not well formed or expressed.

Processes of Soil Formation

Most soils in Union County have a strongly expressed profile, in which the processes of soil formation produced very distinct changes in the material from which the soils were derived. These are the undulating to rolling soils on glacial till deposits and on glacial outwash terraces along the major valleys. In contrast, the soils on flood plains are only slightly modified from the parent material.

All the factors of soil formation act in unison to control the processes by which horizons form. These processes are (1) additions, (2) removals, (3) transfers, and (4) transformations. Some promote horizon differentiation, but others retard or obliterate differences that are already present.

In this region the most evident addition to the soil is organic matter. Soils that formed under deep-rooted grasses, or where a high water table has restricted decomposition of organic matter, have a deep, dark-colored surface horizon. The surface horizon is high in organic matter and has a good structure, and base saturation exceeds 50 percent. Examples of such soils are Pewamo or Brookston soils. Some organic matter accumulates as a thin surface mat in most soils, but is usually obliterated by cultivation. Severe erosion can remove all evidence of this addition to the soil profile.

Leaching of carbonate from calcareous parent material is one of the most significant losses that precedes many other chemical changes in the solum. Most of the glacial till in Union County has a high content of carbonate (25 to 45 percent). In most soils carbonates have been leached to a depth of 2 feet or more, and the upper 2 feet is now acid. Other minerals in the soil are subjected to the same chemical weathering, but their resistance is higher and removal is slower. Following the removal of carbonates, alteration of such minerals as biotite and feldspar results in changes of color within the profile. Free iron oxides are produced that may be segregated by a fluctuating high water table to produce gray colors and mottling, as in Brookston soils, for example. Unless the water table is seasonally high within the profile, brownish colors that have stronger chroma or redder hue than those in the C horizon are typical.

Seasonal wetting and drying of the soil profile is largely responsible for the transfer of clay from the A horizon to the ped surfaces in the B horizon. The fine clays become suspended in percolating water moving through the A horizon. They are carried by the water to the B horizon. There, the fine clays are deposited on the ped surfaces by drying or by precipitation caused by free carbonates. This transfer of fine clay accounts for the patchy or nearly continuous clay films on ped surfaces in the B horizon of such soils as the Morley, Miamian, and Celina soils.

Transformations of mineral compounds occur in most soils. The results are most apparent if the formation of horizons is not affected by rapid erosion or by accumulation of material at the surface. The primary silicate minerals are weathered chemically to produce secondary minerals, mainly those of the layer-lattice silicate clays. Most of the layer-lattice clays remain in the soil profile, but clay from the A horizon is transferred to deeper horizons.

Classification of the Soils

The purpose of soil classification is to help us remember the significant characteristics of soils, assemble our knowledge about the soils, see their relationships to one another and to the whole environment, and develop principles relating to their behavior and their response to manipulation. First through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The current system of soil classification (*8, 9, 13*) was adopted by the Cooperative Soil Survey in 1965. It is a comprehensive system, designed to accommodate all soils. In this system classes of soils are defined in terms of observable or measurable properties. The properties chosen are primarily those that result on the grouping of soils of similar genesis, or mode of origin. Genesis does not, however, appear in the definitions of the classes.

The current system of classification 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. Table 9 shows the classification of the soils of Union County according to this system. Brief descriptions of the six categories follow.

Order.—Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate orders are those that tend to give broad climatic groupings of soils. Two exceptions to this generalization are the Entisols and the Histosols, both of which occur in many different climates. Five of the ten orders are represented in Union County: Alfisols, Inceptisols, Mollisols, Histosols, and Entisols.

Suborder.—Each order is divided into suborders, mainly on the basis of soil characteristics that result in grouping soils according to genetic similarity. The climatic range is narrower than that of the order. The properties used are mainly those that reflect either the presence of absence of waterlogging or differences in climate or vegetation.

Great group.—Each suborder is divided into great groups on the basis of similarity in the kind and sequence of the major horizons and in major soil properties. The horizons considered are those in which clay, iron, or humus have accumulated and those in which pans that interfere with the growth of roots and the movement of water have formed. The properties are soil temperature, chemical composition (mainly content of calcium, magnesium, sodium, and potassium), and the like.

Subgroup.—Each great group is divided into subgroups, one that represents the central (typic) concept of the group, and others, called intergrades, that have one or more properties of another great group, suborder, or order.

Family.—Families are established within each subgroup, primarily on the basis of properties important to the growth of plants or properties significant in engineering. Texture, mineral composition, reaction, soil temperature, permeability, thickness of horizons, and consistence are among the properties considered.

Series.—A series is a group of soils that have horizons similar in all important characteristics, except for texture of the surface layer, and similar in arrangement in the profile. (See the section "How This Survey Was Made.")

Laboratory Data

Laboratory data is given for six soil series in Union County in table 10. Profile descriptions for these soils are given in the section "Descriptions of the Soils." Data shown in table 10 was obtained by laboratory analysis at the Agronomy Department, Ohio Agricultural Research and Development Center, Columbus, Ohio. The soils analyzed were selected for testing to add to the knowledge of Ohio soils and to aid in the proper classification of the soils.

The following paragraphs outline some of the procedures used to obtain the data presented in table 10.

Data on particle size distribution were obtained by the pipette method outlined by Steele and Bradfield (*10*), but using sodium hexametaphosphate as the dispersing agent and a 10-gram soil sample. The sands were determined by sieving. The percentage of fine silt and coarse clay, 20 microns to 0.2 micron, was determined by sedimentation, and the fine clay, less than 0.2 micron, by sedimentation in a centrifuge. The percentage of coarse silt was obtained by substracting that of sand, fine silt, and clay from the total sample. The percentage of organic matter was determined by a dry combustion method. Exchangeable bases were extracted with a neutral solution of ammonium acetate. The exchangeable potassium in this solution was determined with a flame photometer (*5*). Exchangeable calcium and magnesium in this solution were determined by the EDTA titration method (*4*). Exchangeable hydrogen (which also includes titratable aluminum) was determined by the triethanolamine method (*5*), and cation exchange capacities by the summation of exchangeable cations. Calcium carbonate equivalent was determined titrimetrically by the procedure of Hutchison and MacLenna described by C. S. Piper (*6*). All pH measurements were made by using a 1:1 soil-water ratio.

Published mechanical and chemical analysis data are also available on similar soils in the soil surveys for adjacent Champaign and Delaware Counties. Data on Brookston, Celina, Crosby, Fox, Kane, and Lippincott soils are available in the Champaign County soil survey, and data on Blount, Morley, and Pewamo soils are available in the Delaware County soil survey. Unpublished data from numerous other soil sites in Union County can be obtained in mimeograph form from the Agronomy Department, Ohio Agricultural Research and Development Center, Columbus, Ohio.

General Nature of the County

This section provides general information about the climate, industries, geology and relief, farming, and drainage in Union County.

Geology and Relief

Union County is in the Central Lowland (*15*) province of the United States. Glaciers deposited a mantle of till material of varying thickness over limestone bedrock in the area that is now Union County. The earliest glaciation probably took place during the Illinoian age, and the second during the Wisconsin age.

TABLE 9.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Algiers	Fine-loamy, mixed, nonacid, mesic	Aquic Udifluvents	Entisols.
Blount	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Brookston	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Celina	Fine, mixed, mesic	Aquic Hapludalfs	Alfisols.
Crosby	Fine, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Eel	Fine-loamy, mixed, mesic	Fluvaquentic Eutrochrepts	Inceptisols.
Fox [1]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Genesee [2]	Fine-loamy, mixed, mesic	Fluventic Eutrochrepts	Inceptisols.
Henshaw [3]	Fine-silty, mixed, mesic	Aquic Hapludalfs	Alfisols.
Homer [4]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Kane	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Aquic Argiudolls	Mollisols.
Kendallville	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Lippincott	Clayey over sandy or sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Miamian	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Montgomery [5]	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Morley [6]	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Muskego	Coprogenous, euic, mesic	Limnic Medisaprists	Histosols.
Nappanee	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Odell	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Paulding	Very fine, illitic, nonacid, mesic	Typic Haplaquepts	Inceptisols.
Pewamo	Fine, mixed, mesic	Typic Argiaquolls	Mollisols.
Ross [7]	Fine-loamy, mixed, mesic	Cumulic Hapludolls	Mollisols.
St. Clair	Fine, illitic, mesic	Typic Hapludalfs (Aquic)	Alfisols.
Shoals	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Sleeth	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Sloan	Fine-loamy, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Warsaw	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiudolls	Mollisols.
Westland [8]	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Wetzel	Fine, illitic, mesic	Typic Ochraqualfs	Alfisols.

[1] The Fox soils in this county are taxadjuncts to the Fox series. They have a higher clay content in the upper 20 inches of the B horizon than is currently described in the range defined for the Fox series.

[2] The Genesee soils in this county are taxadjuncts to the Genesee series. They generally do not have carbonates within a depth of 40 inches and are thus outside the range described for the Genesee series.

[3] The Henshaw soils in this county are taxadjuncts to the Henshaw series. They are outside the range described for the Henshaw series because they have a few gray mottles directly below the A horizon and the B2 horizon is neutral to mildly alkaline.

[4] The Homer soils in this county are taxadjuncts to the Homer series. They have a slightly higher clay content in the B2tg horizon than is described in the range defined for the Homer series.

[5] The Montgomery soils in this county are taxadjuncts to the Montgomery series. They have a thicker solum and are deeper over carbonates than is described in the range defined for the Montgomery series.

[6] The Morley soils in this county are taxadjuncts to the Morley series. They are outside the range described for the Morley series because they have 2-chroma mottles in the upper 10 inches of the Bt horizon.

[7] The Ross soils in this county are taxadjuncts to the Ross series. They have a slightly higher clay content to a depth of 40 inches than is described in the range defined for the Ross series.

[8] The Westland soils in this county are taxadjuncts to the Westland series. They have a slightly higher clay content in the upper part of the B horizon than is described in the range defined for the Westland series.

TABLE 10.—*Laboratory*

[Analyses were made at the Agronomy Department, Ohio Agriculture Research and

Soil, location, and site number	Horizon	Depth from surface	Particle-size distribution: Very coarse sand (2.0–1.0 mm)	Coarse sand (1.0–0.5 mm)	Medium sand (0.50–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Total sand (2.0–0.05 mm)	Silt (0.05–0.002 mm)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Blount silt loam, 0 to 2 percent slopes: Allen Township; 1 mile southeast of Allen Center, 825 feet northwest of County Road 148–B, and 2,900 feet northeast of County Road 160. Laboratory data UN–16.	Ap	0–6	1.0	3.1	3.5	9.1	7.3	24.0	52.4
	B1t	6–10	1.1	1.9	2.3	5.6	5.3	16.2	48.8
	B21t	10–12	.9	1.8	2.2	5.4	4.8	15.1	43.7
	B22t	12–17	.9	1.7	1.7	4.5	4.6	13.4	42.5
	B22t	17–22	1.0	2.2	2.0	5.0	5.2	15.4	44.1
	B3t	22–26	1.7	2.7	2.3	5.7	6.7	19.1	50.0
	B3t	26–31	1.4	2.9	2.4	5.8	6.9	19.4	50.4
	C	31–47	2.2	3.5	2.7	6.3	6.5	21.2	51.1
	C	47–60	2.8	4.1	2.8	6.0	6.6	22.3	51.4
Crosby silt loam, 0 to 2 percent slopes: Union Township; 6½ miles south of Marysville, 1 mile south of Penn Central Railroad tracks on State Route 38; 400 feet southeast from State Route 38. Laboratory data UN–19.	A1	0–3	1.1	2.0	1.6	3.6	3.4	11.7	63.4
	A2	3–7	1.5	3.3	2.3	3.8	3.6	14.5	63.3
	B1	7–11	1.0	2.6	2.0	3.7	3.4	12.7	59.7
	IIB21t	11–17	.6	1.4	1.4	2.9	2.9	9.2	53.1
	IIB22t	17–25	.6	1.2	1.3	3.0	3.5	9.6	48.9
	C	25–35	3.9	4.8	3.1	5.6	6.9	24.3	58.1
Morley silt loam, 2 to 6 percent slopes, moderately eroded: Taylor Township; 3⅔ miles northwest of Marysville, 1,980 feet northwest of intersection of State Route 31 and County Road 128. Laboratory data UN–26.	Ap	0–7	1.2	2.4	2.5	6.6	6.4	19.1	58.7
	B1t	7–10	1.0	1.6	1.4	3.9	4.8	12.8	47.6
	B21t	10–13	.6	1.4	1.4	3.8	4.6	11.8	43.7
	B22t	13–17	.5	1.5	1.4	4.1	5.1	12.6	40.5
	B23t	17–24	.4	1.2	1.2	3.8	5.1	11.7	43.0
	B31t	24–29	1.5	2.2	1.9	4.9	5.7	16.2	47.4
	B32t	29–38	1.3	2.3	1.8	4.3	5.6	15.3	50.5
	C	38–60	1.8	2.7	2.0	4.7	5.8	17.0	52.2
Nappanee silt loam, 0 to 2 percent slopes: Liberty Township; 4 miles southwest of Raymond; three-fourths mile southwest of intersection of County Roads 179 and 258. Laboratory data UN–S27.	Ap	0–7	------	------	------	------	------	------	------
	B1g	7–9	------	------	------	------	------	------	------
	B21tg	9–13	.1	.3	.2	.8	1.1	2.5	42.6
	IIB22tg	13–20	.3	.4	.4	1.0	1.3	3.4	42.6
	IIB3t	20–25	------	------	------	------	------	------	------
	IIC1	25–39	------	------	------	------	------	------	------
	IIC2	39–60	.5	.9	.7	1.6	1.6	5.3	44.9
Paulding silty clay: Liberty Township; 2½ miles west of Raymond; 2,300 feet east of intersection of County Roads 252 and 229. Laboratory data UN–21.	Ap1	0–4	.2	.9	.8	1.9	1.8	5.6	46.8
	Ap2	4–7	.2	.8	.6	1.2	1.2	4.0	45.0
	B21g	7–14	.0	.2	.2	.6	.7	1.7	39.9
	B22g	14–21	.1	.2	.1	.5	.8	1.7	37.2
	B22g	21–28	.0	.1	.1	.5	.7	1.4	35.9
	B23g	28–35	.0	.1	.1	.5	.7	1.4	35.2
	B23g	35–42	.0	.1	.2	.4	.4	1.1	38.1
	B3g	42–52	.4	.5	.3	.4	.5	2.1	48.4
	C	52–62	.2	.3	.2	.3	.2	1.2	41.3
St. Clair silt loam, 2 to 6 percent slopes: Allen Township; 6 miles northwest of Marysville; 1 mile north of U.S. Route 33; 1,450 feet east of intersection of County Roads 149 and 137. Laboratory data UN–S31.	Ap	0–5	------	------	------	------	------	------	------
	B1	5–8	------	------	------	------	------	------	------
	B21t	8–16	.1	.4	.5	1.4	1.4	3.8	33.8
	B22t	16–21	1.3	.9	.6	1.7	1.5	6.0	35.9
	B3t	21–28	------	------	------	------	------	------	------
	C1	28–40	------	------	------	------	------	------	------
	C2	40–60	.3	.3	.2	.6	.6	2.0	44.4

data

Development Center, Columbus, Ohio. Dashes indicate the value was not determined]

Particle size distribution—Con.		Textural class	Reaction	Organic-matter content	$CaCO_3$ equivalent	Exchangeable cations				Sum of exchangeable cations	Sum of bases	Base saturation
Clay (less than 0.002 mm)	Fine clay (less than 0.0002 mm)					H	Ca	Mg	K			
Percent	*Percent*		*pH*	*Percent*	*Percent*	*Meq per 100 gm*	*Meq per 100 gm*	*Meq per 100 gm*	*Meq per 100 gm*	*Meq per 100 gm*	*Meq per 100 gm*	*Percent*
23. 6	6. 6	Silt loam	6. 9	3. 5	----	4. 2	11. 6	4. 0	0. 23	20. 0	15. 8	79
35. 0	10. 7	Silty clay loam	6. 2	1. 0	----	5. 2	9. 6	4. 2	. 22	19. 2	14. 0	73
41. 2	15. 4	Silty clay	6. 3	1. 1	----	5. 7	12. 3	5. 1	. 26	23. 4	17. 7	76
44. 1	18. 9	Silty clay	6. 5	1. 2	----	5. 5	14. 0	6. 2	. 29	26. 0	50. 5	79
40. 5	15. 1	Silty clay	7. 3	1. 1	1. 8	----	----	----	----	----	----	----
30. 9	9. 9	Silty clay loam	7. 8	. 9	20. 4	----	----	----	----	----	----	----
30. 2	9. 7	Silty clay loam	7. 8	----	20. 1	----	----	----	----	----	----	----
27. 7	8. 6	Clay loam	7. 9	----	24. 2	----	----	----	----	----	----	----
26. 3	7. 1	Silt loam	7. 9	----	23. 6	----	----	----	----	----	----	----
24. 9	9. 1	Silt loam	6. 3	7. 0	----	8. 3	12. 5	3. 9	1. 08	25. 8	17. 5	68
22. 2	5. 7	Silt loam	5. 5	1. 7	----	7. 8	6. 5	2. 9	. 26	17. 5	9. 7	55
27. 6	11. 0	Silty clay loam	4. 9	1. 0	----	9. 8	5. 4	3. 5	. 28	19. 0	9. 2	48
37. 7	20. 8	Silty clay loam	4. 4	1. 0	----	17. 6	6. 1	5. 1	. 41	29. 2	11. 6	38
41. 5	22. 4	Silty clay	5. 5	1. 0	----	9. 0	13. 3	9. 8	. 41	32. 5	23. 5	72
17. 6	4. 6	Silt loam	7. 8	. 7	48. 8	----	----	----	----	----	----	----
22. 2	2. 8	Silt loam	5. 8	2. 6	----	6. 3	6. 7	1. 4	. 32	14. 7	8. 4	57
39. 6	15. 0	Silty clay loam	5. 2	. 9	----	7. 4	7. 8	1. 9	. 28	17. 4	10. 0	57
44. 5	17. 4	Silty clay	5. 0	. 9	----	9. 7	8. 6	2. 3	. 29	20. 9	11. 2	54
46. 9	20. 9	Silty clay	4. 9	. 7	----	10. 9	8. 5	3. 0	. 33	22. 7	11. 8	52
45. 3	18. 3	Silty clay	6. 3	. 2	----	4. 9	11. 7	3. 9	. 31	20. 8	15. 9	76
36. 4	12. 9	Silty clay loam	7. 7	----	9. 3	----	----	----	----	----	----	----
34. 2	11. 6	Silty clay loam	7. 8	----	21. 1	----	----	----	----	----	----	----
30. 8	8. 4	Silty clay loam	7. 8	----	25. 7	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----
54. 9	30. 9	Silty clay	5. 4	. 7	----	8. 7	12. 2	11. 0	. 49	32. 4	23. 7	73
54. 0	29. 6	Silty clay	6. 6	. 9	----	4. 3	11. 6	11. 7	. 47	28. 1	23. 8	85
----	----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----
49. 8	15. 8	Silty clay	7. 9	----	26. 1	----	----	----	----	----	----	----
47. 6	12. 5	Silty clay	5. 9	5. 0	----	11. 6	17. 5	6. 0	. 66	35. 8	24. 2	68
51. 0	16. 4	Silty clay	6. 0	4. 1	----	9. 4	19. 8	6. 6	. 61	36. 4	27. 0	74
58. 4	22. 4	Clay	6. 5	2. 6	----	8. 5	20. 1	6. 5	. 61	35. 7	27. 2	76
61. 1	26. 2	Clay	6. 9	1. 7	----	6. 7	26. 2	6. 8	. 59	40. 3	33. 6	83
62. 7	28. 8	Clay	7. 1	1. 6	----	4. 6	23. 0	6. 7	. 56	34. 9	30. 3	87
63. 4	28. 8	Clay	7. 5	----	. 8	----	----	----	----	----	----	----
60. 8	26. 3	Clay	7. 4	----	. 9	----	----	----	----	----	----	----
49. 5	17. 0	Silty clay	7. 9	----	19. 2	----	----	----	----	----	----	----
57. 5	17. 9	Silty clay	7. 9	----	20. 6	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----
62. 4	26. 8	Clay	5. 3	. 5	----	13. 1	10. 0	5. 2	. 41	28. 8	15. 7	55
58. 1	23. 5	Clay	7. 5	----	4. 1	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----
53. 6	15. 7	Silty clay	8. 1	----	26. 0	----	----	----	----	----	----	----

The Wisconsin glaciers completely covered the glacial drift deposited by the earlier Illinoian glaciers; therefore, the Illinoian till material is not exposed in Union County.

The glacial till is not homogeneous. It varies mainly in texture and composition and is high in content of calcareous material derived mostly from local limestone bedrock. Recessional moraines transect the county from northwest to southeast and are characterized by broad belts of sloping topography.

The glaciers deposited stratified sand and gravel outwash, mostly along a few of the principal streams in the county. Lacustrine material was deposited in relatively small areas on bottoms of temporary glacial lakes over glacial till. Recent alluvial material was deposited on the flood plains of existing streams.

The limestone bedrock in Union County is mostly covered by glacial till. It is exposed only in places where streams have cut down through the till. The bedrock in Union County is Monroe Limestone, except at the extreme eastern edge of the county, where the bedrock is Delaware Limestone (*15*).

Drainage

The present drainage of Union County developed on a surface deposited by the last glacier of the Wisconsin age. This surface consisted mostly of areas of gently sloping ground moraines and areas of steeper recessional moraines.

The streams in the county are Rush, Fulton, Bokes, Mill, Big Darby, Blues, Little Darby, Treacle, and Spain Creeks and Powder Lock, Otter, Sugar, Robinson, Brush, Rocky Fork, Buck, and Proctor Runs.

Big Darby and Blues Creeks and most of the other creeks flow from northwest to southeast. Big Darby Creek flows along the southern edge of a recessional moraine, and Blues Creek flows along the northern edge of a recessional moraine.

All streams drain into the Scioto River, which is outside the boundaries of Union County.

Industry

Most of the industrial activity in the county is around the city of Marysville and southeast of Marysville. A number of highly diversified industries manufacture electrical products, hydraulic equipment, and rubber products. Such specialized lawn-care products as seeds and fertilizers are processed in the county and sold nationwide.

Two limestone quarries produce limestone products for many uses. Agricultural limestone is also produced for use in the surrounding area.

Farming

According to the 1969 United States Census of Agriculture, there were 1,444 farms in Union County. A total of 247,500 acres was in farms.

The sale of livestock products made up 64 percent of the income derived from farming, and the remaining 36 percent was from the sale of crops.

The numbers of the principal kinds of fowl and livestock in 1969 were 25,641 cattle and calves, including 6,595 milk cows; 48,115 hogs and pigs; 18,248 sheep and lambs, and 51,473 chickens 4 months old and over.

The 1969 acreages of the main crops harvested were 49,067 acres of corn; 12,551 acres of wheat; 11,212 acres of oats; 57,253 acres of soybeans; 109 acres of rye; 17,242 acres of alfalfa and alfalfa mixtures cut for hay; and 8,252 acres of clover, mixtures of clover and timothy, and clover and grasses cut for hay.

Climate [3]

The climate of Union County is marked by large annual and daily changes in temperature. Summers are moderately warm and humid. On an average, 19 days have temperatures of 90° F. or higher. Winters are cold and cloudy. On an average of 4 days, temperatures are below zero. The weather changes every few days as a result of the passing of cold or warm fronts and their associated centers of high or low pressure. Table 11 shows temperature and precipitation data from records kept at Marysville. Average extreme annual temperatures as given in table 11 differ from those in any month because the annual extremes in temperature do not occur in the same month each year. Table 12 shows probabilities of last freezing temperatures in spring and first in fall.

As is characteristic of continental climates, precipitation in Union County varies widely from year to year, but it is generally abundant and well distributed. Fall is the driest season. The average number of days each year with .01, .10, .50, and 1.00 inch or more of precipitations is 105, 71, 24, and 7 days respectively. Thunderstorms occur on about 40 days each year and are most frequent from April through August. Heavy rains of 2.1, 2.8, 3.2, 3.8, 4.2, and 4.6 inches in a 24-hour period can be expected to occur at least once every 2, 5, 10, 25, 50, and 100 years, respectively.

With the exception of small grain and hay, crops are generally planted in the period mid-April through mid-June. During a 10-year period, rainfall in excess of 1.2 inches per week can be expected 8 times in April, 10 times in May, and 11 times in June. Rains of this magnitude delay fieldwork and can cause soil loss because this is the time of year when vegetative cover is most sparse.

If evaporation exceeds rainfall for prolonged periods, a drought can occur. Since 1929, extended periods of moderate to extreme drought in central Ohio, as determined from the Palmer Drought Severity Index, have occurred during the 1930, 1931, 1934, 1936, 1953, 1954, 1955, and 1962 growing seasons. The longest continuing period of moderate to extreme drought in central Ohio was 21 months, from November 1952 to July 1954.

During most days in summer, relative humidity values in the afternoon range from 50 to 60 percent. For the year, relative humidity averages about 80 percent at 1 a.m. and 7 a.m., 60 percent at 1 p.m. and 70 percent at 7 p.m. Cloudiness is greatest in winter and least in summer. The percentage of possible sunshine is about 70 percent in July and 30 percent in December. Windspeed

[3] Prepared by MARVIN E. MILLER, State climatologist, Columbus, Ohio.

TABLE 11.—*Temperature and precipitation*

[All data from Marysville]

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average maximum	Temperature: Average minimum	Precipitation: Average monthly total	Precipitation: One year in 10 will have— Less than—	Precipitation: One year in 10 will have— More than—	Precipitation: Average snowfall	Precipitation: Average number of days with 1 inch or more of snow
	° F	*° F*	*° F*	*° F*	*Inches*	*Inches*	*Inches*	*Inches*	*Number*
January	36	18	56	−3	2. 98	0. 74	5. 86	7. 0	2
February	39	20	60	0	2. 40	1. 02	4. 04	5. 1	2
March	47	27	72	9	3. 48	1. 37	6. 03	4. 2	1
April	61	37	81	22	3. 75	1. 66	6. 22	. 7	1
May	73	48	87	32	3. 63	1. 51	6. 18	0	0
June	81	57	93	43	4. 19	1. 45	7. 55	0	0
July	85	60	94	48	3. 62	1. 85	5. 65	0	0
August	84	59	94	45	3. 03	1. 40	4. 95	0	0
September	78	51	92	34	2. 70	. 87	4. 97	0	0
October	67	41	83	24	2. 17	. 29	4. 83	0	0
November	50	30	71	13	2. 39	1. 13	3. 86	2. 6	1
December	38	21	59	0	2. 24	. 83	3. 96	5. 9	2
Year	62	39	96	−8	36. 58	28. 73	44. 99	25. 5	9

TABLE 12.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Marysville]

Probability	Dates for given probability and temperature: 16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	March 29	April 10	April 18	May 3	May 17
2 years in 10 later than	March 24	April 4	April 13	April 28	May 12
5 years in 10 later than	March 13	March 23	April 2	April 18	May 1
Fall:					
1 year in 10 earlier than	November 11	October 26	October 19	October 6	September 23
2 years in 10 earlier than	November 15	October 31	October 23	October 10	September 27
5 years in 10 earlier than	November 26	November 11	November 2	October 19	October 7

averages about 7 m.p.h. in summer and 10 m.p.h. in winter. Damaging winds of 35 to 85 m.p.h. occur most often in spring and summer. Since 1900, four tornadoes have been reported in Union County.

Soil moisture goes through a seasonal cycle each year that is almost independent of the amount of precipitation received. The water needs of all crops reach a maximum in July and August, and rainfall is always insufficient to meet those needs. Soil moisture reaches its lowest point in October and is replenished during winter and spring when precipitation exceeds water loss by evaporation.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

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 forfinger.

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.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

End moraine. Belt of sharply rolling or hummocky land composed of till deposited along the roughly continuous edge of a glacier. An end moraine marks the position of the ice during a halt or minor readvance.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glacial outwash (geology). Cross-bedded gravel, sand, and silt deposited by melt water as it flowed from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Ground moraine (geology). Glacial till accumulated beneath the advancing ice and deposited from it during its dissolution rather than aggregated in a thickened belt at the ice edge; the deposit is relatively thin and characteristically forms an undulating plain with gently sloping swells, sags, and closed depressions.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these.

Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Illuviation. The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils has moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

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

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Loess. A fine-grained eolian (wind-carried) deposit consisting dominantly of silt-sized particles.

Mottling, soil. 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.

Neutral soil. In practice, a soil having a pH value between 6.6 and 7.3. Strictly speaking, a soil that has a pH value of 7.0.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

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.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. Individual rock or mineral fragments in a soil that range in diameter 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.

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.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

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 either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, 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."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trash mulch seeding. A soil and water conservation practice involving minimum land preparation prior to the seeding of grasses and legumes so that the ground surface has a protective cover of mulch.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Estimated yields, table 1, page 12.
Woodland, table 2, page 14.
Wildlife, table 3, page 15.
Engineering, tables 4, 5, and 6, pages 18 through 37.
Nonfarm uses, table 7, page 40.
Acreage and extent, table 8, page 49.

Map symbol	Mapping unit	Described on page	Capability unit Symbol	Capability unit Page
Ag	Algiers silt loam	48	IIw-2	7
BoA	Blount silt loam, 0 to 2 percent slopes	50	IIw-5	7
BoB	Blount silt loam, 2 to 6 percent slopes	50	IIw-5	7
BoB2	Blount silt loam, 2 to 6 percent slopes, moderately eroded	50	IIIe-2	9
Bs	Brookston silty clay loam	51	IIw-6	8
CeA	Celina silt loam, 0 to 2 percent slopes	52	I-1	6
CeB	Celina silt loam, 2 to 6 percent slopes	52	IIe-1	6
CrA	Crosby silt loam, 0 to 2 percent slopes	52	IIw-5	7
CrB	Crosby silt loam, 2 to 6 percent slopes	52	IIw-5	7
Cu	Cut and fill land	53	Unassigned	---
Ee	Eel silt loam	53	IIw-1	6
FoA	Fox silt loam, 0 to 2 percent slopes	54	IIs-1	8
FoB	Fox silt loam, 2 to 6 percent slopes	54	IIe-3	6
FoB2	Fox silt loam, 2 to 6 percent slopes, moderately eroded	54	IIe-3	6
FoC2	Fox silt loam, 6 to 12 percent slopes, moderately eroded	54	IIIe-1	9
Gn	Genesee silt loam	55	IIw-1	6
Gp	Gravel pits	55	Unassigned	---
HeA	Henshaw silt loam, 0 to 2 percent slopes	56	IIw-3	7
Ho	Homer silt loam	56	IIw-3	7
Ka	Kane silt loam	57	IIw-3	7
KeA	Kendallville silt loam, 0 to 2 percent slopes	58	I-1	6
KeB	Kendallville silt loam, 2 to 6 percent slopes	58	IIe-1	6
Lc	Lippincott silty clay loam	58	IIw-4	7
MlB	Miamian silt loam, 2 to 6 percent slopes	59	IIe-1	6
MlC2	Miamian silt loam, 6 to 12 percent slopes, moderately eroded	59	IIIe-1	9
MlD2	Miamian silt loam, 12 to 18 percent slopes, moderately eroded	59	IVe-1	10
MlF2	Miamian silt loam, 18 to 35 percent slopes, moderately eroded	59	VIe-1	10
Mn	Montgomery silty clay loam	60	IIIw-2	9
MrB	Morley silt loam, 2 to 6 percent slopes	61	IIe-2	6
MrB2	Morley silt loam, 2 to 6 percent slopes, moderately eroded	61	IIIe-2	9
MrC	Morley silt loam, 6 to 12 percent slopes	61	IIIe-3	9
MrC2	Morley silt loam, 6 to 12 percent slopes, moderately eroded	61	IIIe-3	9
MrD2	Morley silt loam, 12 to 18 percent slopes, moderately eroded	61	IVe-1	10
MrE2	Morley silt loam, 18 to 25 percent slopes, moderately eroded	61	VIe-1	10
MrF2	Morley silt loam, 25 to 50 percent slopes, moderately eroded	61	VIIe-1	10
Mu	Muskego muck	61	IIIw-2	9
NpA	Nappanee silt loam, 0 to 2 percent slopes	62	IIIw-1	9
NpB	Nappanee silt loam, 2 to 6 percent slopes	62	IIIw-1	9
OdA	Odell silt loam, 0 to 2 percent slopes	63	IIw-5	7
Pa	Paulding silty clay	64	IIIw-1	9
Pm	Pewamo silty clay loam	64	IIw-6	8
Qu	Quarries	64	Unassigned	---
Ro	Ross silt loam	65	IIw-1	6
ScB	St. Clair silt loam, 2 to 6 percent slopes	66	IIIe-2	9
ScB2	St. Clair silt loam, 2 to 6 percent slopes, moderately eroded	66	IIIe-2	9
ScC	St. Clair silt loam, 6 to 12 percent slopes	66	IVe-1	10
ScC2	St. Clair silt loam, 6 to 12 percent slopes, moderately eroded	66	IVe-1	10
Sh	Shoals silt loam	66	IIw-2	7
SlA	Sleeth silt loam, 0 to 2 percent slopes	67	IIw-3	7
So	Sloan silty clay loam	68	IIIw-2	9
WaB	Warsaw silt loam, 1 to 4 percent slopes	68	IIe-3	6
Wc	Westland silty clay loam	69	IIw-4	7
We	Wetzel silty clay loam	70	IIw-6	8

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