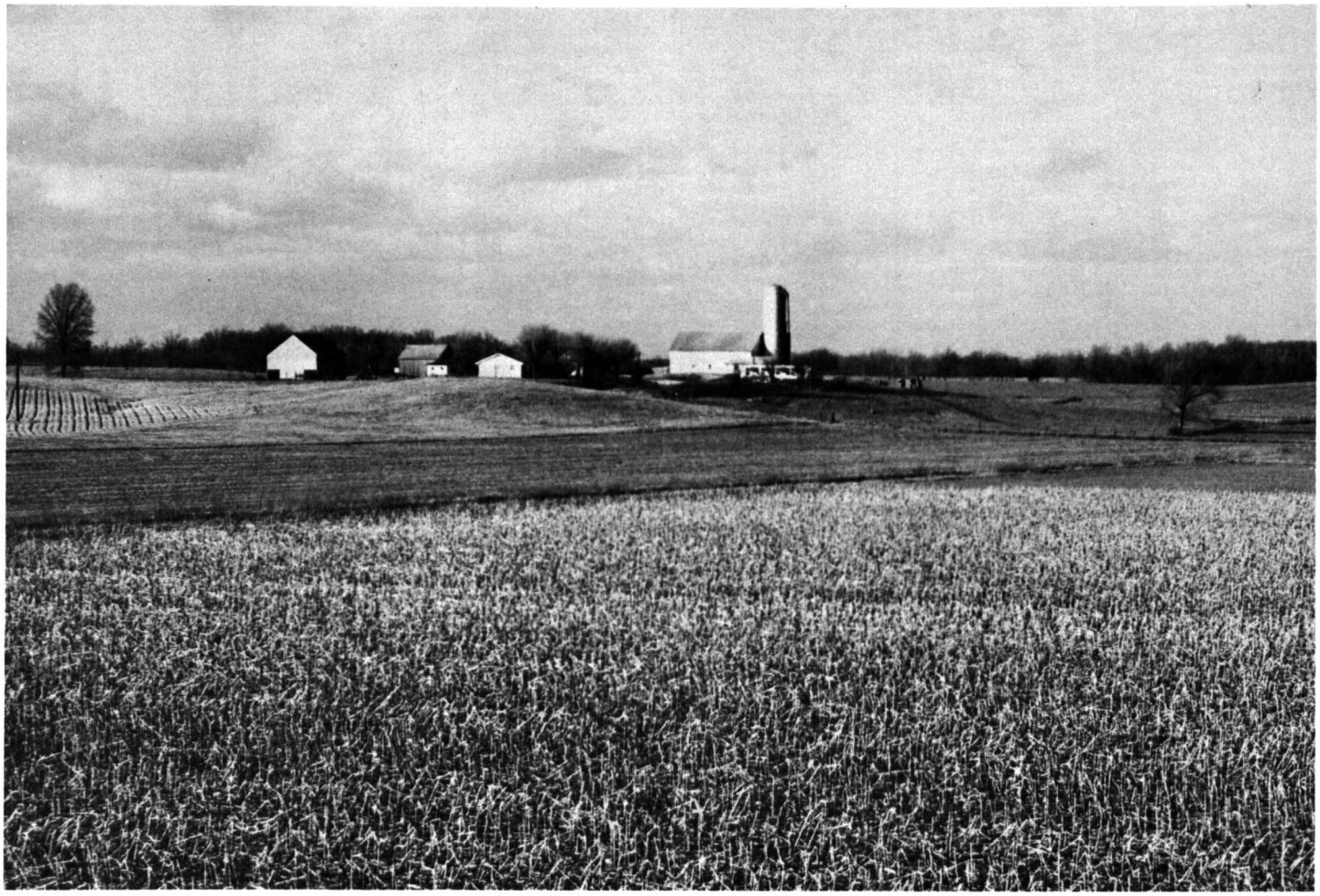
SOIL SURVEY OF

# Bartholomew County, Indiana



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

**This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.**

**Major fieldwork for this soil survey was completed in the period 1967–71. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service and the Purdue University Agricultural Experiment Station. It is part of the technical assistance furnished to the Bartholomew County Commissioners and approved by the County Council.**

**Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.**

# HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Bartholomew County contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; in judging the suitability of areas for use as sanitary landfills and sewage lagoons; and in judging the suitability of tracts of land for farming, industry, and recreation.

### Locating Soils

All the soils of Bartholomew 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 in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol. It also shows the page where each soil is described and the page for the capability unit, tree and shrub group, and woodland group in which the soil has been placed.

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 information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

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

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

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

*Park and recreation boards, recreation directors, and others* concerned with public and private recreation can find information about soils and recreational development in the section "Use of Soils for Recreation."

*Community planners and others* can read about soil properties that affect the choice of sites for dwellings, industrial buildings, schools, sanitary landfills, and sewage lagoons in the section "Town and Country Planning."

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

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

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

Cover: The Whitaker loam in the foreground has been in corn. Buildings in the background are on Rossmoyne silt loam, 2 to 6 percent slopes, eroded. The moderately sloping area is Cincinnati silt loam, 6 to 12 Percent slopes, eroded.

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# SOIL SURVEY OF BARTHOLOMEW COUNTY, INDIANA

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

BARTHOLOMEW COUNTY is in the north central part of southern Indiana. It has an area of 402 square miles, or 257,280 acres. Columbus, the county seat, is in the central part of the county at the junction of the Driftwood and Flat Rock Rivers and at the beginning of the East Fork of the White River.

The air distances from Columbus to principal cities in Indiana are shown in figure 1. The population of Bartholomew County was 57,022 in 1970. Columbus accounted for 27,141 of the population according to the 1970 census (*15*).[1]

The eastern part of the county is mainly nearly level to moderately sloping soils on uplands of the Wisconsin till plain and steeper soils along major streams that have entrenched into the till. The central part of the county is mainly broad, nearly level, and gently sloping soils on terraces and flood plains along the Driftwood River, the Flatrock River, and the East Fork of the White River. Most of the bottom lands are subject to flooding. The older Illinoian till plain is west of the Driftwood River and the East Fork of the White River. It consists of nearly level to strongly sloping soils, and steeper soils where the dissecting streams have cut into the till. In the far western part of the county are high and steep unglaciated soils that are underlain by sandstone and shale bedrock.

About two-thirds of the acreage of the county is used for crops. Most of the strongly sloping and steep soils are used for pasture and woodland. Cash grain and livestock are the major farming enterprises in the eastern part of the county. General farming is the major enterprise in the western part of the county. Some tree farms are in the unglaciated far western part of the county.

A part of this survey gives information on nonfarm uses of soils. The areas around cities and towns have been annexed and the land use is being changed. Some areas lend themselves to urban development with few limitations; but other areas have so many limitations that nonfarm uses are questionable. Such nonfarm uses as recreational development and hunting are not confined to surburban areas.

The climate of the county is midcontinental and is favorable for farming.

For more information about Bartholomew County, refer to the section "General Nature of the County" at the back of this survey.

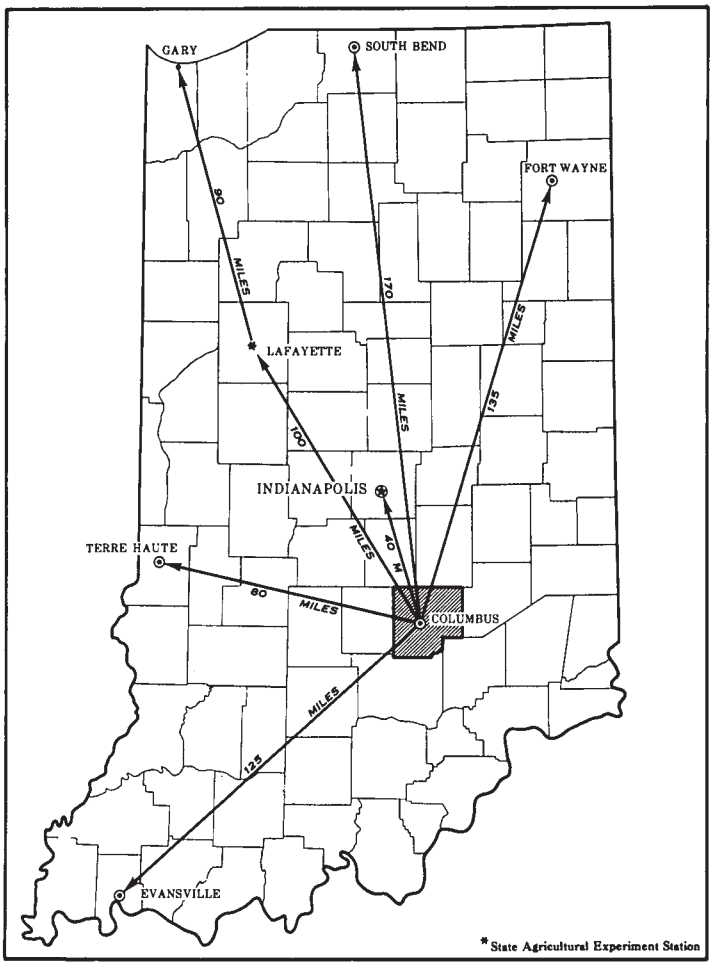


*Figure 1.*—**Location of Bartholomew County in Indiana.**

[1] Italic numbers in parentheses refer to Literature Cited, p. 165.

## How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Bartholomew 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. Cincinnati 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 layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miami silt loam, 2 to 6 percent slopes, eroded, is one phase within the Miami series; and Rensselaer loam is one phase within the Rensselaer series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. Two such mapping units are shown on the soil map of Bartholomew County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Fox complex, 6 to 12 percent slopes, severely eroded, is an example of a complex in Bartholomew County.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Berks and Weikert soils, 25 to 50 percent slopes, is an undifferentiated group in this county.

In most areas surveyed there are places where the soil material is so disturbed, 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. Gullied land is a land type in Bartholomew 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 kinds of soil. Yields under defined management are estimated for all the soils.

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

## General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Bartholomew 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, 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, 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 names of some soil associations are unlike those appearing on recently published surveys in adjacent counties. This is due to the change in concepts of soil series in the application of the soil classification system and to the percentage of the major soils in the various soil associations.

The terms for texture used in the title of the associations apply to the texture of the surface layer. An example is the words "medium textured and moderately fine textured" in the title of association 2. The 14 soil associations have been grouped into 6 general kinds of landscapes for broad interpretative purposes.

Camp Atterbury is not included on the detailed map but is included on the general soil map. The general information on soils of Camp Atterbury is mainly taken from the Bartholomew County Soil Survey published in 1947. Because of this included area, certain soils on the general soil map are more extensive than shown in table 1.

The soil associations in Bartholomew County are discussed on the following pages.

## Deep, Well-drained to Poorly Drained, Medium Textured and Moderately Fine Textured, Nearly Level Soils That Formed in Alluvium

The associations in this group are made up mostly of soils that border major streams and are subject to flooding. These soils make up about 16 percent of the county. They are used mainly for growing corn and soybeans. Grasses and legumes are also grown. Hardwood trees are in a few areas of poorly drained soils and in a few places that have been cut by streams and are too small for efficient crop production. These soils are severely limited for use in town and country development.

### *1. Stendal-Bonnie-Wakeland association*

*Deep, somewhat poorly drained and poorly drained, medium-textured, nearly level soils on bottom lands*

This soil association is on bottom lands. It occupies about 5 percent of the county. The association is about 50 percent Stendal soils, 15 percent Bonnie soils, 10 percent Wakeland soils, and 25 percent minor soils.

Stendal soils are on broad and narrow bottom lands. They are nearly level and are somewhat poorly drained. Permeability is moderate. These soils formed in strongly acid, medium-textured alluvium. The surface layer is typically dark grayish-brown silt loam underlain by mottled brown and grayish-brown silty alluvium.

Bonnie soils are on broad bottom lands and in low-lying areas. Drainage is slow and these soils are poorly drained. They are nearly level. The soils formed in strongly acid, medium-textured alluvium. The surface layer is typically gray silt loam underlain by mottled gray silty alluvium.

Wakeland soils are nearly level and somewhat poorly drained on broad, flat flood plains. These soils formed in medium acid or neutral, medium-textured alluvium. The surface layer is typically dark grayish-brown silt loam underlain by mottled, brown and grayish-brown silty alluvium.

The minor soils of this association are in the Haymond, Wilbur, and Steff series. The well-drained Haymond soils are mainly adjacent to streams. The moderately well drained Wilbur and Steff soils are adjacent to streams in places or lie between areas of well-drained Haymond soils and somewhat poorly drained Stendal or Wakeland soils.

If an adequate drainage system is established and maintained, the soils in this association are suited to most crops commonly grown in the county. Corn, soybeans, legumes, and grasses are the main crops. This association is also suitable for trees. Flooding and wetness are the major limitations that affect farming and town and country planning.

### *2. Genesee-Ross-Shoals association*

*Deep, well drained and somewhat poorly drained, medium textured and moderately fine textured, nearly level soils on bottom lands*

This soil association is on bottom lands. It occupies about 11 percent of the county. The association is about 35 percent Genesee soils, 15 percent Ross soils, 15 percent Shoals soils, and 35 percent minor soils (fig. 2).

Genesee soils are on broad bottom lands and are mainly adjacent to the major rivers or streams. They are nearly level and well drained. Permeability is moderate. These soils formed in loamy, moderately alkaline alluvium. The surface layer and underlying layers are typically dark-brown loam.

Ross soils are on broad flood plains. They are generally a few feet higher and farther from the streams or rivers than the Genesee soils. These soils are mainly on flood plains of the Driftwood River, the Flatrock River, and the East Fork of the White River. They also are nearly level and are well drained. The soils formed in moderately alkaline loamy alluvium. Permeability is moderate. The surface layer and underlying layers are typically dark-brown, medium-textured or moderately fine textured loam.

Shoals soils are nearly level, moderately permeable, and somewhat poorly drained. They are on flood plains in the low backwater areas and old stream meander channels. These soils formed in neutral or mildly alkaline loamy alluvium. The surface layer is typically dark grayish-brown silt loam and is underlain by mot-

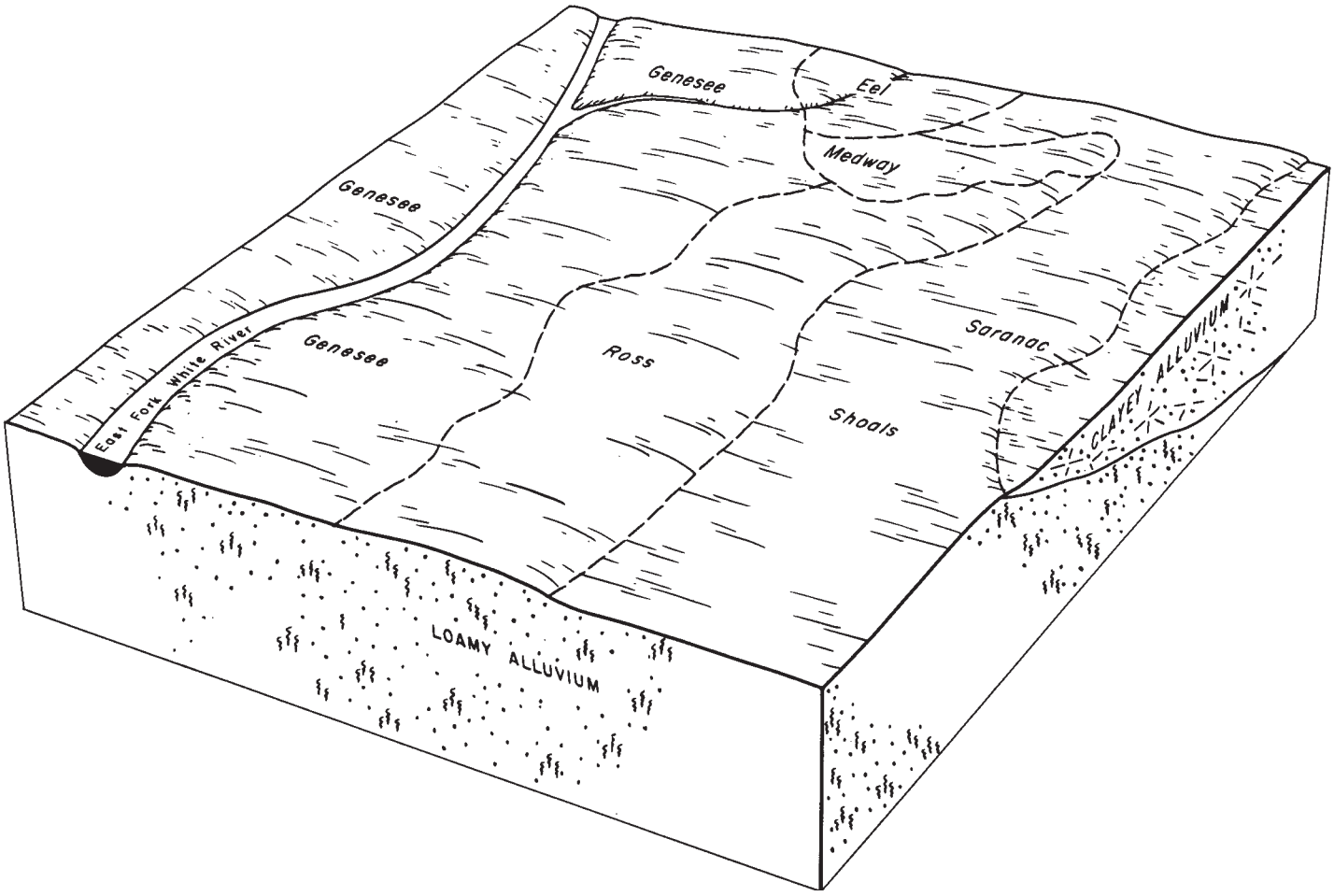


*Figure 2.*—**Typical pattern of soils and underlying material in the Genesee-Ross-Shoals association.**

tled, dark-brown and dark grayish-brown silt loam and loam.

The minor soils of this association are in the Saranac, Eel, Landes, Genesee, and Medway series. The very poorly drained, moderately fine textured Saranac soils are in low-lying backwater areas. The moderately well drained Eel soils are adjacent to the Genesee soils in places. The well-drained, moderately coarse textured Genesee soils are mainly on natural levees. The well-drained Landes soils formed in sandy and gravelly deposits and are adjacent to the Ross soils in places. The moderately well drained Medway soils are on bottom lands.

The soils in this association are used mainly for crops, but some areas are in pasture or are wooded. Corn, soybeans, and grain sorghum are the major crops. Wheat is grown in areas that are protected from flooding or in higher areas that are flooded occasionally for short periods. The soils are also suited to pasture grasses or trees. Flooding in winter and early in spring and wetness on the somewhat poorly drained soils in the backwater areas and old stream channels are the major limitations for farming and for town and country planning.

## Deep, Somewhat Poorly Drained to Very Poorly Drained, Medium Textured and Moderately Fine Textured, Nearly Level and Gently Sloping Soils That Formed in Loess and the Underlying Glacial Till, in Glacial Till, or in Outwash

The associations in this group are made up mostly of soils that have a seasonal high water table. These soils make up about 23 percent of the county. Where they are adequately drained, they are used mainly for growing corn and soybeans. Wheat, grasses, and legumes are also grown. These soils are moderately to severely limited for use in town and country development.

### *3. Rensselaer-Whitaker association*

*Deep, very poorly drained and somewhat poorly drained, moderately fine textured and medium textured, nearly level soils on terraces*

This soil association is on broad flat terraces. The soils in this association formed in loamy outwash and the underlying stratified sand and silt that is leached free of carbonates to a depth of 40 to 60 inches. The

association occupies about 2 percent of the county. It is about 50 percent Rensselaer soils, 40 percent Whitaker soils, and 10 percent minor soils (fig. 3).

Rensselaer soils are in slight depressions and long, narrow drainage channels. They are nearly level and very poorly drained. Permeability is slow. The surface layer is very dark grayish-brown loam or clay loam and the subsoil is mottled grayish-brown or dark grayish-brown clay loam.

Whitaker soils are on broad flats. They are nearly level and somewhat poorly drained. Permeability is moderate. The surface layer is typically dark grayish-brown loam and the subsoil is mottled, brown or grayish-brown clay loam or sandy clay loam.

The minor soils of this association are in the Martinsville and Westland series. The nearly level to moderately sloping, well-drained Martinsville soils are along terrace breaks and on side slopes along drainageways. The nearly level, very poorly drained Westland soils are on terraces along drainageways.

If an adequate drainage system is established and maintained, the soils in this association are suited to most crops commonly grown in the county. Corn, soybeans, wheat, and hay are the major crops. The soils are also suited to pasture grasses or trees. The major limitation that affects farming is wetness and the major limitations that affect town and country planning are wetness and the seasonal high water table.

### *4. Crosby-Brookston association*

*Deep, somewhat poorly drained and very poorly drained, medium textured and moderately fine textured, nearly level and gently sloping soils on uplands*

This soil association is on broad side slopes, along natural drainageways, and on small knolls. It occupies about 9 percent of the county. The association is about 55 percent Crosby soils, 30 percent Brookston soils, and 15 percent minor soils (fig. 4).

Crosby soils are nearly level on broad areas and gently sloping on ridges and breaks along drainageways. They formed in thin loess and the underlying loamy till. They are somewhat poorly drained. Permeability is slow. The surface layer is typically dark grayish-brown silt loam and the subsoil is mottled, grayish-brown clay loam.

Brookston soils are in slight depressions and long and narrow drainageways. They are nearly level and very poorly drained. Permeability is slow. These soils formed in loamy sediment derived from till, and the underlying till. The surface layer is typically very dark grayish-brown silty clay loam and the subsoil is mottled, dark grayish-brown clay loam.

The minor soils of this association are the gently sloping, moderately well drained Celina soils and the gently sloping, well-drained Miami soils.

If an adequate drainage system is established and maintained, this association is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. The soils are also suited to

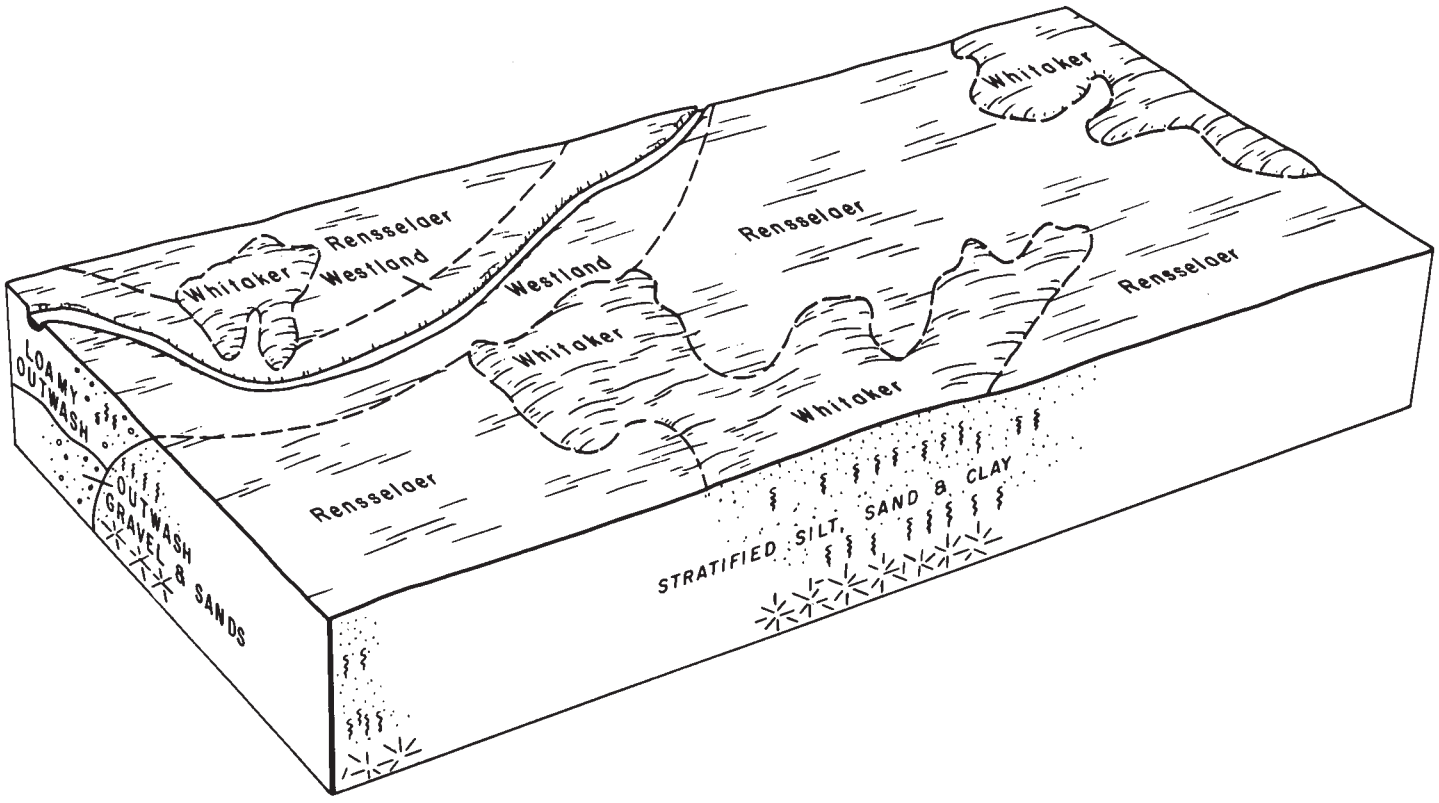


*Figure 3.*—**Typical pattern of soils and underlying material in the Rensselaer-Whitaker association.**

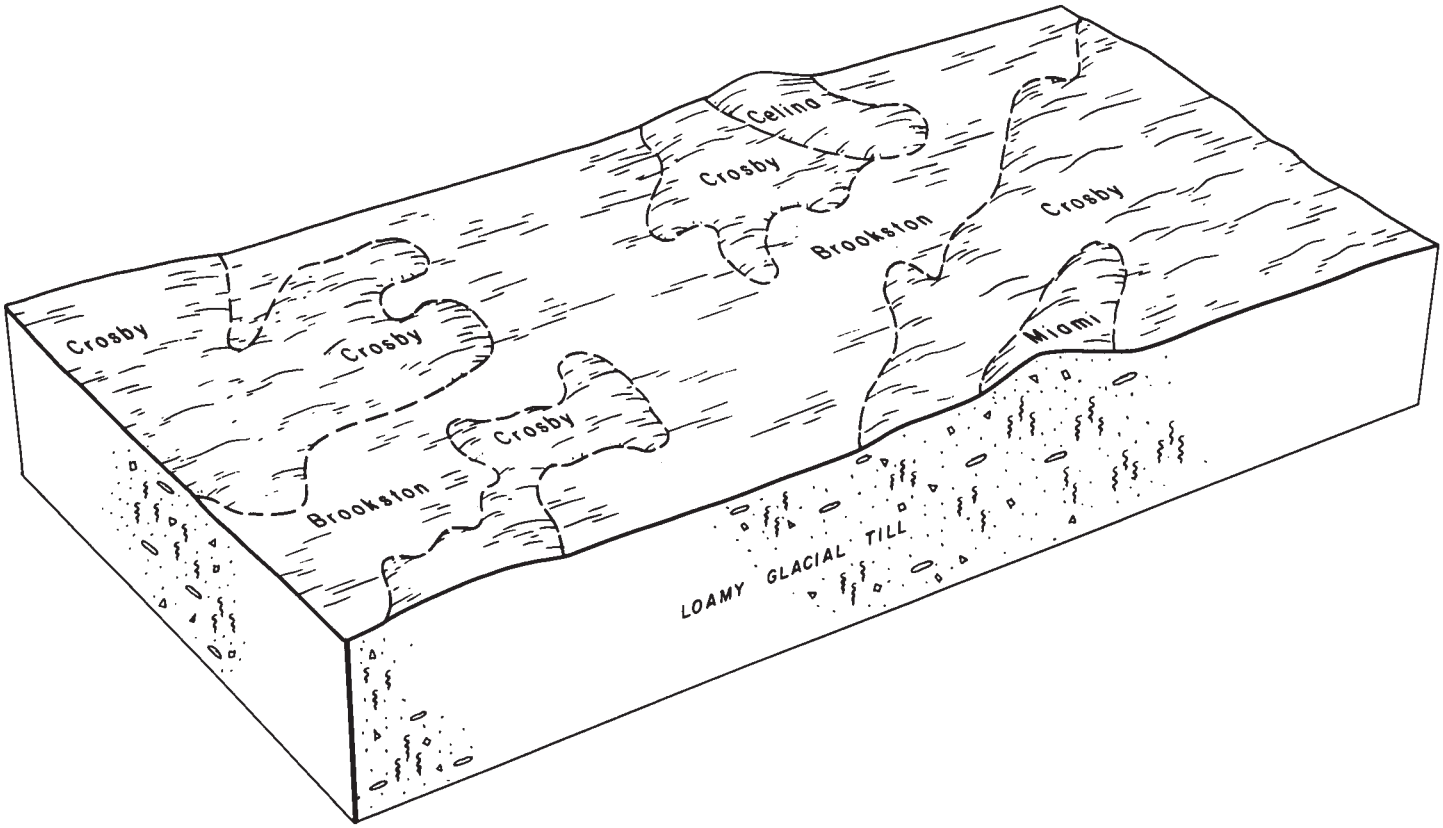


*Figure 4.*—**Typical pattern of soils and underlying material in the Crosby-Brookston association.**

trees or pasture grasses. The major limitation that affects farming is wetness and the major limitations that affect town and country planning are slow permeability, wetness, and the seasonal high water table.

### 5. *Fincastle-Brookston association*

*Deep, somewhat poorly drained and very poorly drained, medium textured and moderately fine textured, nearly level and gently sloping soils on uplands*

This soil association is on broad upland areas and on side slopes along the upper ends of natural drainageways. It occupies about 8 percent of the county. The association is about 60 percent Fincastle soils, 20 percent Brookston soils, and 20 percent minor soils.

Fincastle soils are nearly level on broad areas and gently sloping on ridges and breaks along drainageways. They are somewhat poorly drained. Permeability is slow. These soils formed in 18 to 40 inches of loess and the underlying loamy till. The surface layer is dark grayish-brown silt loam and the subsoil is mottled, grayish-brown silty clay loam.

Brookston soils are in slight depressions and long and narrow drainageways. They are nearly level and very poorly drained. Permeability is slow. They formed in loamy sediment derived from loess and till and the underlying till. The surface layer is very dark grayish-brown silty clay loam and the subsoil is mottled, dark grayish-brown clay loam.

The minor soils of this association are in the Xenia, Celina, and Miami series. The Xenia and Celina soils are gently sloping and moderately well drained and are on knolls and breaks. The well-drained, gently sloping Miami soils are on knolls and breaks.

If an adequate drainage system is established and maintained, the soils in this association are suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. The soils are also suited to pasture grasses or trees. The major limitation that affects farming is wetness, and the major limitations that affect town and country planning are slow permeability, wetness, and the seasonal high water table.

### 6. *Avonburg-Clermont association*

*Deep, somewhat poorly drained and poorly drained, medium-textured, nearly level and gently sloping soils on uplands*

This soil association is on broad upland flats and along the upper ends of drainageways. The soils in it formed in loess and the underlying, leached loamy till. It occupies about 4 percent of the county. It is about 55 percent Avonburg soils, 35 percent Clermont soils, and 10 percent minor soils (fig. 5).

Avonburg soils are nearly level on flats and are gently sloping on short breaks along natural draws. They are somewhat poorly drained. The surface layer is typically dark grayish-brown silt loam and the subsoil is mottled, yellowish-brown silty clay loam or silt loam. A very slowly permeable fragipan is at a depth of 24 to 32 inches.

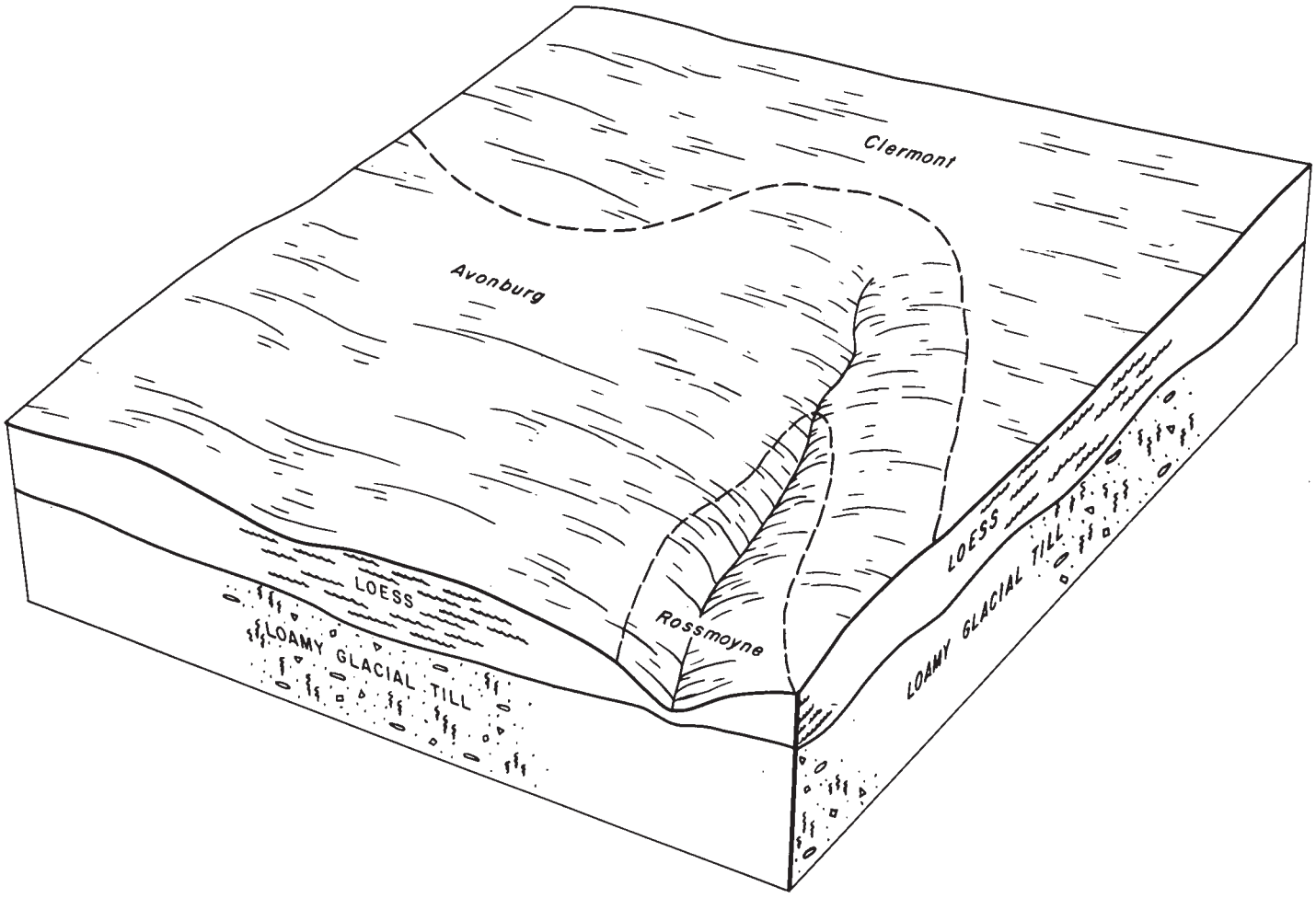


*Figure 5.*—**Typical pattern of soils and underlying material in the Avonburg-Clermont association.**

Clermont soils are on broad flats. They are nearly level and are poorly drained. The surface layer is grayish-brown silt loam and the subsoil is mottled, gray, very slowly permeable silty clay loam or silt loam.

The minor soils of this association are the moderately well drained Rossmoyne soil and the well-drained Cincinnati soils. These soils are gently sloping to moderately sloping on side slopes of natural draws.

If an adequate drainage system is established and maintained, the soils in this association are suited to most crops commonly grown in the county. Corn, soybeans, and grasses and legumes for forage are the major crops. The soils are also suited to trees. Wetness and very slow permeability are the major limitations that affect farming and town and country planning.

## Moderately Deep and Deep, Well-drained, Medium-textured, Gently Sloping to Steep Soils That Formed in Loess and the Underlying Sandstone and Shale Residuum

This association is made up mostly of well-drained soils that formed over sandstone and shale bedrock. It is in the eastern part of the county, which was not affected by glaciation. These soils make up about 6 percent of the county. They are used mainly for growing hardwood trees. Where the soils are gently sloping to strongly sloping, grasses and legumes are grown for use as forage. Corn, wheat, and soybeans are also grown. These soils are moderately to severely limited for use in town and country development.

### 7. *Berks-Gilpin-Zanesville association*

*Moderately deep to deep, well-drained, medium-textured, gently sloping to steep soils on uplands*

This soil association is on ridgetops and hillsides. The soils in it formed in loess and the underlying material that weathered from sandstone and shale bedrock. The association occupies about 6 percent of the county. It is about 35 percent Berks soils, 30 percent Gilpin soils, 15 percent Zanesville soils, and 20 percent minor soils (fig. 6).

The well-drained Berks soils are steep on hillsides. Permeability is moderate. The surface layer is typically dark grayish-brown silt loam and the subsoil is light yellowish-brown channery or shaly silt loam. They overlie interbedded sandstone and shale at a depth of 20 to 40 inches.

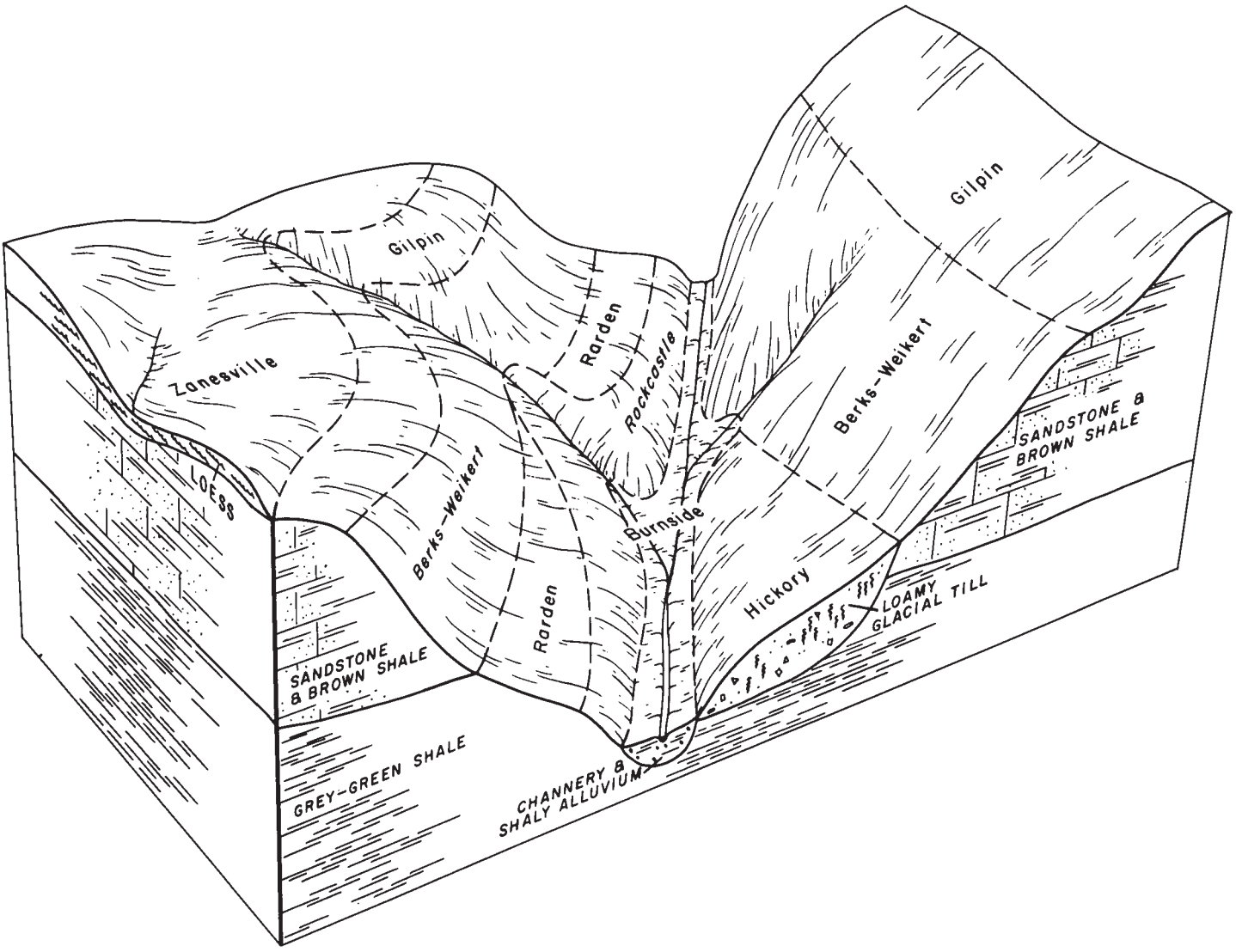


*Figure 6.*—**Typical pattern of soils and underlying material in the Berks-Gilpin-Zanesville association.**

Gilpin soils are strongly sloping and moderately steep on hillsides or side slopes along natural draws. They are well drained and have moderate permeability. They typically have a surface layer of dark-brown or brown silt loam and a subsoil of yellowish-brown silty clay loam. These overlie interbedded sandstone and shale at a depth of 20 to 40 inches.

The well-drained Zanesville soils are gently sloping on ridgetops and moderately sloping on hillsides and side slopes along drainageways. The surface layer is typically dark-brown silt loam and the subsoil is strong-brown and yellowish-brown silty clay loam and has a very slowly permeable fragipan. Sandstone and shale bedrock are at a depth of 40 to 80 inches.

The minor soils of this association are in the Weikert, Rockcastle, Hickory, Rarden, and Burnside series. The steep, well-drained Weikert, Rockcastle, and Hickory soils and the well-drained, moderately sloping and strongly sloping Rarden soils are on uplands. The well-drained Burnside soils are in narrow bottoms.

If erosion-control practices are established and maintained, Zanesville soils are suited to most crops commonly grown in the county. Gilpin soils are mainly suited to pasture or trees. Berks soils are best suited to trees. Erosion and runoff are the major hazards in farming. Major limitations that affect town and country planning are the very slow permeability of Zanesville soils, and slopes and shallowness to bedrock of Gilpin and Berks soils.

## Moderately Deep and Deep, Well-drained, Medium-Textured and Moderately Coarse Textured, Nearly Level to Strongly Sloping Soils That Formed in Outwash

This association is made up mostly of well-drained soils that formed over gravel and sand. Most areas of these soils parallel the East Fork of the White River. These soils make up about 12 percent of the county.

They are used mainly for corn and soybeans. In most areas, yields are low during periods of little rainfall. Most of these soils are slightly or moderately limited for use in town and country development. A few sloping areas are severely limited.

### *8. Fox-Nineveh-Ockley association*

*Moderately deep and deep, well-drained, medium textured to moderately coarse textured, nearly level to strongly sloping soils on terraces*

This soil association is on terraces. The soils in it formed in loamy outwash and the underlying loose gravel and sand. The association occupies about 12 percent of the county. It is about 35 percent Fox soils, 30 percent Nineveh soils, 10 percent Ockley soils, and 25 percent minor soils (fig. 7).

Fox soils are nearly level on broad areas and gently sloping to strongly sloping on short breaks. They are well drained. Permeability is moderate. The surface layer is typically dark-brown loam and the subsoil is dark-brown clay loam or gravelly clay loam. The underlying loose sand and gravel is at a depth of 24 to 40 inches.

Nineveh soils are also nearly level on broad areas and are gently sloping on short breaks. They are well drained. Permeability is moderate. The surface layer is typically very dark grayish-brown loam or gravelly loam and the subsoil is dark-brown, sandy gravelly clay loam. They overlie loose sand and gravel at a depth of 24 to 40 inches.

Ockley soils are in broad areas. They are nearly level and are well drained. Permeability is moderate. The surface layer is typically dark-brown loam and the subsoil is dark-brown clay loam or gravelly clay loam. They overlie loose sand and gravel at a depth of 40 to 60 inches.

The minor soils of this association are in the Shoals, Martinsville, Sleeth, Westland, Rensselaer, and Rodman series. The somewhat poorly drained, nearly level Shoals soils are on flood plains. The Martinsville soils are well drained and nearly level. The Sleeth soils are somewhat poorly drained and nearly level. The Westland and Rensselaer soils are very poorly drained and nearly level. The Rodman soils are excessively drained and steep. All of these soils are on terraces.

The soils in this association are suited to most crops commonly grown in the county. The soils are also suited to pasture grasses or trees. Because Fox and Nineveh soils have a low to moderate available water capacity, crops grown on these soils are subject to damage by drought in years of below average rainfall. Corn, grain sorghum, wheat, and alfalfa are the main crops. The major hazard in farming on the sloping soils is erosion. The major limitations that affect town and country planning are the danger of ground water contamination by septic effluent and the hazard of erosion on the sloping areas.

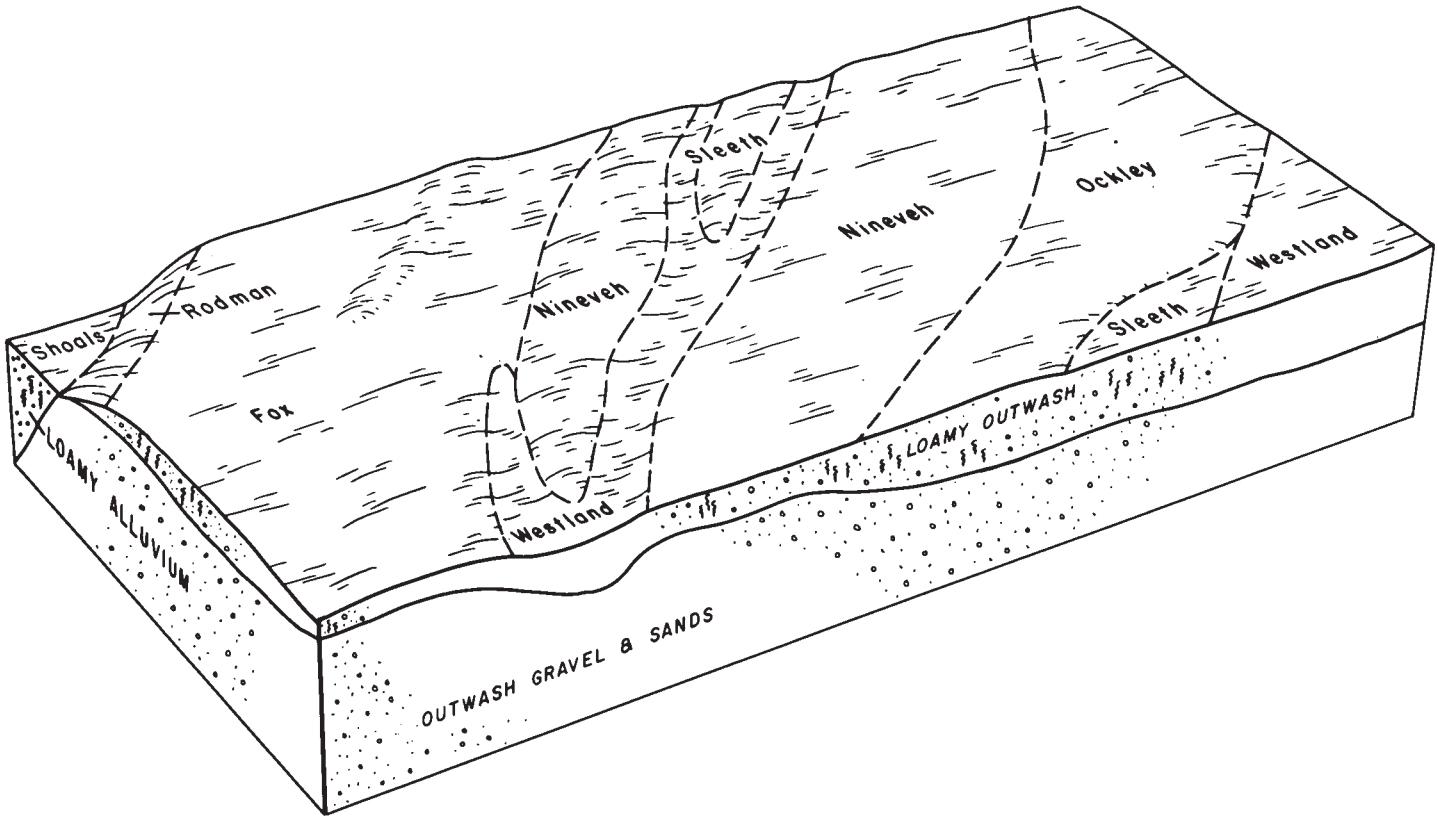


***Figure 7.*—Typical pattern of soils and underlying material in the Fox-Nineveh-Ockley association.**

## Deep, Somewhat Poorly Drained to Well Drained, Medium-textured, Nearly Level to Steep Soils That Formed in Loess and the Underlying Outwash, in Loess and the Underlying Glacial Till, or in Glacial Till

The associations in this group are made up mostly of soils that are somewhat poorly drained to well drained and that formed over till, lacustrine material, and old alluvium. These soils make up about 38 percent of the county. The nearly level to moderately sloping soils in these associations are used mainly for growing corn and soybeans. The strongly sloping to steep soils are used for growing grasses, legumes, and hardwood trees. These soils are slightly to severely limited for use in town and country development.

### *9. Dubois-Otwell-Bartle association*

*Deep, somewhat poorly drained and well drained, medium-textured, nearly level to strongly sloping soils on terraces*

This soil association formed in loess and the underlying stratified silty and clayey material. It occupies about 2 percent of the county. The association is about 40 percent Dubois soils, 20 percent Otwell soils, 15 percent Bartle soils, and 25 percent minor soils.

Dubois soils are on broad bench-like terraces along the streams in the western part of the county. They are nearly level and are somewhat poorly drained. These soils formed in silty deposits of loess and the underlying lacustrine material. The surface layer is typically dark grayish-brown silt loam and the subsoil is mottled, yellowish-brown and light brownish-gray silty clay loam. A very slowly permeable fragipan is at a depth of 23 to 35 inches.

Otwell soils are on bench-like areas in the stream valleys in the western part of the county. They are well drained and are gently sloping to strongly sloping. They formed in loess and the underlying lacustrine deposits. The surface layer is typically dark grayish-brown silt loam and the subsoil is yellowish-brown silty clay loam. A very slowly permeable fragipan is at a depth of 20 to 32 inches.

Bartle soils are on broad terraces along streambanks. They are nearly level and are somewhat poorly drained. They formed in silty deposits of loess or loess and the underlying silt. The surface layer is typically dark grayish-brown silt loam and the subsoil is mottled, yellowish-brown and light brownish-gray silt loam. A very slowly permeable fragipan is at a depth of 24 to 32 inches.

The minor soils of this association are in the Peoga, Stendal, and Wakeland series. The nearly level, poorly drained Peoga soils are on flat benches, generally adjacent to foot slopes of the uplands. The somewhat poorly drained, nearly level Stendal and Wakeland soils are in narrow bottoms.

If an adequate drainage system is established and maintained on the somewhat poorly drained soils, and erosion control practices are established and maintained on the gently sloping to strongly sloping soils, the soils in this association are suited to most crops commonly grown in the county. Wetness is the major limitation in farming on the Dubois and Bartle soils and erosion is the major hazard on the Otwell soils. The soils in this association are also suited to pasture grasses or trees. The major limitations that affect town and country planning are the very slow permeability of the fragipan, wetness, and seasonal high water table of Dubois and Bartle soils, and slopes of Otwell soils.

### *10. Cincinnati-Rossmoyne-Hickory association*

*Deep, moderately well drained and well drained, medium-textured, nearly level to steep soils on terraces*

This soil association is on ridgetops and on hillsides and side slopes along natural drainage systems. These soils formed in loess and the underlying, leached loamy till. This association occupies about 18 percent of the county. It is about 50 percent Cincinnati soils, 25 percent Rossmoyne soils, 15 percent Hickory soils, and 10 percent minor soils (fig. 8).

Cincinnati soils are on hillsides and side slopes along natural draws. They are gently sloping to strongly sloping and are well drained. The surface layer is typically brown silt loam and the subsoil is yellowish-brown silty clay loam or silt loam. A very slowly permeable fragipan is at a depth of 20 to 32 inches.

Rossmoyne soils are on ridgetops and side slopes along the upper ends of natural draws. They are gently sloping and are moderately well drained. The surface layer is typically dark yellowish-brown silt loam and the subsoil is mottled, yellowish-brown silt loam or silty clay loam. A very slowly permeable fragipan is at a depth of 24 to 32 inches.

Hickory soils are on hillsides and side slopes along natural draws. They are moderately sloping to steep and are well drained. Permeability is moderate. The surface layer is typically dark grayish-brown or brown silt loam and the subsoil is yellowish-brown clay loam.

The minor soils of this association are in the Avonburg, Wakeland, and Stendal series. The somewhat poorly drained, nearly level Avonburg soils are on ridgetops. The somewhat poorly drained, nearly level Wakeland and Stendal soils are in narrow bottoms.

If adequate erosion control practices are established and maintained, the gently sloping and moderately sloping soils of this association are suited to most crops commonly grown in the county. The strongly sloping and moderately steep soils are mainly used for pasture or woodland. The steep soils are best suited to trees and most of these areas are used for woodland. The major limitations for farming are slopes and the very slow permeability of the soils that have a fragipan. The major hazards are runoff and erosion. The major limitations that affect town and country planning are the very slow permeability of Cincinnati and Rossmoyne soils and the slopes of Cincinnati and Hickory soils.

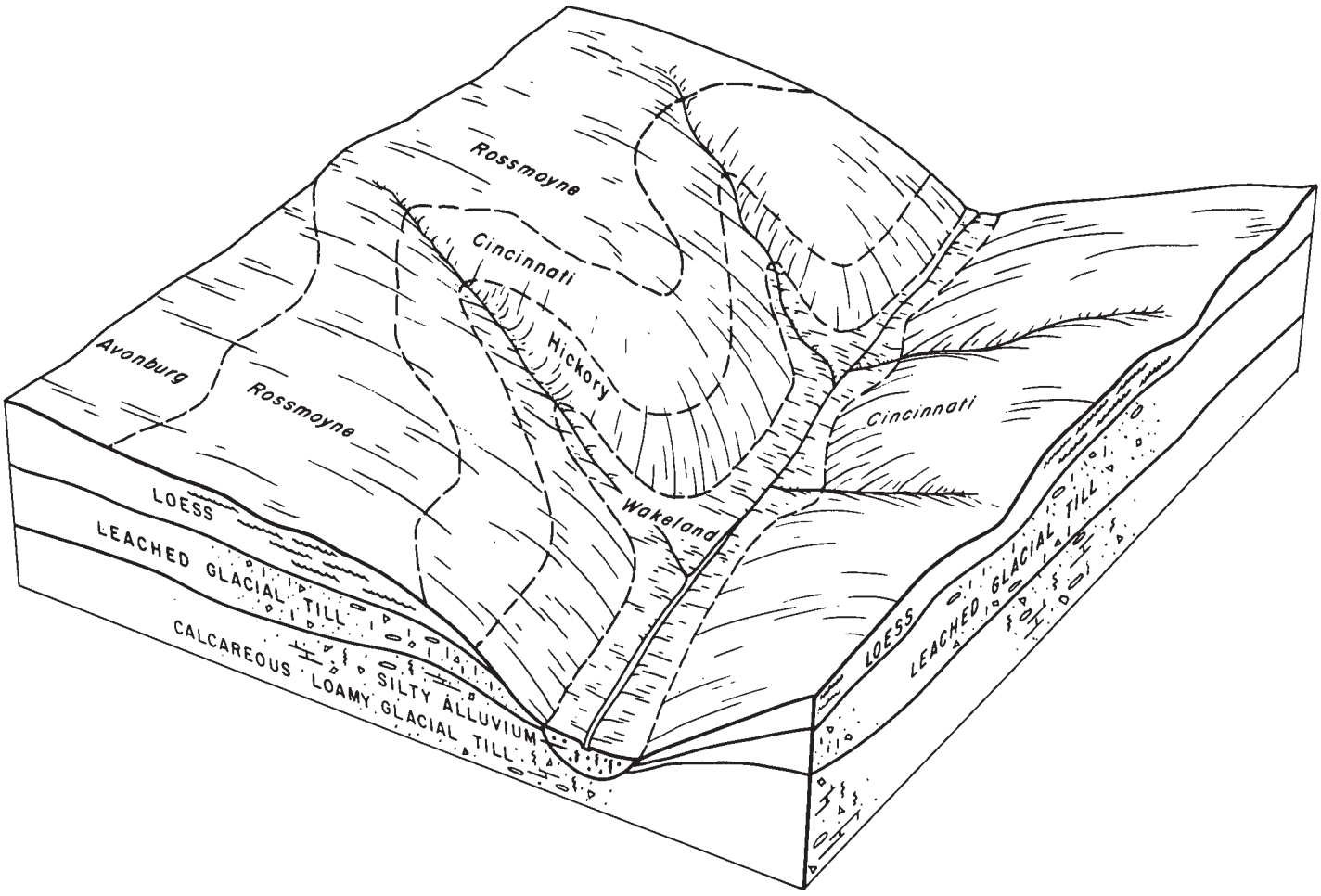


***Figure 8.*—Typical pattern of soils and underlying material in the Cincinnati-Rossmoyne-Hickory association.**

### *11. Miami-Crosby-Celina association*

*Deep, well drained to somewhat poorly drained, medium-textured, nearly level to strongly sloping soils on uplands*

This soil association is on ridgetops and knolls and on side slopes along drainageways and hillsides. The soils in it formed in thin loess and the underlying loamy till. The association occupies about 9 percent of the county. It is about 40 percent Miami soils, 25 percent Crosby soils, 15 percent Celina soils, and 20 percent minor soils (fig. 9).

Miami soils are on hillsides and side slopes along natural draws. They are gently sloping to strongly sloping and are well drained. Permeability is moderate. The surface layer is typically dark-brown silt loam and the subsoil is dark yellowish-brown clay loam.

Crosby soils are on ridgetops. They are nearly level and gently sloping and are somewhat poorly drained. Permeability is slow. The surface layer is typically dark grayish-brown silt loam and the subsoil is mottled, grayish-brown clay loam.

Celina soils are on knolls and ridgetops and on side slopes along the upper ends of drainageways. They are gently sloping and are well drained. Permeability is moderately slow. The surface layer is typically brown silt loam and the subsoil is yellowish-brown clay loam that has some mottling.

The minor soils of this association are in the Shoals, Brookston, and Hennepin series. The somewhat poorly drained, nearly level Shoals soils are in narrow bottoms. The very poorly drained, nearly level Brookston soils are in some drainageways. The well-drained, steep Hennepin soils are on breaks along stream valleys.

The soils in this association are suited to most crops commonly grown in the county. Corn, soybeans, wheat, and hay are the major crops. The soils are also suited to pasture grasses or trees. If cultivated, Miami and Celina soils need erosion-control practices. Crosby soils generally need some type of drainage system. The major hazards in farming are erosion and runoff on the Miami and Celina soils. The major limitations that affect town and country planning are slow permeability and the seasonal high water table of Crosby soils and the slopes of Miami and Celina soils.

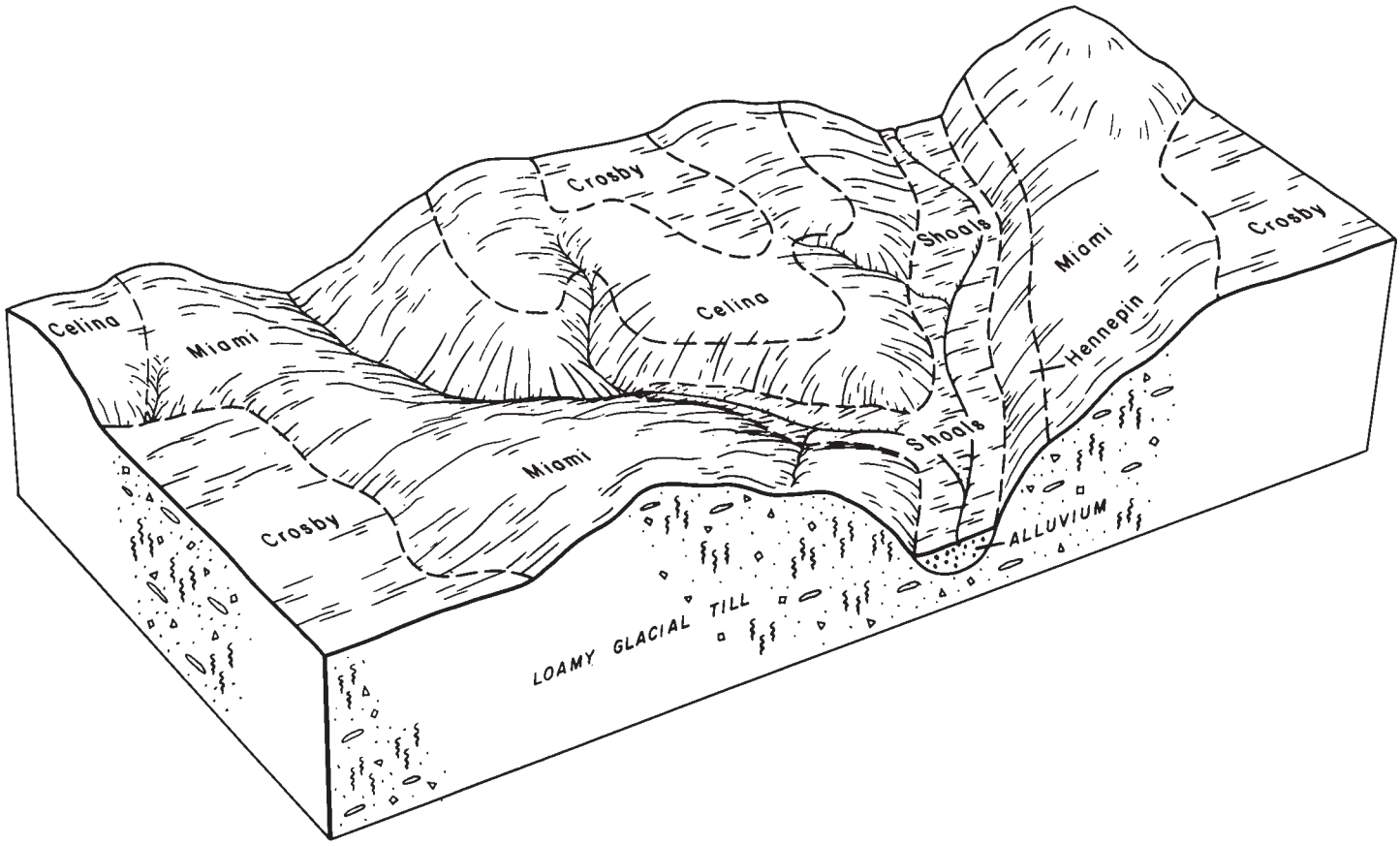


*Figure 9.*—**Typical pattern of soils and underlying material in the Miami-Crosby-Celina association.**

### *12. Miami-Fincastle-Hennepin association*

*Deep, well drained and somewhat poorly drained, medium-textured, nearly level to steep soils on uplands*

This soil association is on ridgetops, side slopes, drainageways, and breaks along major streams. It occupies about 9 percent of the county. The association is about 35 percent Miami soils, 25 percent Fincastle soils, 10 percent Hennepin soils, and 30 percent minor soils.

Miami soils are on hillsides and side slopes along natural draws. They are gently sloping to strongly sloping and are well drained. Permeability is moderate. They formed in thin loess and the underlying loamy till. The surface layer is typically dark-brown silt loam and the subsoil is dark yellowish-brown and dark-brown clay loam.

Fincastle soils are on ridgetops and upper ends of drainageways. They are nearly level and gently sloping and are somewhat poorly drained. Permeability is slow. They formed in 20 to 40 inches of loess and the underlying loamy till. The surface layer is typically dark grayish-brown silt loam and the subsoil is mottled, grayish-brown silty clay loam.

Hennepin soils are on steep breaks along the major stream valleys and some deep natural draws. They are well drained. Permeability is moderate. They formed in loamy till. The surface layer is typically dark grayish-brown loam and the subsoil is brown loam.

The minor soils of this association are in the Russell, Xenia, Shoals, and Brookston series. The gently sloping, well-drained Russell soils and the moderately well drained Xenia soils are on knolls and ridges. The somewhat poorly drained, nearly level Shoals soils are in narrow bottoms. The very poorly drained, nearly level Brookston soils are in drainageways.

Miami and Fincastle soils are suited to most crops commonly grown in the county. Corn, soybeans, wheat, and hay are the major crops. These soils are also suited to pasture grasses or trees. If these soils are cropped, the gently sloping to strongly sloping soils need erosion-control practices. Fincastle soils generally need some type of drainage system. Hennepin soils are best suited to trees. The major limitations for farming are wetness of the Fincastle soils and erosion and runoff on the Miami and Hennepin soils. The major limitations that affect town and country planning are slow permeability, wetness, and the seasonal high water table of Fincastle soils, and the slopes of Miami and Hennepin soils.

## Deep, Somewhat Poorly Drained to Well Drained, Medium-textured to Coarse-textured, Nearly Level to Moderately Sloping Soils That Formed in Windblown Sand or Outwash

The associations in this group are made up mostly of soils that are somewhat poorly drained to well

drained over windblown sand and stratified outwash. These soils make up about 5 percent of the county. Most areas are close to the East Fork of the White River. These soils are used mainly for growing corn and soybeans. In most areas, yields are low during periods of little rainfall. Most of these soils are only slightly limited for use in town and country development. The somewhat poorly drained soils, however, are moderately to severely limited.

### *13. Princeton-Ayrshire-Bloomfield association*

*Deep, well drained and somewhat poorly drained, moderately coarse textured and coarse textured, nearly level to moderately sloping soils on uplands*

This soil association formed in sandy windblown deposits. The moderately sloping areas are somewhat dune shaped and have areas of soils that have less slope between them. The association occupies about 3 percent of the county. It is about 50 percent Princeton soils, 25 percent Ayrshire soils, 10 percent Bloomfield soils, and 15 percent minor soils (fig. 10).

Princeton soils are on ridges and hills that are somewhat dune shaped. They are gently sloping to moderately sloping and are well drained. Permeability is moderate. The surface layer is typically dark-brown fine sandy loam and the subsoil is reddish-brown sandy clay loam. They overlie loose fine sand at a depth of 40 to 60 inches.

Ayrshire soils are in areas between the higher dune-shaped hills. They are nearly level and are somewhat poorly drained. Permeability is moderate. The surface layer is typically dark grayish-brown fine sandy loam and the subsoil is grayish-brown sandy clay loam. They overlie stratified fine sand and minor amounts of silt at a depth of 40 to 60 inches.

Bloomfield soils are on dune-shaped ridges. They are moderately sloping and are well drained. Permeability is moderately rapid. The surface layer is typically dark-brown loamy fine sand and the subsoil is alternating bands of pale-brown fine sand and dark-brown sandy loam at a depth of 54 to 84 inches. They overlie loose fine sand.

Minor soils of this association are in the Rensselaer and Miami series. The very poorly drained Rensselaer soils are in low depressions. The gently sloping and moderately sloping, well-drained Miami soils are on some ridges and side slopes along natural draws.

If erosion-control practices are established and maintained, the Princeton and Bloomfield soils are suited to most crops commonly grown in the county. Corn, grain sorghum, and wheat are the major crops. These soils are better suited to such drought-tolerant

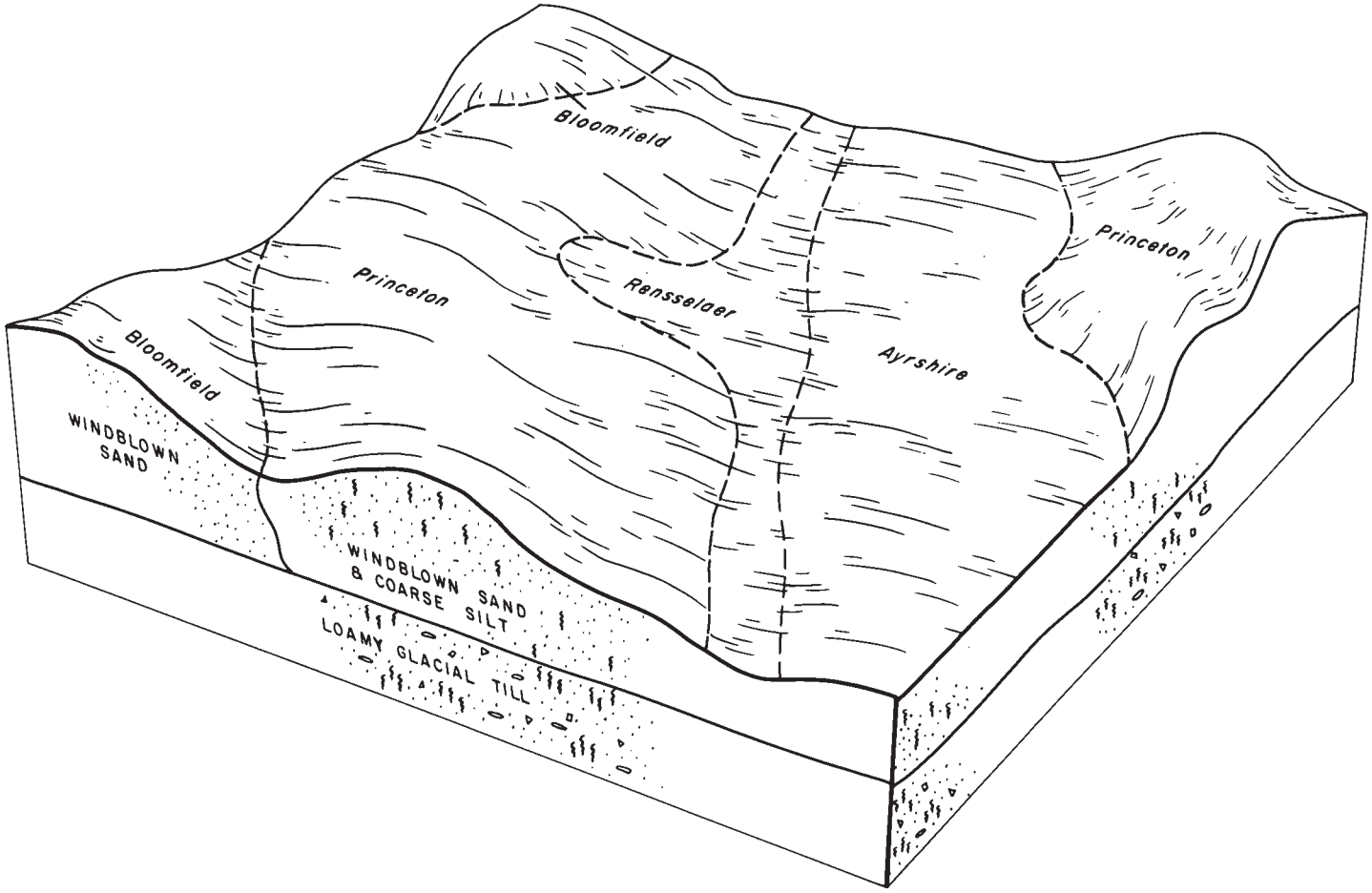


*Figure 10.*—**Typical pattern of soils and underlying material in the Princeton-Ayrshire-Bloomfield association.**

crops as grain sorghum or to such early spring crops as wheat. They are also suited to such crops as melons. If an adequate drainage system is established and maintained, the Ayrshire soils are suited to most crops commonly grown in the county. The soils are suited to pasture grasses or trees. The major limitation of the Ayrshire soils is wetness. The major limitations of Princeton and Bloomfield soils are droughtiness and erosion. The major limitations that affect town and country planning are wetness and the seasonal high water table of Ayrshire soils, slopes of Princeton soils, and slopes and droughtiness of Bloomfield soils.

#### *14. Martinsville-Whitaker association*

*Deep, well drained and somewhat poorly drained, medium textured and moderately coarse textured, nearly level and gently sloping soils on terraces*

This soil association is on broad flats and ridges on terraces. These soils formed in loamy outwash and the underlying stratified sand and silt. The association occupies about 2 percent of the county. It is about 60 percent Martinsville soils, 25 percent Whitaker soils, and 15 percent minor soils.

Martinsville soils are nearly level on broad flats and gently sloping on ridges and side slopes along drainageways. They are well drained. Permeability is moderate. The surface layer is typically dark-brown loam or sandy loam and the subsoil is dark-brown or reddish-brown clay loam or sandy clay loam.

Whitaker soils are on broad flats and long, narrow old drainage channels. They are nearly level and are somewhat poorly drained. Permeability is moderate. The surface layer is typically dark grayish-brown loam and the subsoil is mottled, brown or grayish-brown clay loam or sandy clay loam.

The minor soils of this association are in the Nineveh and Fox series. The nearly level to gently sloping, well-drained Nineveh soils are on terraces. The well-drained, gently sloping and moderately sloping Fox soils generally are on terrace breaks.

If an adequate drainage system is established and maintained on the Whitaker soils, all of the major soils in this association are suited to most crops commonly grown in the county. These soils are suited to corn, soybeans, wheat, and alfalfa. They are also suited to pasture grasses or trees. The Martinsville soils have few limitations for crops. Wetness is the major limitation that affects farming on the Whitaker soils. Major limitations for town and country planning are wetness and the seasonal high water table of Whitaker soils.

## *Descriptions of the Soils*

This section describes the soil series and mapping units in Bartholomew County. Each soil series is described in detail, and then, briefly, each mapping unit in that series is described. 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 is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Gullied land and Riverwash, for example, do not belong to a soil series but, nevertheless, are listed in alphabetic 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 soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland group in which the mapping unit has been placed. The page for the description of each capability unit, woodland group, or other interpretative group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

Because of the change in concepts of soil series in the classification system, the names of some soils are unlike those appearing in recently published surveys in adjacent counties.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*12*).

Where homes, cities, industries, airports, or abandoned airports appear on the maps, the soils have been disturbed. Most of these built-up areas have been cut or filled. The soil has been mechanically compacted in places.

### Avonburg Series

The Avonburg series consists of deep, somewhat poorly drained, nearly level and gently sloping soils on uplands. These soils formed in 2 to 4 feet of loess and the underlying glacial till that has been leached of carbonates to a depth of 10 feet or more. A very firm and brittle fragipan is at a depth of about 2 to 2½ feet. The native vegetation was mainly water-tolerant mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsurface layer is light-gray silt loam about 10 inches thick. The subsoil is about 102 inches thick. The upper

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

| Soil | Acres | Percent |
|---|---|---|
| Avonburg silt loam, 0 to 2 percent slopes | 7,200 | 2.8 |
| Avonburg silt loam, 2 to 4 percent slopes, eroded | 2,200 | .9 |
| Ayrshire fine sandy loam | 2,100 | .8 |
| Bartle silt loam | 1,400 | .5 |
| Berks and Weikert soils, 25 to 50 percent slopes | 2,750 | 1.1 |
| Bloomfield loamy fine sand, 6 to 12 percent slopes | 484 | .2 |
| Bonnie silt loam | 4,550 | 1.7 |
| Brookston silty clay loam | 10,300 | 4.0 |
| Burnside loam | 434 | .2 |
| Camden silt loam, 0 to 2 percent slopes | 279 | .1 |
| Celina silt loam, 2 to 6 percent slopes, eroded | 8,300 | 3.2 |
| Cincinnati silt loam, 2 to 6 percent slopes, eroded | 540 | .2 |
| Cincinnati silt loam, 6 to 12 percent slopes, eroded | 3,600 | 1.4 |
| Cincinnati silt loam, 6 to 12 percent slopes, severely eroded | 5,400 | 2.1 |
| Cincinnati silt loam, 12 to 18 percent slopes, eroded | 1,700 | .7 |
| Cincinnati silt loam, 12 to 18 percent slopes, severely eroded | 1,900 | .7 |
| Clermont silt loam | 5,000 | 1.9 |
| Corydon stony silt loam, 25 to 40 percent slopes | 300 | .1 |
| Crosby silt loam, 0 to 2 percent slopes | 15,200 | 6.0 |
| Crosby silt loam, 2 to 4 percent slopes, eroded | 4,400 | 1.7 |
| Dubois silt loam | 1,700 | .7 |
| Eel silt loam | 2,700 | 1.0 |
| Fincastle silt loam, 0 to 2 percent slopes | 13,700 | 5.4 |
| Fincastle silt loam, 2 to 4 percent slopes, eroded | 5,550 | 2.2 |
| Fox loam, 0 to 2 percent slopes | 8,400 | 3.2 |
| Fox loam, 2 to 6 percent slopes, eroded | 1,600 | .6 |
| Fox complex, 6 to 12 percent slopes, severely eroded | 940 | .3 |
| Genesee loam | 7,300 | 2.8 |
| Gilpin silt loam, 12 to 18 percent slopes, eroded | 900 | .3 |
| Gilpin silt loam, 12 to 18 percent slopes, severely eroded | 720 | .3 |
| Gilpin silt loam, 18 to 25 percent slopes | 1,100 | .4 |
| Gullied land | 295 | .1 |
| Haymond silt loam | 590 | .2 |
| Hennepin loam, 18 to 40 percent slopes | 1,950 | .8 |
| Henshaw silt loam | 980 | .4 |
| Hickory silt loam, 6 to 12 percent slopes, eroded | 790 | .3 |
| Hickory silt loam, 12 to 18 percent slopes, eroded | 258 | .1 |
| Hickory silt loam, 18 to 25 percent slopes, eroded | 2,700 | 1.0 |
| Hickory silt loam, 25 to 50 percent slopes | 700 | .3 |
| Hickory silty clay loam, 6 to 12 percent slopes, severely eroded | 640 | .3 |
| Hickory silty clay loam, 12 to 18 percent slopes, severely eroded | 890 | .3 |
| Landes gravelly sandy loam, gravelly substratum | 1,600 | .6 |
| Martinsville sandy loam, 0 to 2 percent slopes | 2,300 | .9 |
| Martinsville loam, 0 to 2 percent slopes | 4,150 | 1.6 |
| Martinsville loam, 2 to 6 percent slopes, eroded | 840 | .3 |
| McGary silt loam | 384 | .2 |
| Medway silty clay loam | 1,600 | .6 |
| Miami silt loam, 2 to 6 percent slopes, eroded | 3,500 | 1.3 |
| Miami silt loam, 6 to 12 percent slopes, eroded | 1,700 | .6 |
| Miami silt loam, 12 to 18 percent slopes, eroded | 670 | .3 |
| Miami clay loam, 2 to 6 percent slopes, severely eroded | 461 | 0.2 |
| Miami clay loam, 6 to 12 percent slopes, severely eroded | 6,700 | 2.6 |
| Miami clay loam, 12 to 18 percent slopes, severely eroded | 1,300 | .5 |
| Milton silt loam, 0 to 2 percent slopes | 580 | .2 |
| Milton silt loam, 2 to 6 percent slopes, eroded | 650 | .3 |
| Milton silt loam, 6 to 12 percent slopes, eroded | 420 | .2 |
| Nineveh loam, 0 to 2 percent slopes | 6,400 | 2.4 |
| Nineveh loam, 2 to 6 percent slopes, eroded | 1,200 | .5 |
| Nineveh gravelly loam, 0 to 2 percent slopes | 950 | .4 |
| Ockley loam, 0 to 2 percent slopes | 1,300 | .5 |
| Otwell silt loam, 2 to 6 percent slopes, eroded | 1,200 | .5 |
| Otwell silt loam, 6 to 12 percent slopes, eroded | 330 | .1 |
| Otwell silt loam, 6 to 12 percent slopes, severely eroded | 580 | .2 |
| Otwell silt loam, 12 to 18 percent slopes, eroded | 290 | .1 |
| Peoga silt loam | 930 | .4 |
| Princeton fine sandy loam, 2 to 6 percent slopes | 3,000 | 1.2 |
| Princeton fine sandy loam, 6 to 12 percent slopes, eroded | 1,450 | .6 |
| Rarden silt loam, 6 to 12 percent slopes, eroded | 210 | .1 |
| Rarden silt loam, 12 to 18 percent slopes, eroded | 500 | .2 |
| Rarden silty clay loam, 12 to 18 percent slopes, severely eroded | 298 | .1 |
| Rensselaer loam | 366 | .2 |
| Rensselaer clay loam | 2,800 | 1.1 |
| Riverwash | 660 | .3 |
| Rockcastle silty clay loam, 18 to 35 percent slopes | 1,200 | .5 |
| Rodman gravelly loam, 25 to 45 percent slopes | 138 | (1) |
| Ross silt loam | 3,100 | 1.2 |
| Ross silty clay loam | 3,100 | 1.2 |
| Rossmoyne silt loam, 2 to 6 percent slopes, eroded | 7,000 | 2.7 |
| Russell silt loam, 2 to 6 percent slopes, eroded | 660 | .3 |
| Saranac silt loam, overwash | 790 | .3 |
| Saranac silty clay loam | 3,000 | 1.2 |
| Shoals silt loam | 5,600 | 2.2 |
| Sleeth loam | 960 | .4 |
| Steff silt loam | 455 | .2 |
| Stendal silt loam | 5,200 | 2.0 |
| Stonelick sandy loam | 1,300 | .5 |
| Wakeland silt loam | 1,400 | .5 |
| Westland clay loam | 2,000 | .8 |
| Whitaker loam | 4,000 | 1.5 |
| Wilbur silt loam | 425 | .2 |
| Xenia silt loam, 2 to 6 percent slopes, eroded | 425 | .2 |
| Zanesville silt loam, 2 to 6 percent slopes, eroded | 500 | .2 |
| Zanesville silt loam, 6 to 12 percent slopes, eroded | 730 | .3 |
| Zanesville silt loam, 6 to 12 percent slopes, severely eroded | 730 | .3 |
| Zipp silty clay loam | 780 | .3 |
| Borrow pits | 100 | (1) |
| Federal land | 25,200 | 9.8 |
| Gravel pits | 390 | .2 |
| Quarries | 138 | (1) |
| Water | 6,200 | 2.4 |
| Total | 257,280 | 100.0 |

[1] Less than 0.05 percent.

9 inches is yellowish-brown, firm light silty clay loam mottled gray; the next 36 inches is a yellowish-brown, very firm and brittle, heavy silt loam fragipan mottled light gray; the next 12 inches is yellowish-brown, firm silt loam; and the bottom 45 inches is yellowish-brown, firm clay loam mottled light gray. The next layer, extending to a depth of about 130 inches, is yellowish-brown, firm, calcareous loam.

Avonburg soils have a low content of organic matter. Available water capacity is moderate and

permeability is very slow. The seasonal high water table is at a depth of 1 to 3 feet.

Representative profile of Avonburg silt loam, 0 to 2 percent slopes, in a cultivated field 100 feet west and 70 feet north of the southeast corner of SW¼NW¼ sec. 16, T. 8 N., R. 5 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable; few worm holes and worm casts 2 to 4 millimeters in diameter; abundant roots; neutral; abrupt, smooth boundary.

A2g—8 to 18 inches, light-gray (10YR 7/2) silt loam; many, medium, distinct, yellowish-brown (10YR 5/4, 5/8) mottles; weak, coarse, subangular blocky structure; friable; few fine pores less than 1 millimeter in diameter; few worm holes and brown (10YR 5/3) worm casts 2 to 4 millimeters in diameter; few roots; few black (10YR 2/1) concretions; strongly acid; clear, irregular boundary.

B2t—18 to 27 inches, yellowish-brown (10YR 5/6) light silty clay loam; many, medium, distinct, gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; firm; discontinuous light-gray (10YR 7/1) silt coatings on faces of some peds; continuous gray (N 6/0) clay films on faces of peds; few worm holes 2 to 3 millimeters in diameter; few fine roots mainly in worm holes and vertical cleavage plains; tongues of A2 material 2 to 4 inches wide; very strongly acid; gradual, irregular boundary.

IIBx1—27 to 39 inches, yellowish-brown (10YR 5/6) silt loam; common, medium, distinct, light-gray (10YR 7/1) mottles; moderate, very coarse, prismatic structure that parts to weak, thick, platy; very firm and brittle; black (10YR 2/1) coatings in some fine voids and on some vertical cleavage plains; few black (10YR 2/1) concretions; gray (N 6/0) linings on few very fine voids less than 1 millimeter in diameter; gray (N 6/0) clay films 1 to 3 millimeters thick and light-gray (10YR 6/1) silt coatings mainly on faces of prisms; very strongly acid; gradual, smooth boundary.

IIBx2—39 to 63 inches, yellowish-brown (10YR 5/6) silt loam; common, medium, distinct, light-gray (10YR 7/1) mottles; very coarse, moderate, prismatic structure that parts to weak, very thick, platy; very firm and brittle; black (10YR 2/1) coatings in some fine voids and cracks; few black (10YR 2/1) concretions; very fine voids less than 1 millimeter in diameter that have gray (N 6/0) linings; gray (N 6/0) clay films 1 to 2 millimeters thick and light-gray (10YR 6/1) silt coatings mainly on faces of prisms; common sand grains and few small pebbles; strongly acid; gradual, smooth boundary.

IIB31—63 to 75 inches, yellowish-brown (10YR 5/6, 5/8) silt loam; common, medium, distinct, light-gray (10YR 7/2) mottles; weak, coarse, prismatic structure; firm; gray (10YR 5/1) clay films in cracks and in some fine voids; white (10YR 8/2) silt coatings on faces of prisms and fine voids; fine voids less than 1 millimeter in diameter; common sand grains and few small pebbles; slightly acid; gradual, smooth boundary.

IIB32—75 to 120 inches, yellowish-brown (10YR 5/6, 5/8) clay loam; common, medium, distinct, light-gray (10YR 7/2) mottles; massive; firm; gray (10YR 5/1) clay films and white (10YR 8/2) silt coatings in some cracks; linings in a few fine voids; fine sand coatings on a few vertical cleavage plains; neutral; clear, wavy boundary.

IIC—120 to 130 inches, yellowish-brown (10YR 5/4) loam till; massive; firm; moderately alkaline (calcareous).

The solum ranges from 108 to 120 inches in thickness. The loess is 24 to 45 inches thick. Depth to the fragipan ranges from 24 to 32 inches. Depth to carbonates ranges from 108 to 120 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). The A2 horizon ranges in color from light gray (10YR 7/2) to grayish brown (10YR 5/2) and light yellowish brown (10YR 6/4). In places the profile has a thin, grayish-brown (10YR 5/2) or brown (10YR 4/3) silt loam B1 horizon. The heavy silt loam or light silty clay loam B2t horizon ranges in color from grayish brown (10YR 5/2) to light yellowish brown (10YR 6/4). The silt loam, heavy silt loam, light silty clay loam, heavy loam, or light clay loam IIBx horizon ranges in color from gray (10YR 5/1) to yellowish brown (10YR 5/6). The gray (10YR 5/1) to yellowish-brown (10YR 5/6) B3 horizon is loam, clay loam, or silt loam. It is more than 15 to 20 percent sand.

Avonburg soils formed in similar material to and are adjacent to or near the poorly drained Clermont and the moderately well drained Rossmoyne soils. Although they formed in similar material, Avonburg soils are not so gray in the upper part of the solum as Clermont soils and they are grayer or contain more gray mottles in the upper part of the solum than the Rossmoyne soils. Also, Clermont soils have a brittle layer but lack the fragipan of the Avonburg soils.

**Avonburg silt loam, 0 to 2 percent slopes** (AvA).—This soil is on wide ridgetops and large flats, a few more than one-fourth mile wide, on uplands. Areas range from 5 to more than 100 acres in size. This soil has the profile described as representative of the series. Included in mapping are small areas of poorly drained soils and small areas of gently sloping soils.

Runoff is slow on this soil, and wetness is the main limitation to use and management. If an adequate drainage system is established and maintained, this soil is suited to corn, soybeans, and small grain. It is also suited to pasture and trees. Capability unit IIw–3; woodland group 3w5.

**Avonburg silt loam, 2 to 4 percent slopes, eroded** (AvB2).—This soil is on the sides of natural draws; on narrow, long ridgetops; on narrow areas between large flats; and on narrow areas between more steeply sloping soils. The slopes are slightly concave on the draws and slightly convex on the ridges. Areas are irregularly shaped and range from 5 to more than 60 acres in size. This soil has a profile similar to that described as representative of the series, but about 5 to 7 inches of the surface layer has been lost through erosion. The present surface layer consists of a mixture of the original surface layer and part of the subsoil. Included in mapping are small areas of slightly eroded soils and small areas of moderately well drained soils.

Runoff is medium on this soil, wetness is the major limitation to use and management, and erosion is the major hazard. If a suitable drainage system is established and maintained, and if erosion-control practices are used, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the main crops. This soil is also suited to grasses and legumes for forage and to trees that tolerate wetness. Capability unit IIw–3; woodland group 3w5.

## Ayrshire Series

The Ayrshire series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils formed in wind-deposited stratified fine sand and silt. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 8 inches thick. The subsurface layer is light brownish-gray fine sandy loam about 6 inches thick. The subsoil is about 43 inches thick. The upper 8 inches is mottled, brown, friable loam; the next 23 inches is mottled, grayish-brown, firm sandy clay loam; and the lower 12 inches is grayish-brown and yellowish-brown, very friable heavy sandy loam. The underlying material, extending to a depth of about 86 inches, is gray and yellowish-brown stratified sand, fine sand, very fine sand, and silt.

Ayrshire soils have a moderate content of organic matter. Available water capacity is high and permeability is moderate. The seasonal high water table is at a depth of 1 to 3 feet. Runoff is slow.

Representative profile of Ayrshire fine sandy loam in a cultivated field 330 feet west and 20 feet south of the northeast corner of sec. 9, T. 9 N., R. 6 E.:

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

A2—8 to 14 inches, light brownish-gray (10YR 6/2) fine sandy loam; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; weak, medium, granular structure; friable; slightly acid; clear, smooth boundary.

B1—14 to 22 inches, brown (10YR 5/3) loam; many, medium, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; patchy grayish-brown (10YR 5/2) clay films; few organic fills in worm holes; few black (10YR 2/1) concretions; medium acid; clear, wavy boundary.

B21tg—22 to 32 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; grayish-brown (10YR 5/2) clay films on faces of peds; pale-brown (10YR 6/3) sand coating on faces of peds in places; few black (10YR 2/1) concretions; medium acid; clear, wavy boundary.

B22tg—32 to 45 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) and dark-brown (7.5YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; gray (10YR 5/1) clay films on faces of peds; few black (10YR 2/1) concretions; neutral; clear, wavy boundary.

B3g—45 to 57 inches, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) heavy sandy loam; massive; very friable; moderately alkaline (calcareous); clear, wavy boundary.

C—57 to 86 inches, gray (10YR 6/1) and yellowish-brown (10YR 5/6) stratified sand, fine sand, very fine sand, and silt; moderately alkaline (calcareous).

The solum ranges from 40 to 60 inches in thickness. In the Ap horizon, color ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). The A2 horizon is light brownish gray (10YR 6/2) or grayish brown (10YR 5/2). The loam or fine sandy loam B1 horizon ranges in color from brown (10YR 5/3) to yellowish brown (10YR 5/4). In places this soil lacks a B1 horizon. The sandy clay loam or light clay loam B2 horizon ranges in color from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4, 5/6). In places this soil lacks a B3 horizon. The C horizon ranges in color from gray (10YR 5/1) to yellowish brown (10YR 5/4, 5/6). It ranges from stratified fine sand to stratified silt and very fine sand.

Ayrshire soils have positions on the landscape and drainage characteristics similar to those of Crosby soils. They formed in similar material to and are adjacent to or near the well-drained Princeton soils. Ayrshire soils have a thicker solum that contains more sand, fewer pebbles, and less clay than Crosby soils. Ayrshire soils are grayer throughout than Princeton soils and have mottles, caused by wetness, that the Princeton soils do not have.

**Ayrshire fine sandy loam** (0 to 2 percent slopes) (Ay).—This soil is on broad flats and on narrow areas intermingled with dune-shaped areas of well-drained soils. Areas are irregularly shaped and range from 5 to more than 60 acres in size. Included in mapping are small areas of well-drained Princeton soils and very poorly drained Rensselaer soils.

Wetness is the major limitation to use and management of this soil. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIw–2; woodland group 3w5.

## Bartle Series

The Bartle series consists of deep, somewhat poorly drained, nearly level soils on terraces. These soils formed in silty old alluvium and have a very firm and brittle fragipan beginning at a depth of 2 to 3 feet. The native vegetation was mainly water-tolerant mixed hardwoods.

In a representative profile the surface layer is grayish-brown silt loam about 8 inches thick. The subsurface layer is mottled, grayish-brown, friable silt loam about 6 inches thick. The subsoil is about 51 inches thick. The upper 5 inches is mottled, pale-brown, friable silt loam; the next 13 inches is mottled, light brownish-gray, very firm and brittle silt loam; and the lower 33 inches is a fragipan that is very firm and brittle silt loam to light silty clay loam and is mottled light brownish gray in the upper part and brown in the lower part. The underlying material, to a depth of about 96 inches, is brown and gray stratified silty clay loam and silt loam.

Bartle soils have a low content of organic matter. Available water capacity is moderate. Permeability is very slow in the fragipan. The seasonal high water table is at a depth of 1 to 3 feet. Runoff is slow.

Representative profile of Bartle silt loam in a cultivated field 855 feet east and 170 feet south of the northwest corner of SW¼ sec. 32, T. 9 N., R. 5 E.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam; weak, medium, granular structure; friable; few black (10YR 2/1) iron-manganese concretions; slightly acid; abrupt, smooth boundary.

A2—8 to 14 inches, grayish-brown (10YR 5/2) silt loam; many, medium, distinct, gray (10YR 6/1) and brownish-yellow (10YR 6/6) mottles; weak, thin, platy structure; friable; common fine voids less than 1 millimeter in diameter; few fine roots; common black (10YR 2/1) iron-manganese concretions; strongly acid; clear, wavy boundary.

B1—14 to 19 inches, pale-brown (10YR 6/3) silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure that parts to weak, medium, subangular; friable; grayish-brown (10YR 5/2) clay films on faces of peds; light-gray (10YR 7/2) silt films on vertical faces

of peds; few roots in vertical cleavage planes; very strongly acid; clear, irregular boundary.

B2t—19 to 32 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure that parts to weak, medium, subangular blocky; very firm and brittle; discontinuous grayish-brown (10YR 5/2) clay films on faces of peds; light-gray (10YR 7/2) silt films on vertical faces of peds; few roots in clay and silt films; few black (10YR 2/1) concretions; very strongly acid; gradual, smooth boundary.

Bx1—32 to 50 inches, light brownish-gray (10YR 6/2) silt loam; common, medium, distinct, light-gray (10YR 6/1) and yellowish-brown (10YR 5/4, 5/6) mottles; moderate, coarse, prismatic structure that parts to weak, thick, platy; very firm and brittle; grayish-brown (10YR 5/2) clay films on faces of prisms cleavage planes; light-gray (10YR 7/2) silt films on faces of prisms; black (10YR 2/1) iron-manganese concretions and accumulations; common fine voids 1 millimeter in diameter, that have grayish-brown (10YR 5/2) linings in the prism interior; strongly acid; gradual, smooth boundary.

Bx2—50 to 65 inches, brown (10YR 5/3) silt loam to light silty clay loam; many, medium, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure; very firm and brittle; gray (10YR 5/1) clay films on faces of prisms; common black (10YR 2/1) iron-manganese concretions and accumulations; light-gray (10YR 7/2) silt coatings on faces of prisms; fine voids 1 millimeter in diameter that have gray (10YR 5/1) linings in the prism interior; slightly acid; gradual, smooth boundary.

C—65 to 96 inches, variegated brown (10YR 5/3), gray (10YR 6/1), brown (10YR 5/3) stratified silty clay loam, silt loam, and minor amount of clay; massive; neutral.

The solum ranges from 55 to 72 inches in thickness. Depth to the fragipan ranges from 24 to 32 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). The Ap horizon ranges in reaction from strongly acid to neutral depending on amount of lime applied. The A2 horizon ranges from gray (10YR 5/1) to pale brown (10YR 6/3). Some places do not have a B1 horizon. The B2t horizon ranges from grayish brown (10YR 5/2) to pale brown (10YR 6/3). It is heavy silt loam to light silty clay loam. The Bx horizon ranges from grayish brown (2.5Y 5/2) to light yellowish brown (10YR 6/4). It is silt loam or light silty clay loam. A thin grayish-brown (10YR 5/2) to yellowish-brown (10YR 5/6) silt loam B3 horizon is present in places.

Bartle soils have positions on the landscape similar to those of Dubois and Peoga soils. Bartle soils are similar in drainage, but have less clay in the B horizon and upper part of the fragipan than Dubois soils. They are not so gray in the upper part of the solum as Peoga soils.

**Bartle silt loam** (0 to 2 percent slopes) (Ba).—This soil is on broad bench-like flats between areas of bottom lands and uplands. Areas range from 5 to about 40 acres in size. Some flats are more than one-quarter mile wide.

Included with this soil in mapping are small gently sloping areas mainly on the toe slopes at the base of the uplands and on the side slopes of natural draws. Also included are small areas of poorly drained soils.

Wetness is the major limitation to us eand management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIw–3; woodland group 3w5.

## Berks Series

The Berks series consists of moderately deep, well drained, steep and very steep soils on uplands. These soils formed in about 20 to 40 inches of silty, shaly, and channery material weathered from sandstone and shale. They overlie stratified shale and sandstone bedrock at a depth of about 20 to 40 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 2 inches thick. The subsoil is about 26 inches thick. The upper 6 inches is yellowish-brown, friable silt loam; the next 13 inches is light yellowish-brown, friable shaly silt loam; and the lower 7 inches is pale-brown, friable shaly silt loam. The underlying bedrock, at a depth of about 25 inches, is brown shale and sandstone.

Berks soils are low in content of organic matter. Available water capacity is low to moderate and permeability is moderate.

Representative profile of Berks silt loam, from an area of Berks and Weikert soils, 25 to 50 percent slopes, in woods approximately 1,060 feet east and 1,330 feet south of the northwest corner of sec. 36, T. 9 N., R. 4 E.:

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

B21—2 to 8 inches, yellowish-brown (10YR 5/6, 5/8) silt loam; weak, fine, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B22—8 to 14 inches, light yellowish-brown (10YR 6/4) shaly silt loam; weak, fine, subangular blocky structure; friable; common ½- to 1-inch pieces of weathered shale; extremely acid; clear, wavy boundary.

B23—14 to 21 inches, light yellowish-brown (10YR 6/4) shaly silt loam; weak, coarse, subangular blocky structure; friable; light yellowish-brown (2.5Y 6/4) and yellowish-brown (10YR 5/8) coatings on some shale fragments; common ½- to 3-inch pieces of weathered shale; extremely acid; clear, wavy boundary.

B3—21 to 28 inches, pale-brown (10YR 6/3) shaly silt loam; weak, coarse, subangular blocky structure; friable; 35 to 50 percent ½- to 3-inch shale fragments; soil material between fragments; very strongly acid; abrupt, irregular boundary.

R—28 inches, stratified brown shale and sandstone.

The solum ranges from 20 to 36 inches in thickness. Depth to bedrock ranges from 20 to 40 inches.

In the A horizon color ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). The A horizon is silt loam, shaly silt loam, or channery silt loam. The B horizon ranges from yellowish brown (10YR 5/4, 5/8) to strong brown (7.5YR 5/6, 5/8). The B horizon is channery silt loam, shaly silt loam, or silt loam. In places a C horizon is present that is brown (10YR 5/3) or yellowish-brown (10YR 5/6) shaly or channery silt loam. The underlying bedrock is sandstone or brown shale.

Berks soils are adjacent to or near Weikert and Gilpin soils and are on landscapes similar to those soils. The Berks soils have a thicker solum and are deeper over bedrock than Weikert soils. They have less clay but contain a higher content of shale and sandstone fragments than Gilpin soils.

**Berks and Weikert soils, 25 to 50 percent slopes** (BeF).—These soils are on hillsides and overlie interbedded shale and sandstone. Areas range from 40

to more than 160 acres in size and in places slopes are more than 300 feet long.

Berks soils formed where the underlying bedrock is less resistant to weathering, so the soil is moderately deep. Berks soils in this unit have the profile described as representative of the series, but the surface layer is channery silt loam or is shaly silt loam in places.

Weikert soils formed where the underlying bedrock is resistant to weathering or where slopes are so steep that natural erosion does not permit the accumulation of weathered material. Weikert soils in this unit have the profile described as representative of the series, but in places the surface texture is silt loam or shaly silt loam. Weikert soils are mainly on the south- and west-facing slopes and are commonly on the points of ridges. In a few places bedrock outcrops are present.

Included with these soils in mapping are areas of Rockcastle and Rarden soils, generally at the base of hillsides where the gray-green shale is exposed below the interbedded sandstone and shale. Also included are areas of Gilpin soils on narrow ridgetops and on strongly sloping and moderately steep areas mainly on the upper part of hillsides.

Runoff is very rapid, and erosion, runoff, and shallowness over bedrock are the major limitations to use and management. These soils are better suited to trees than to pasture or hay. Most of the acreage is used for forest or for recreational developments. The main native forest trees are chestnut oak and scarlet oak. The rate of three growth is slow but is somewhat better on north- and east-facing slopes. Capability unit VIIe–2; woodland group 3r12.

## Bloomfield Series

The Bloomfield series consists of deep, well-drained, moderately sloping soils on uplands. These soils formed in wind-deposited sand. The native vegetation was drought-tolerant mixed hardwoods.

In a representative profile the surface layer is dark-brown loamy fine sand about 9 inches thick. The subsurface layer is brown, loamy fine sand about 5 inches thick. The next layer is 19 inches of yellowish-brown, loose fine sand. The next layer, about 39 inches thick, is pale-brown, loose fine sand that has discontinuous bands of dark-brown and yellowish-brown, friable sandy loam. The underlying material, to a depth of about 86 inches, is pale-brown and very pale brown loose fine sand.

Bloomfield soils are moderate in content of organic matter. Available water capacity is low to moderate, and permeability is moderately rapid. These soils are droughty. Runoff is medium.

Representative profile of Bloomfield loamy fine sand, 6 to 12 percent slopes, in a cultivated field 70 feet east and 1,092 feet north of the southwest corner of SE¼ sec. 33, T. 9 N., R. 6 E.:

Ap—0 to 9 inches, dark-brown (10YR 4/3) loamy fine sand; very weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—9 to 14 inches, brown (10YR 5/3) loamy fine sand; single grained; loose; medium acid; gradual, smooth boundary.

A3—14 to 33 inches, yellowish-brown (10YR 5/4) fine sand; single grained; loose; medium acid; abrupt, wavy boundary.

A&Bt—33 to 72 inches, pale-brown (10YR 6/3) fine sand (A); single grained; loose; lamellae and bands of dark-brown (7.5YR 4/4) and dark yellowish-brown (10YR 4/4) sandy loam (Bt); massive; friable; lamellae are wavy and discontinuous and range in thickness from ¼ inch to 4 inches; the thicker bands are below a depth of 53 inches; medium acid; gradual, irregular boundary.

C—72 to 86 inches, pale-brown (10YR 6/3) and very pale brown (10YR 7/3) fine sand; single grained; loose; slightly acid.

The solum ranges from 54 to 84 inches in thickness. In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to dark brown (10YR 4/3). In uncultivated areas a thin very dark grayish-brown (10YR 3/2) A1 horizon is present. The A2 horizon ranges from dark yellowish brown (10YR 4/4) to brown (10YR 5/3) and is loamy fine sand or fine sand. Depth to the A&Bt horizon ranges from 30 to 45 inches. In the upper part of the A&Bt horizon the bands of Bt material range from ¼ inch to 2 inches in thickness and range from loamy sand to heavy sandy loam. In the lower part of the A&Bt horizon the bands of Bt material range from 1 to 8 inches in thickness and range from sandy loam to light sandy clay loam. In the C horizon reaction ranges from slightly acid to moderately alkaline (calcareous). The C horizon is fine sand or loamy fine sand.

Bloomfield soils formed in similar material and are adjacent in the landscape to Princeton soils. They have less clay in the subsoil, lack a continuous B horizon, and have more sand in the upper part of the solum than Princeton soils.

**Bloomfield loamy fine sand, 6 to 12 percent slopes** (BmC).—This soil is in rolling dune-like areas. Areas of this soil are irregularly shaped and range from 5 to 25 acres in size. In some places, mainly on west-facing slopes, soil blowing has removed the upper part of the profile and the bands of sandy loam are directly below the plow layer. In places on ridgetops, depth to the sandy loam bands is about 16 to 20 inches. In places on the leeward side of ridges, loose sand is about 4 feet deep.

Included with this soil in mapping are gently sloping areas and strongly sloping areas. Also included are small areas of Princeton soils.

Erosion on this soil is the major hazard and low available water capacity is the major limitation to use and management. This soil is marginally suited to most of the crops commonly grown in the county. It is better suited to small grains and grain sorghum than to such crops as corn and soybeans. The soil is suited to melons and orchard crops. In years when rainfall is less than normal or is poorly distributed, crops are subject to damage from drought. Capability unit IIIe–12; woodland group 2s15.

## Bonnie Series

The Bonnie series consists of deep, poorly drained, nearly level soils on bottom lands. These soils formed in silty alluvial material. The native vegetation was mixed water-tolerant hardwoods.

In a representative profile the surface layer is gray silt loam about 14 inches thick. The underlying material, to a depth of about 60 inches, is friable silt loam that is mottled, light gray in the upper 34 inches and mottled, light brownish gray in the lower 12 inches.

Bonnie soils are low in content of organic matter. Available water capacity is high and permeability is slow. The soils are subject to flooding, mainly during winter and early in spring, but occasionally a damaging overflow occurs during the growing season. Runoff is slow. The seasonal high water table is at a depth of 0 to 1 foot.

Representative profile of Bonnie silt loam in woods 20 feet east and 160 feet south of the northwest corner of SW¼SW¼ sec. 4, T. 7 N., R. 5 E.:

A11—0 to 1 inch, light brownish-gray (10YR 6/2) silt loam; moderate, medium, granular structure; friable; few black (10YR 2/1) iron-manganese concretions; many fine roots; neutral; abrupt, smooth boundary.

A12g—1 to 14 inches, gray (10YR 5/1) silt loam; common, medium, faint, grayish-brown (10YR 5/2) mottles; weak, medium, platy structure; friable; light-gray (10YR 6/1) silt in some root and worm holes; few black (10YR 2/1) iron-manganese concretions; medium acid; clear, smooth boundary.

C1g—14 to 28 inches, light-gray (10YR 6/1) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) and few yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure; friable; some fine voids that have yellowish-red (5YR 4/6) linings; few black (10YR 2/1) iron-manganese concretions; strongly acid; gradual, smooth boundary.

C2g—28 to 40 inches, light-gray (10YR 6/1) heavy silt loam; few, medium, distinct, grayish-brown (10YR 5/2) and yellowish-red (5YR 4/6) mottles; weak, coarse, subangular blocky structure; friable; some fine voids that have yellowish-red (5YR 4/6) linings; few black (10YR 2/1) iron-manganese concretions; strongly acid; clear, smooth boundary.

C3g—40 to 48 inches, light-gray (10YR 6/1) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) mottles; massive; friable; strongly acid; clear, smooth boundary.

C4g—48 to 60 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, distinct, brown (10YR 5/3) and strong-brown (7.5YR 5/6) mottles; massive; friable; slightly acid.

Below the A horizon this soil is mostly strongly acid or very strongly acid. In the Ap horizon color ranges from dark gray (10YR 4/1) to light brownish gray (10YR 6/2). The A1 horizon, in uncultivated areas, is 1 to 3 inches of light brownish-gray (10YR 6/2) to very dark grayish-brown (10YR 3/2) and dark grayish-brown (10YR 4/2) silt loam. The C horizon, below the Ap horizon and to a depth of about 40 inches, ranges from grayish brown (10YR 5/2) to light gray (10YR 7/1). It ranges from medium to heavy silt loam.

Bonnie soils are similar in drainage to Clermont soils and formed in material similar to that of Stendal soils. They lack the clay accumulation in the subsoil of Clermont soils. Bonnie soils are on bottom lands, whereas Clermont soils are on uplands. Bonnie soils are grayer in their upper part than Stendal soils.

**Bonnie silt loam** (0 to 2 percent slopes) (Bo). This soil is on broad flats, some more than one-half mile wide, and in old sloughs on bottom lands. Included in mapping are small areas of somewhat poorly drained Stendal soils.

Some areas of this soil are low and have not been drained. These areas are wet during most of the season and are indicated on the map by wet spot symbols.

Wetness on this soil is the major limitation to use and management, and flooding is the major hazard. If a suitable drainage system is established and maintained (fig. 11), this soil is suited to corn and soybeans. Fall-seeded small grain is subject to flood damage during winter and early in spring. This soil is also suited to grasses and legumes for forage and to water-tolerant trees. Capability unit IIIw–10; woodland group 2w11.

## Brookston Series

The Brookston series consists of deep, very poorly drained, nearly level soils on uplands. These soils are slightly depressional. They formed in loamy sediment derived from till and the underlying loamy glacial till. The native vegetation was water-tolerant hardwood trees and shrubs along with some sedges and grasses.

In a representative profile the surface layer is about 16 inches of silty clay loam that is very dark grayish brown in the upper 7 inches and very dark brown in the lower 9 inches. The subsoil is about 29 inches thick. The upper 12 inches is mottled, dark grayish-brown, firm silty clay loam; and the lower 17 inches is mottled, gray, firm clay loam. The underlying material, to a depth of about 60 inches, is grayish-brown, friable loam to grayish brown and brown, firm loam.

Brookston soils are high in content of organic matter. Available water capacity is high and permeability is slow. Runoff is very slow or ponded. Depth to the seasonal high water table is 0 to 1 foot.

Representative profile of Brookston silty clay loam in a cultivated field 80 feet west and 140 feet north of the southwest corner of SW¼SW¼ sec. 15, T. 9 N., R 7 E.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) crushed, grayish-brown (10YR 5/2) dry, light silty clay loam; weak, fine and medium, granular structure; firm; few worm casts; neutral; abrupt, smooth boundary.

A12—7 to 16 inches, very dark brown (10YR 2/2) silty clay loam; moderate, fine, subangular blocky structure; firm; black (10YR 2/1) coatings on faces of peds; neutral; clear, wavy boundary.

B21tg—16 to 28 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; common, medium, distinct, olive-brown (2.5Y4/4) and some yellowish-brown (10YR 5/4) mottles; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; firm; very dark gray (10YR 3/1) clay films on faces of peds; common, fine and medium, sand grains; neutral; gradual, wavy boundary.

B22tg—28 to 45 inches, gray (10YR 5/1) clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) and olive-brown (2.5Y 4/4) mottles; weak, coarse, subangular blocky structure; firm; dark-gray (10YR 4/1) clay films on faces of peds; common, fine and medium, sand grains; neutral; clear, wavy boundary.

C1g—45 to 52 inches, grayish-brown (10YR 5/2) heavy loam; many, medium and coarse, distinct, yellowish-brown (10YR 5/4) and olive-brown (2.5Y 4/4) mottles; massive; friable; some cleavage plains coated with gray (10YR 5/1) clay films; moderately alkaline (calcareous).

C2g—52 to 60 inches, grayish-brown (10YR 5/2) and brown (10YR 5/3) heavy loam; massive; firm; moderately alkaline (calcareous).

The solum ranges from 38 to 50 inches in thickness. The A horizon ranges from 12 to 18 inches in thickness and from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color. A B1g horizon of gray (10YR 5/1) or dark-gray (10YR 4/1) silty clay loam or clay loam is present in

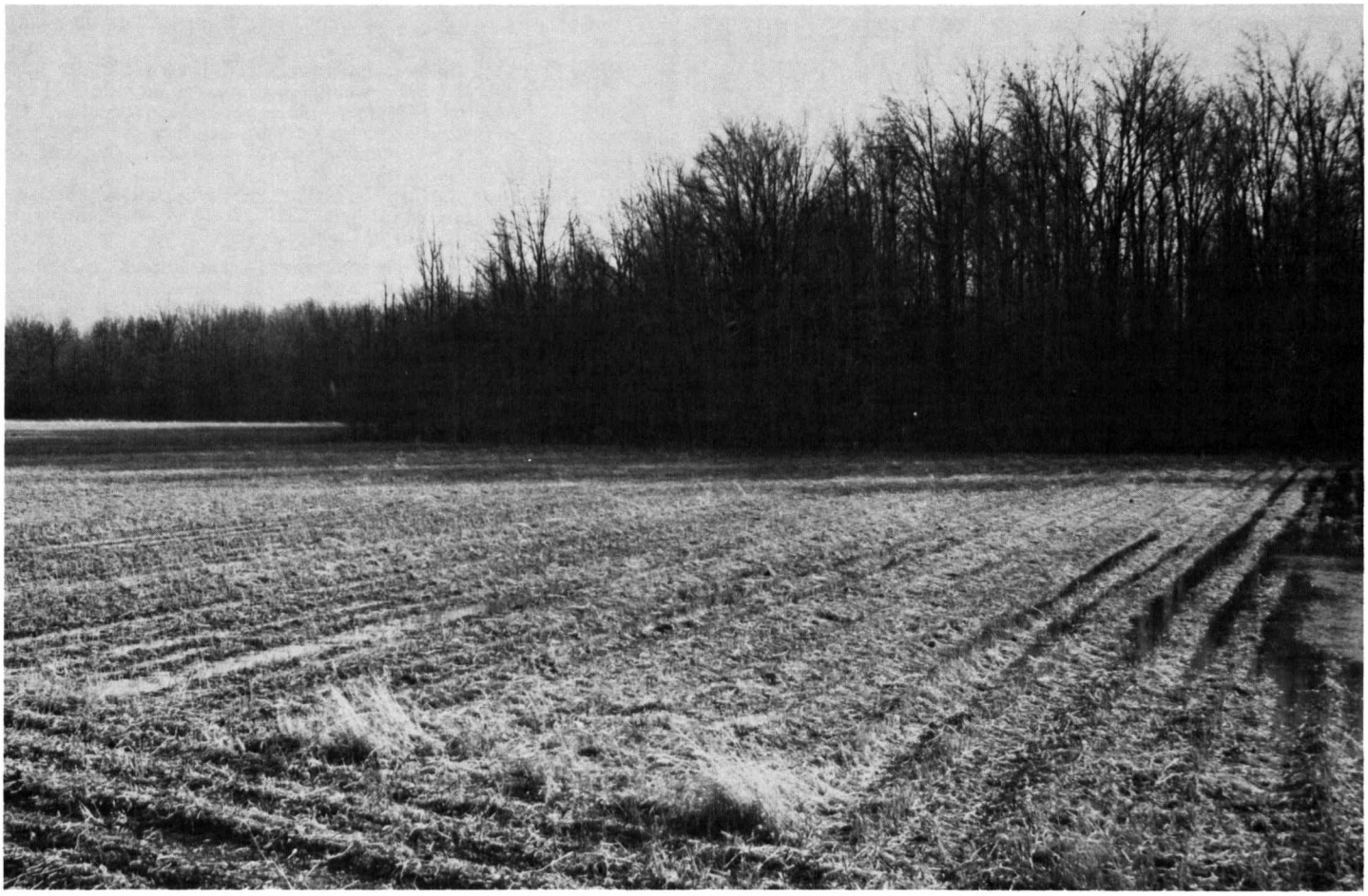

*Figure 11.*—**Field of Bonnie silt loam that has been in row crops. Even though drained, this soil is wet during winter and early in spring.**

some places. The B2 horizon ranges from dark gray (10YR 4/1) to olive gray (5Y 5/2). It is clay loam or silty clay loam that commonly has 15 to 20 percent sand. Some profiles do not have a B3 horizon. The B3 horizon, where present, ranges from loam to clay loam. The C horizon is loam or clay loam.

Brookston soils have positions on the landscape and drainage characteristics similar to those of Westland and Rensselaer soils. They have fewer pebbles in the lower part of the subsoil and do not have the gravel and sand C horizon of Westland soils. Brookston soils have less sand throughout the solum and do not have the C horizon of stratified sand and silt of Rensselaer soils.

**Brookston silty clay loam** (0 to 2 percent slopes) (Br).—This soil is on uplands in wide depressions and long swales. Areas are irregularly shaped and range from a few to more than 60 acres in size and in places are more than one-quarter mile wide.

Included with this soil in mapping are areas that have silt loam surface layers, some areas that have fine-textured subsoils, and some areas that have 10 to 15 inches of overwash. Also included in mapping are small areas of Crosby and Fincastle soils.

In areas where this soil is associated with Fincastle soils, the soil formed in silty material 20 to 35 inches thick and in a few places near areas of Princeton soils they overlie silty material.

Wetness and maintenance of soil structure on this soil are the major limitations to use and management. If worked wet this soil becomes puddled, plows up cloddy, and good seedbeds are difficult to prepare. Some areas are subject to ponding. If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. This soil is also suited to grasses and legumes for forage and to water-tolerant trees. Capability unit IIw–1; woodland group 2w11.

## Burnside Series

The Burnside series consists of moderately deep, well-drained nearly level soils on bottom lands. These soils formed in channery and shaly alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown loam about 3 inches thick. The underlying material is about 39 inches thick. The upper 9 inches is yellowish-brown, friable loam, and the lower 30 inches is dark yellowish-brown, friable flaggy loam (fig. 12). The underlying bedrock, to a depth of about 60 inches, is olive-gray and grayish-brown clay shale.

Burnside soils are moderate in content of organic matter. Available water capacity is low to moderate

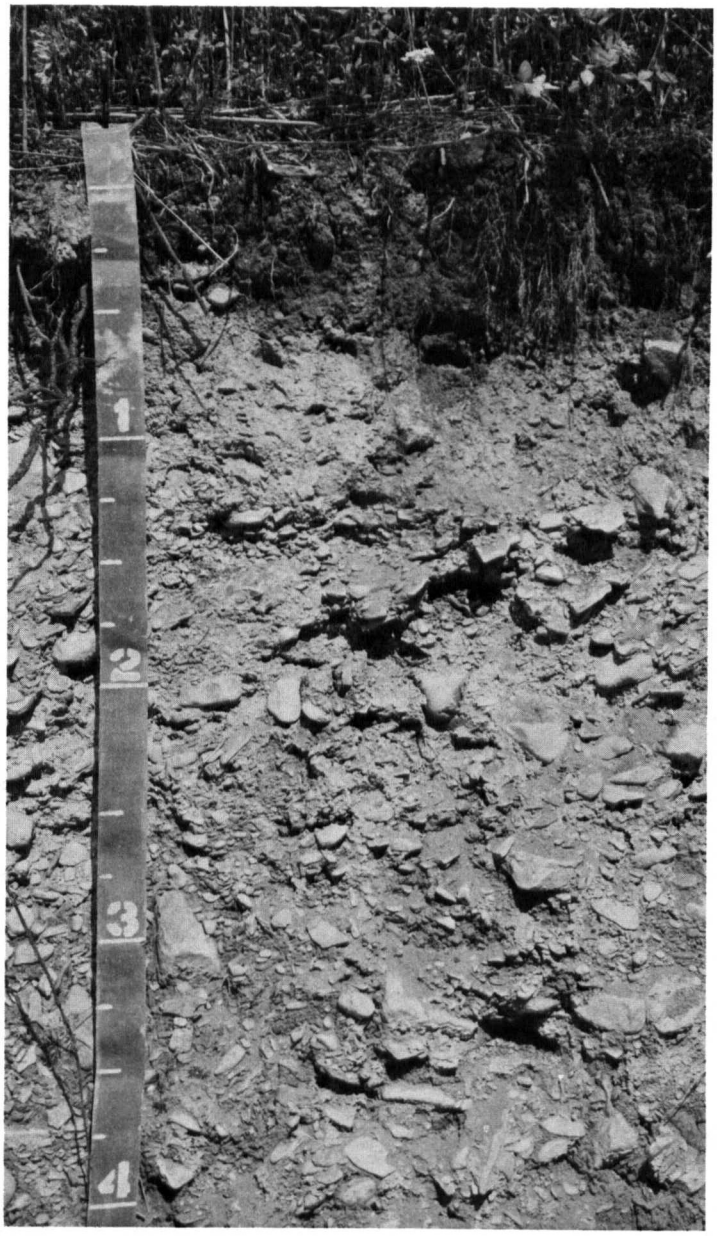

*Figure 12.*—**Profile of Burnside loam containing shaly and channery fragments in the subsoil.**

and permeability is moderate. The soils are subject to flooding, usually of short duration. Runoff is slow.

Representative profile of Burnside loam in woods about 50 feet west and 150 feet north of the southeast corner of NW¼ sec. 2, T. 8 N., R. 4 E.:

AO—½ inch to 0, leaf litter.
A11—0 to 1 inch, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; few ½- to 2-inch fragments of sandstone and shale; strongly acid; abrupt, smooth boundary.
A12—1 to 3 inches, dark-brown (10YR 4/3) loam; moderate, fine, granular structure; friable; few ¼- to 2-inch fragments of sandstone and shale; very strongly acid; clear, smooth boundary.
C1—3 to 12 inches, yellowish-brown (10YR 5/4) loam; moderate, very fine, subangular blocky structure; friable; few ¼- to 2-inch fragments of sandstone and shale; very strongly acid; clear, wavy boundary.
C2—12 to 42 inches, dark yellowish-brown (10YR 4/4) flaggy loam; weak, medium, subangular blocky structure; friable; more than 50 percent of the horizon is sandstone fragments larger than 2 millimeters in diameter; very strongly acid; abrupt, wavy boundary.
IIC3—42 to 60 inches, olive-gray (5Y 5/2), olive (5Y 5/4), and grayish-brown (2.5Y 5/2) clay shale; very strongly acid in the upper part.

Depth to the IIC horizon ranges from 40 to 60 inches. In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). The A1 horizon, in uncultivated areas, is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The C horizon ranges from 35 to 80 percent sandstone and shale fragments. This horizon ranges from dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/4). The C2 horizon ranges from flaggy loam to channery loam.

Burnside soils are on flood plain positions similar to those of Haymond soils. They are more acid and contain a higher content of rock fragments than Haymond soils.

**Burnside loam** (0 to 2 percent slopes) (Bu).—This soil is on long narrow bottom lands along streams in valleys between steep and very steep soils overlying shale and sandstone bedrock (fig. 13). Included in mapping are small areas of gently sloping soils on alluvial fans and a few small areas of moderately well drained and somewhat poorly drained soils.

Flooding, usually of short duration, and droughtiness on this soil in mid and late summer are major limitations to use and management. This soil is suited to most crops commonly grown in the county, but such crops as fall-seeded small grain can be damaged by winter flooding. In years when rainfall is less than normal or is poorly distributed, crops are subject to drought damage. Capability unit IIs–7; woodland group 1o8.

## Camden Series

The Camden series consists of deep, well-drained, nearly level soils on terraces. These soils formed in loess or water-deposited silty material and the underlying outwash material. The native vegetation was hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 9 inches thick. The subsurface layer is yellowish-brown, friable silt loam about 3 inches thick. The subsoil is about 57 inches thick. The upper 4 inches is dark-brown, friable silt loam; the next 16 inches is yellowish-brown, firm silty clay loam; the next 22 inches is dark yellowish-brown, firm silty clay loam; and the lower 15 inches is dark-brown firm clay loam. The underlying material, to a depth of 96 inches, is brown, loose sand.

Camden soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. Runoff is slow.

Representative profile of Camden silt loam, 0 to 2 percent slopes, in a cultivated field 364 feet north and 70 feet west of the southeast corner of SW¼NW¼ sec. 5, T. 8 N., R. 6 E.:

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

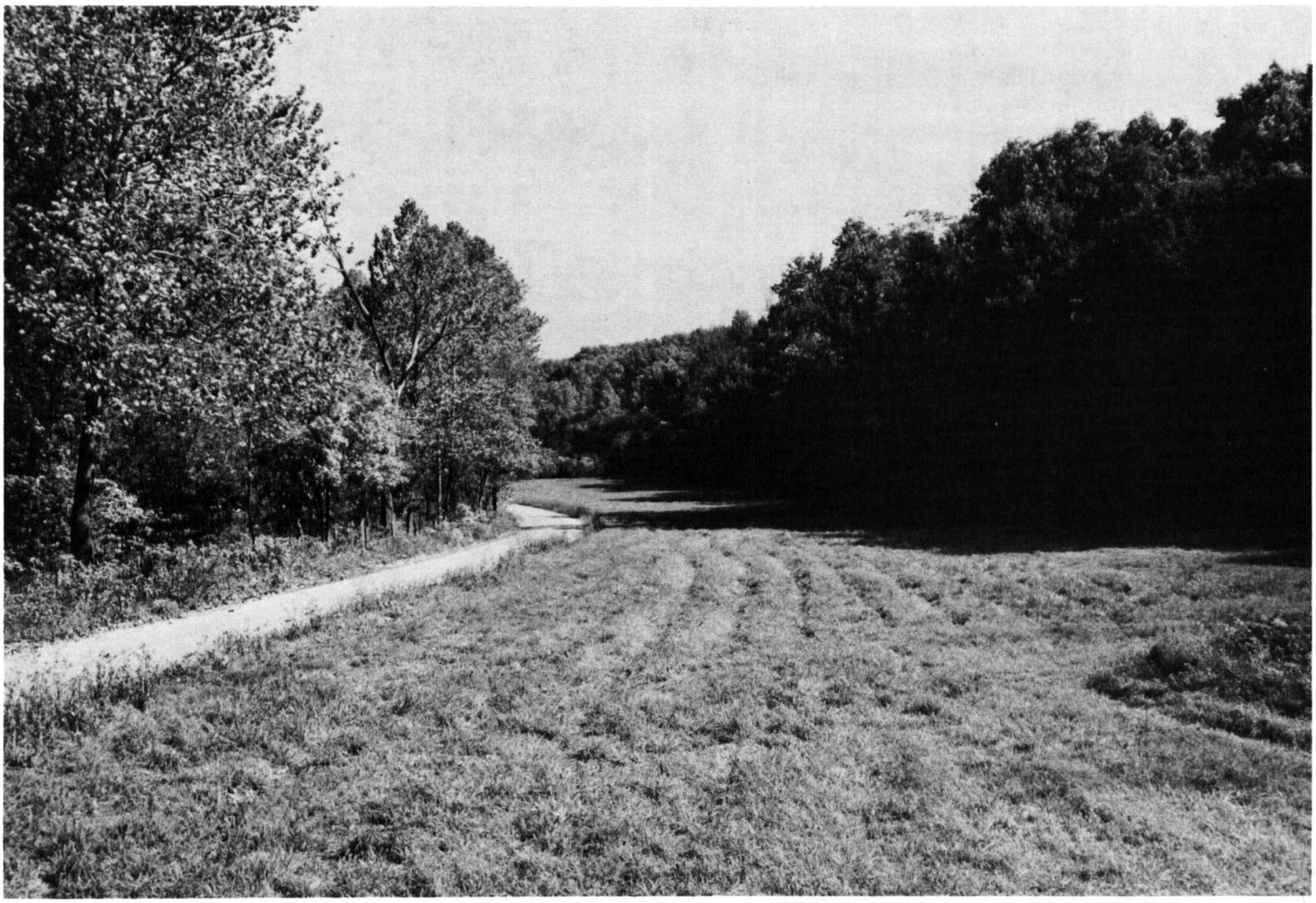

*Figure 13.*—**Area of Burnside loam on a narrow bottom in a valley between Berks and Weikert soils, 25 to 50 percent slopes.**

A2—9 to 12 inches, yellowish-brown (10YR 5/4) silt loam; moderate, medium, platy structure; friable; few fine voids less than 1 millimeter in diameter; slightly acid; clear, smooth boundary.

B1—12 to 16 inches, dark-brown (10YR 4/3) heavy silt loam; moderate, fine and medium, subangular blocky structure; friable; discontinuous, thin, dark yellowish-brown (10YR 3/4) coatings on faces of peds; few fine voids less than 1 millimeter in diameter that have dark yellowish-brown (10YR 3/4) linings; neutral; clear, smooth boundary.

B21t—16 to 32 inches, yellowish-brown (10YR 5/4) silty clay loam; weak, fine, prismatic structure that parts to moderate, medium, angular and subangular blocky; firm; continuous dark-brown (10YR 3/3) clay films; neutral; gradual, smooth boundary.

B22t—32 to 54 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, coarse, subangular blocky structure; firm; continuous dark-brown (10YR 3/3) clay films on faces of peds; neutral; clear, smooth boundary.

IIB3t—54 to 69 inches, dark-brown (7.5YR 4/4) clay loam; weak, very coarse, subangular blocky structure; firm; discontinuous dark-brown (7.5YR 3/2) clay films on faces of peds and bridging sand grains and small pebbles; neutral; clear, wavy boundary.

IIC—69 to 96 inches, brown (10YR 5/3) sand; single grained; loose; moderately alkaline (calcareous).

The solum ranges from 40 to 72 inches in thickness. In the Ap horizon color ranges from dark brown (10YR 4/3) to brown (10YR 5/3). The A2 horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4). A B1 horizon is not present in some places. The B2 horizon ranges from dark brown (7.5YR 4/4) to yellowish brown (10YR 5/4). It is silty clay loam or clay loam in the lower part. A B3 horizon is not present in some places. The underlying material is loose sand, stratified sand and silt, or loose stratified sand that has a small amount of gravel.

Camden soils have positions in the landscape and thickness and drainage characteristics similar to those of Martinsville and Ockley soils. They have less sand in the upper part of the solum than Martinsville soils. Camden soils have a lower content of gravel in the upper part of the solum than Ockley soils.

**Camden silt loam, 0 to 2 percent slopes** (Ca).—This soil is on bench-like terraces. Areas range from 10 to 40 acres in size and in places are ⅛ to ¼ mile wide.

Included with this soil in mapping are areas of gently sloping soils mainly on breaks between the level areas and adjacent bottom lands. Also included are soils on terraces along Sand Creek that have a very strongly acid subsoil and underlying material and some moderately well drained soils.

This soil has slight limitations to use and management; however, some areas are flooded during periods of extremely high water. This soil is suited to most crops commonly grown in the county. Corn, soybeans,

and wheat are the major crops. The soil is also suited to grasses and legumes for forage and to trees, Such deep-rooted trees as black walnut grow well on this soil. Capability unit I–1; woodland group 1o1.

## Celina Series

The Celina series consists of deep, moderately well drained, gently sloping soils. These soils formed in about 2 to 3 feet of loess and the underlying loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is brown silt loam about 6 inches thick. The subsoil is about 28 inches thick. The upper 5 inches is mottled, yellowish-brown, friable silt loam; the next 6 inches is mottled, yellowish-brown, firm silty clay loam; and the lower 17 inches is mottled, yellowish-brown, firm clay loam. The underlying material, to a depth of about 60 inches, is brown, grayish-brown, and yellowish-brown, friable to firm loam.

Celina soils are moderate in content of organic matter. Available water capacity is high and permeability is moderately slow. Runoff is medium. Depth to the seasonal high water table is 3 to 6 feet.

Representative profile of Celina silt loam, 2 to 6 percent slopes, in a cultivated field 550 feet south and 150 feet east of the northwest corner of SE¼SW¼ sec. 10, T. 9 N., R. 7 E.:

Ap—0 to 6 inches, brown (10YR 5/3) silt loam; weak, medium, granular structure; friable; few pieces of yellowish-brown (10YR 5/4) material mixed in; medium acid; abrupt, smooth boundary.

B1—6 to 11 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, medium, faint, brown (10YR 5/3) and a few grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; friable; patchy dark yellowish-brown (10YR 4/4) clay films on faces of peds; strongly acid; clear, smooth boundary.

B21t—11 to 17 inches, yellowish-brown (10YR 5/4) silty clay loam; few, medium, distinct, grayish-brown (10YR 5/2) and brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; firm; dark yellowish-brown (10YR 4/4) clay films on faces of peds; strongly acid; clear, wavy boundary.

IIB22t—17 to 28 inches, yellowish-brown (10YR 5/4) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) and brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; firm; yellowish-brown (10YR 5/4) clay films on faces of peds; few light-gray (10YR 7/2) silt coatings on vertical cleavage plains; strongly acid; clear, wavy boundary.

IIB3—28 to 34 inches, yellowish-brown (10YR 5/4) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) and dark-gray (10YR 4/1) mottles; weak, coarse, subangular blocky structure; firm; discontinuous grayish-brown (10YR 5/2) clay films on faces of peds; neutral; clear, wavy boundary.

IIC—34 to 60 inches, brown (10YR 5/3), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/4) loam; massive; friable in upper 12 inches and firm below a depth of 42 inches; accumulations of lime in soft rounded masses; few coatings of grayish-brown (10YR 5/2) clay films extending into cleavage plains in the till; moderately alkaline (calcareous).

The solum ranges from 24 to 40 inches in thickness. The loess is less than 18 inches thick.

In the Ap horizon color ranges from dark brown (10YR 4/3) to brown (10YR 5/3). An A2 horizon of brown (10YR 5/3) silt loam is present in places. In places a B1 horizon is not present. The B2t horizon ranges from silty clay loam to heavy clay loam that averages more than 35 percent clay. The B2t horizon ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). A B3 horizon is not present in places.

Celina soils have positions on the landscape similar to those of Xenia and Miami soils. They are similar in drainage but are shallower to carbonates than Xenia soils. Celina soils have gray mottles in the B21t horizon that Miami soils do not have.

**Celina silt loam, 2 to 6 percent slopes, eroded** (CeB2).—This soil is on the upper ends of side slopes along natural draws, on knolls, and on ridgetops. Areas are concave on side slopes and convex on knolls and ridgetops. Areas generally are irregularly shaped and range from 4 to about 20 acres in size.

Included with this soil in mapping are some slightly eroded areas and small areas of Miami and Crosby soils. Also included are small severely eroded areas, and for some of these areas severely eroded symbols are used on the map.

Severely eroded areas of this soil are cloddy when plowed, making seedbeds difficult to prepare and good stands sometimes difficult to establish. On the lower part of the slopes and in bottoms of draws where areas of somewhat poorly drained Crosby soils are present, some type of drainage system generally is needed.

Erosion on this soil is the major hazard to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grain are the major crops. The soil is also suited to grasses and legumes for forage and to trees. Capability unit IIe–1; woodland group 1o1.

## Cincinnati Series

The Cincinnati series consists of deep, well-drained, gently sloping to strongly sloping soils on uplands. These soils formed in about 2 to 3 feet of loess and in the underlying loamy glacial till. A very firm and brittle fragipan is at a depth of about 20 to 32 inches. The native vegetation was mainly mixed hardwoods.

In a representative profile the surface layer is brown silt loam about 6 inches thick. The subsoil is about 114 inches thick. The upper 4 inches is yellowish-brown, friable silt loam; the next 17 inches is yellowish-brown, firm light silty clay loam and heavy silt loam; the next 35 inches is a fragipan that is mottled, yellowish-brown, very firm loam; and the lower 58 inches is mottled, yellowish-brown, firm clay loam. The underlying material, to a depth of 140 inches, is brown and yellowish-brown, firm loam till.

Cincinnati soils are low in content of organic matter. Available water capacity is moderate. Permeability is very slow in the fragipan.

Representative profile of Cincinnati silt loam, 6 to 12 percent slopes, eroded, at the edge of an old field planted in pine trees, 30 feet east and 100 feet north of the southwest corner of sec. 20, T. 9 N., R. 5 E.:

Ap—0 to 6 inches, brown (10YR 5/3) silt loam; moderate, medium, granular structure; friable; small pieces

of yellowish-brown (10YR 5/4) material mixed in; neutral; abrupt, smooth boundary.

B1—6 to 10 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; friable; few, patchy, dark yellowish-brown (10YR 4/4) clay films on faces of some peds; strongly acid; clear, smooth boundary.

B21t—10 to 20 inches, yellowish-brown (10YR 5/4) light silty clay loam; moderate, medium, subangular blocky structure; firm; dark yellowish-brown (10YR 4/4) clay films on faces of peds; strongly acid; clear, wavy boundary.

B22t—20 to 27 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, coarse, prismatic structure; very firm and brittle; coatings of light brownish-gray (10YR 6/2) silt on top of prism faces; patches of dark-brown (7.5YR 4/4) clay films on faces of some peds; common very fine voids less than 1 millimeter in diameter in ped interiors; very strongly acid; abrupt, wavy boundary.

IIBx1—27 to 43 inches, yellowish-brown (10YR 5/4) loam; strong, very coarse, prismatic structure that parts to weak, thick, platy; very firm and brittle; coatings of light brownish-gray (10YR 6/2) silt on faces of prisms; dark-brown (7.5YR 4/4) clay films on faces of some peds and in fine voids; few black (10YR 2/1) iron-manganese concretions and coatings on faces of peds; extremely acid; gradual, wavy boundary.

IIBx2—43 to 62 inches, yellowish-brown (10YR 5/4, 5/6) heavy loam; moderate, very coarse, prismatic structure; very firm and brittle; light brownish-gray (10YR 6/2) coatings of very fine sand and silt on faces of some prisms; dark yellowish-brown (10YR 4/4) clay films on faces of some peds and in very fine voids; extremely acid; gradual, wavy boundary.

IIB3—62 to 120 inches, yellowish-brown (10YR 5/6) light clay loam; common, medium, distinct, pale-brown (10YR 6/3) mottles; weak, very coarse, subangular blocky structure; firm; discontinuous dark-brown (7.5YR 4/4) clay films on faces of peds and in cracks; strongly acid; gradual, wavy boundary.

IIC—120 to 140 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/4) loam till; massive; firm; moderately alkaline (calcareous).

The solum ranges from 96 to 130 inches in thickness. The loess ranges from 24 to 40 inches in thickness. Depth to the fragipan ranges from 20 to 32 inches.

In the Ap horizon color ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/6). The Ap horizon is strongly acid to neutral depending upon the amount of lime applied. In forested areas a thin A1 horizon of very dark grayish-brown (10YR 3/2) or dark grayish-brown (10YR 4/2) silt loam is present. In places an A2 horizon that is 1 to 6 inches of brown (10YR 5/3), pale-brown (10YR 6/3), or yellowish-brown (10YR 5/4) silt loam is present. The B2t horizon ranges from brown (10YR 5/3) to strong brown (7.5YR 5/6) and is heavy silt loam or light silty clay loam. The Bx horizon ranges from dark yellowish brown (10YR 4/4) to brownish yellow (10YR 6/6, 6/8) and is silt loam, loam, light silty clay loam, or light loam. the B3 horizon is clay loam or heavy loam.

Cincinnati soils are adjacent to the moderately well drained Rossmoyne and Hickory soils. They lack the gray mottles in the upper part of the subsoil of Rossmoyne soils. Cincinnati soils have a thicker solum than Hickory soils and they have a fragipan that Hickory soils do not have.

**Cincinnati silt loam, 2 to 6 percent slopes, eroded** (CnB2).—This soil is on uplands, on side slopes along natural draws and narrow long ridgetops. This soil has a profile similar to that described as representative of the series, but the depth to the fragipan is mainly 26 to 30 inches.

Included with this soil in mapping are a few small severely eroded areas. Some of these areas are indicated on the map by a "severely eroded" symbol. Also included are small areas of moderately well drained Rossmoyne soils and small slightly eroded areas.

Runoff is medium on this soil. The very slowly permeable fragipan, moderate available water capacity, hazard of further erosion and runoff are limitations to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grain are the major crops. The soil is not well suited to alfalfa and other deep-rooted crops because the fragipan restricts the downward penetration of roots. In years when rainfall is less than normal or is poorly distributed, crops are subject to some damage from drought. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIe–7; woodland group 3d9.

**Cincinnati silt loam, 6 to 12 percent slopes, eroded** (CnC2).—This soil is on uplands, on hillsides, side slopes along natural draws, and long ridgetops. This soil has the profile described as representative of the series. The hillsides range from 50 to more than 300 feet in length and areas range from 5 to more than 40 acres in size.

Included with this soil in mapping are a few small severely eroded areas. Some of these areas are indicated on the map by a severely eroded symbol. Also included are some slightly eroded areas that have mainly been in trees or permanent pasture.

Runoff is medium on this soil. The very slow permeability of the fragipan, moderate available water capacity, hazard of further erosion, and runoff are limitations to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, small grain, and grasses and legumes for forage are the major crops. The soil is not well suited to alfalfa and other deep-rooted crops because the fragipan restricts the downward penetration of roots. In years when rainfall is less than normal or is poorly distributed, crops are subject to some damage from drought. This soil is also suited to pasture and to trees. Capability unit IIIe–7; woodland group 3d9.

**Cincinnati silt loam, 6 to 12 percent slopes, severely eroded** (CnC3).—This soil is on hillsides and on side slopes along natural draws. The hillsides are convex shaped and range from less than 100 feet to more than 300 feet in length. Areas of this soil range from 5 to about 30 acres in size. This soil has a profile similar to that described as representative of the series, but erosion has removed most of the surface layer and in places part of the subsoil. The plow layer is mainly yellowish brown. It is not as friable and is more difficult to prepare into a good seedbed than are less eroded areas. Near some toe slopes is an accumulation of soil material that eroded from the upper parts of the slopes. In places the fragipan is exposed on the surface. In places there are a few small gullies. On some hillsides there are small seepy areas where the fragipan is near the surface. Included in mapping are a few areas of strongly sloping soils.

Runoff is rapid on this soil. The very slowly perme-

able fragipan, moderate available water capacity, hazard of further erosion, and runoff are limitations to use and management. This soil is suited to most crops commonly grown in the county, but it has limited suitability for row crops. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa or other deep-rooted crops. In years when rainfall is less than normal or is poorly distributed, crops are subject to some damage by drought. This soil is also suited to pasture grasses and to trees. Capability unit IVe–7; woodland group 3d9.

**Cincinnati silt loam, 12 to 18 percent slopes, eroded** (CnD2).—This soil is on hillsides and side slopes along natural draws. The hillsides range from less than 100 feet to more than 300 feet in length. Areas of this soil range from 10 to more than 30 acres in size. This soil has a profile similar to that described as representative of the series, but the fragipan is not as well developed and in places it is very thin or absent.

Included with this soil in mapping are a few small severely eroded areas. A severely eroded symbol is used on the map for some of these spots. Some included areas that have been in permanent pasture or in trees are slightly eroded. Also included are a few small moderately steeply sloping areas and small areas of Hickory soils.

Runoff is rapid on this soil. The slow permeability of the fragipan, moderate available water capacity, hazard of further erosion, and runoff are limitations to use and management. This soil has limited suitability for row crops. If suitable erosion-control practices are established and maintained, it is suited to small grains and to grasses and legumes for forage. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa and other deep-rooted crops. During years when rainfall is less than normal or when it is poorly distributed, crops and pasture are subject to damage from drought. This soil is also suited to pasture and to trees. Capability unit IVe–7; woodland group 3d9.

**Cincinnati silt loam, 12 to 18 percent slopes, severely eroded** (CnD3).—This soil is on hillsides and side slopes along natural draws. The hillsides range from less than 100 feet to more than 300 feet in length. Areas range from 5 to more than 30 acres in size. This soil has a profile similar to that described as representative of the series, but erosion has removed most of the surface layer and, in places, part of the subsoil. The fragipan also is not as well developed and in places it is very thin or absent. The plow layer is mainly yellowish brown. It is not friable and is more difficult to prepare for a good seedbed than less eroded areas. Near some toe slopes there is an accumulation of soil material that eroded from the upper parts of slopes. In places the fragipan is exposed on the surface. On some hillsides there are small seepy areas where the fragipan is near the surface. A few areas are gullied. Included in mapping are some moderately steep areas and areas of Hickory soils.

Runoff is very rapid on this soil. The very slow permeability of the fragipan, moderate available water capacity, hazard of further erosion, and runoff are limitations to use and management. This soil is not suited to row crops but can be used for grasses and legumes for forage or for trees. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa and other deep-rooted plants. During years when rainfall is less than normal or when it is poorly distributed, crops and pasture are subject to damage from drought. Capability unit VIe–1; woodland group 3d9.

## Clermont Series

The Clermont series consists of deep, poorly drained, nearly level soils on uplands. These soils formed in about 2 to 3 feet of loess and in the underlying loamy glacial till. The native vegetation was mainly mixed water-tolerant hardwoods.

In a representative profile the surface layer is grayish-brown silt loam about 7 inches thick. The subsurface layer is light-gray, friable silt loam about 9 inches thick. The subsoil is about 127 inches thick. The upper 8 inches is mottled, gray and light brownish-gray, friable silt loam; the next 46 inches is mottled, gray, very firm silty clay loam; and the lower 73 inches is mottled, yellowish-brown, firm clay loam. The underlying material, to a depth of about 160 inches, is brown and yellowish-brown, firm loam.

Clermont soils are low in content of organic matter. Available water capacity is high and permeability is very slow. Runoff is very slow or is ponded. Depth to the seasonal high water table is 0 to 1 foot.

Representative profile of Clermont silt loam in a cultivated field about 364 feet east and 52 feet south of the northwest corner of SW¼ sec. 14, T. 8 N., R. 5 E.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam; weak, thin, platy structure; friable; neutral; abrupt, smooth boundary.

A2—7 to 16 inches, light-gray (10YR 7/2) silt loam; common, fine, distinct, yellowish-brown (10YR 5/6) and grayish-brown (2.5Y 5/2) mottles; weak, thick, platy structure; friable; common fine voids less than 1 millimeter in diameter; very strongly acid; clear, wavy boundary.

B2tg—16 to 24 inches, gray (10YR 6/1) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6), yellowish-brown (10YR 5/6), and grayish-brown (2.5Y 5/2) mottles; weak, coarse, subangular blocky structure; friable; discontinuous, thin, gray (10YR 6/1) clay films; light-gray (10YR 7/1) silt coatings on faces of some peds; very strongly acid; abrupt, irregular boundary.

Bx1g—24 to 35 inches, gray (10YR 6/1) light silty clay loam; medium, distinct, yellowish-brown (10YR 5/6), and strong-brown (7.5YR 5/6), and a few yellowish-red (5YR 5/6) mottles; strong, moderate, prismatic structure that parts to weak, thick, platy; very firm and about 40 percent of the horizon is brittle; gray (10YR 5/1) clay films 1 to 3 millimeters thick on faces of some prisms; tongues of light-gray (10YR 7/1) silt extend downward between prisms; few iron-manganese concretions and coatings on faces of peds; few sand grains and pebbles less than ¼-inch in diameter; very strongly acid; gradual, smooth boundary.

IIBx2g—35 to 70 inches, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) light silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; strong, medium, prismatic structure that parts to weak, thick, platy; very firm and about 55 percent of the horizon is brit-

tle; gray (10YR 5/1) clay films mainly on vertical faces of prisms; fine voids less than 1 millimeter in diameter lined with grayish-brown (10YR 5/2) clay films; few sand grains and small pebbles; few black (10YR 2/1) iron-manganese concretions and coatings; very strongly acid; gradual, smooth boundary.

IIB31—70 to 110 inches, yellowish-brown (10YR 5/4) light clay loam; many, medium, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; massive; very firm and about 40 percent of the horizon is brittle; gray (10YR 6/1) clay films on cleavage plains; few iron-manganese concretions and coatings on faces of some peds; common small rounded pebbles; medium acid; gradual, smooth boundary.

IIB32—110 to 143 inches, yellowish-brown (10YR 5/6), light brownish-gray (10YR 6/2), and strong-brown (7.5YR 5/6) clay loam; massive; firm; gray (N 5/0) clay films on cleavage plains; medium acid in upper part and moderately alkaline (calcareous) in lower part; gradual, smooth boundary.

IIC—143 to 160 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/6) loam; massive; very firm; moderately alkaline (calcareous) till; in the lower part the till is mainly gray (10YR 5/1) to dark gray (10YR 4/1).

The solum ranges from 96 to 144 inches in thickness. The loess ranges from 35 to 48 inches in thickness.

In the Ap horizon color ranges from grayish brown (10YR 5/2) to light brownish gray (10YR 6/2). Depending on the amount of lime applied, reaction ranges from strongly acid to neutral. In forested areas an A1 horizon of very dark brown (10YR 2/2) or very dark grayish-brown (10YR 3/2) silt loam is present. The A2 horizon ranges from gray (10YR 6/1) to light gray (10YR 7/2). A B1 horizon is present in places. The B2t horizon ranges from gray (N 6/0) to light gray (10YR 7/1) and from heavy silt loam to light silty clay loam. The Bx horizon ranges from gray (N 5/0) to gray (10YR 6/1) in the upper part and from gray (10YR 6/1) to yellowish brown (10YR 5/6) in the lower part. The Bx horizon is heavy silt loam, silty clay loam, or clay loam. The IIB32 horizon ranges from gray (10YR 6/1) to yellowish brown (10YR 5/6) and from loam to clay loam.

Clermont soils formed in similar material and are adjacent to Avonburg soils. They have drainage characteristics similar to those of Bonnie soils. Clermont soils are grayer in the upper part of the subsoil than Avonburg soils. They are on uplands whereas Bonnie soils are on bottom lands. Clermont soils have a higher clay content than Bonnie soils and have a subsoil that Bonnie soils do not have.

**Clermont silt loam** (0 to 2 percent slopes) (Cr).—This soil is on uplands on broad flats that range from one-eighth to more than 1 mile in width. Areas range from 20 to more than 640 acres in size. Included in mapping are a few small areas of Avonburg soils.

This soil tends to dry out slowly in spring, thus delaying tillage operations. Wetness on this soil is the major limitation to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and hay are the major crops. The soil is also suited to permanent pasture grasses and to trees that tolerate wetness. This soil tends to become cloddy if tilled when wet, thus making a good seedbed difficult to prepare. Capability unit IIIw–12; woodland group 2w11.

## Corydon Series

The Corydon series consists of shallow, well-drained, steep soils on uplands. These soils formed in clayey material weathered from limestone bedrock. Bedrock is at a depth of 10 to 20 inches. The native vegetation was mainly mixed drought-tolerant hardwoods.

In a representative profile the surface layer is dark-brown stony silt loam and silty clay loam about 7 inches thick. The subsoil is dark yellowish-brown and very dark grayish-brown, firm silty clay about 11 inches thick. The underlying limestone bedrock is at a depth of about 18 inches.

Corydon soils are high in content of organic matter. Available water capacity is low to very low and permeability is moderately slow. Runoff is very rapid.

Representative profile of Corydon stony silt loam, 25 to 40 percent slopes, in woods 728 feet south and 156 feet west of the northeast corner of SE¼ sec. 24, T. 10 N., R. 7 E.:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) stony silt loam; moderate, medium, granular structure; firm; many roots; neutral; abrupt, smooth boundary.

A12—3 to 7 inches, dark-brown (10YR 3/3) silty clay loam; moderate, medium, granular structure; firm; neutral; clear, smooth boundary.

B21t—7 to 15 inches, dark yellowish-brown (10YR 4/4) silty clay; moderate, fine, angular and subangular blocky structure; firm; dark-brown (10YR 4/3) clay films on faces of peds; few fine voids less than 1 millimeter in diameter that have dark-brown (10YR 4/3) linings; neutral; clear, smooth boundary.

B22t—15 to 18 inches, very dark grayish-brown (10YR 3/2) silty clay; moderate, fine, angular and subangular blocky structure; firm; few pieces of decomposing limestone; neutral; abrupt, irregular boundary.

R—18 inches, limestone bedrock that has solution channels and cracks filled with material similar to that of the B2 horizon.

The solum ranges from 10 to 20 inches in thickness. Depth to limestone bedrock ranges from 10 to 20 inches. The solum ranges from neutral to moderately alkaline.

In the A1 horizon color ranges from black (10YR 2/1) to dark brown (10YR 3/3). Diameter of stones on the surface ranges from 10 to 20 inches and these stones are 5 feet to more than 20 feet apart. The B horizon ranges from dark brown (10YR 4/3) to reddish brown (5YR 4/4) or yellowish red (5YR 5/6) and is silty clay or clay.

Corydon soils are adjacent to or near well-drained Milton soils. They are on landscapes similar to those Hennepin soils are on. Corydon soils have a thinner solum and are shallower over bedrock than Milton soils. They have a finer textured solum than Hennepin soils. Corydon soils overlie bedrock at a depth of 10 to 20 inches, whereas Hennepin soils overlie loam till at a depth of about 15 inches.

**Corydon stony silt loam, 25 to 40 percent slopes** (CyF).—This soil is on hillsides where streams have entrenched through areas of limestone bedrock. Outcroppings of limestone bedrock are common. In places stones about 10 to 20 inches in diameter are on the surface and range from 5 to 20 feet apart.

Included with this soil in mapping are a few small areas of colluvial soils that are more than 3 feet deep and areas of Miami and Milton soils. Also included are some Hennepin soils in a few places where the till is thick.

The low to very low available water capacity, shallow soil depth, stoniness, hazard of erosion, and runoff are limitations to use and management. This soil is

suited to trees and in places where it can be cultivated or tilled it is suited to early spring pasture. Capability unit VIIe–2; woodland group 3d7.

## Crosby Series

The Crosby series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils formed in loess less than 18 inches thick and in the underlying loamy glacial till. The native vegetation was mixed water-tolerant hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 10 inches thick. The subsoil is about 20 inches thick. The upper 4 inches is mottled, grayish-brown, firm silt loam; the next 10 inches is mottled, grayish-brown, firm clay loam; and the lower 6 inches is mottled, brown, firm clay loam. The underlying material, to a depth of 60 inches, is brown and yellowish-brown, friable to firm loam.

Crosby soils have a moderate content of organic matter. Available water capacity is high and permeability is slow. The seasonal high water table is at a depth of 1 to 3 feet.

Representative profile of Crosby silt loam, 0 to 2 percent slopes, in a cultivated field 50 feet east and 20 feet south of the northwest corner of SW¼ sec. 1, T. 10 N., R. 6 E.:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; few black (10YR 2/1) iron-manganese concretions; neutral; abrupt, smooth boundary.

B1t—10 to 14 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, yellowish-brown (10YR 5/4, 5/6) mottles; weak, medium, subangular blocky structure; firm; patchy gray (10YR 5/1) clay films on faces of some peds; neutral; clear, wavy boundary.

IIB21t—14 to 24 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) and brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; firm; continuous gray (10YR 5/1) clay films on faces of peds; few black (10YR 2/1) iron-manganese concretions; few pebbles; medium acid; clear, wavy boundary.

IIB22t—24 to 30 inches, brown (10YR 5/3) clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) and grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure; firm; continuous gray (10YR 5/1) clay films on faces of peds; few black (10YR 2/1) iron-manganese concretions; about 5 percent pebbles; slightly acid; clear, wavy boundary.

IIC—30 to 60 inches, brown (10YR 5/3), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/6) loam till; massive; friable; about 5 percent pebbles; moderately alkaline (calcareous).

The solum ranges from 26 to 40 inches in thickness. The loess is less than 18 inches thick. Depth to carbonates ranges from 22 to 40 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). The A1 horizon, in uncultivated areas, is thin very dark gray (10YR 3/1) or very dark grayish-brown (10YR 3/2) silt loam. In places an A2 horizon is present. The B2 horizon ranges from clay loam to silty clay loam. It averages more than 35 percent clay. This horizon is grayish brown (10YR 5/2) to dark yellowish brown (10YR 5/6) and has mottles associated with wetness.

Crosby soils have positions in the landscape and drainage characteristics similar to those of Fincastle and Ayrshire soils. They have a thinner solum than Fincastle soils. Crosby soils have a thinner solum and contain less sand throughout than Ayrshire soils.

**Crosby silt loam, 0 to 2 percent slopes** (CzA).—This soil is on uplands on broad flats and ridgetops. Areas range from 3 to more than 400 acres in size and in places are more than one-half mile wide. This soil has the profile described as representative of the series.

Included with this soil in mapping are small gently sloping areas and a few moderately sloping areas. Some of these knolls are shown on the map by a special symbol. They are mainly Celina and Miami soils. Also included are long narrow areas of Brookston soils.

Runoff is slow on this soil, and wetness is the major limitation to use and management. If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIw–2; woodland group 3w5.

**Crosby silt loam, 2 to 4 percent slopes, eroded** (CzB2).—This soil is on the upper ends of drainageways, on low knolls and ridges, and on broad ridgetops. Areas range from 3 to 15 acres in size and from less than 200 feet to more than one-eighth mile in width. This soil has a profile similar to that described as representative of the series, but about 4 to 6 inches of the surface layer has eroded away. In places a moderate amount of material from the subsoil is mixed in with that of the surface layer. Included in mapping are small areas that are severely eroded and a few small areas that are moderately well drained.

Runoff is medium on this soil. Wetness is the major limitation, but the hazard of further erosion is also a limitation to use and management. If a suitable drainage system is established and maintained, and if erosion-control practices are used, this soil is suited to most crops commonly grown in the county. The main crops are corn and soybeans. This soil is also suitable for grasses and legumes for forage and for trees that tolerate wetness. Capability unit IIe–12; woodland group 3w5.

## Dubois Series

The Dubois series consists of deep, somewhat poorly drained, nearly level soils on terraces. These soils formed in about 2 to 4 feet of loess and the underlying lacustrine deposits. They have a very firm and brittle fragipan at a depth of about 2 to 3 feet. The native vegetation was mixed water-tolerant hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsurface layer is light brownish-gray, friable silt loam about 4 inches thick. The subsoil is about 50 inches thick. The upper 6 inches is mottled, yellowish-brown, friable silt loam; the next 5 inches is mottled, light brownish-gray, firm silty clay loam; and the next 39 inches is a very firm, silty clay loam fragipan that is mottled, pale brown in the upper part and yellowish brown in the lower part. The underlying material, to a depth of about 150 inches, is yellowish-brown, light-

gray, grayish-brown, and gray stratified silty clay loam, silt loam, silt, and fine sand.

Dubois soils are low in content or organic matter. Available water capacity is moderate and permeability in the fragipan is very slow. Runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Dubois silt loam in a cultivated field about 360 feet west and 600 feet north of the southeast corner of SW¼ sec. 1, T. 7 N., R. 4 E.:

Ap—0 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; few, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A2—12 to 16 inches, light brownish-gray (10YR 6/2) silt loam; common, medium, distinct, yellowish-brown (10YR 5/6) and dark-red (2.5YR 3/6) mottles; weak, thick, platy structure; friable; few small black (10YR 2/1) iron-manganese concretions; common fine pores less than 1 millimeter in diameter; neutral; clear, irregular boundary.

B1—16 to 22 inches, yellowish-brown (10YR 5/4) silt loam; many, medium, distinct, gray (10YR 6/1) and yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; few black (10YR 2/1) iron-manganese concretions; very strongly acid; clear, wavy boundary.

B2t—22 to 27 inches, light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6, 5/8) mottles; moderate, fine, prismatic structure that parts to moderate, medium, subangular blocky; firm; few very fine pores less than 1 millimeter in diameter in ped interiors; continuous gray (10YR 5/1) clay films on faces of peds and linings of pores; light-gray (10YR 7/1) and white (10YR 8/1) silt coatings on faces of peds; very strongly acid; clear, wavy boundary.

IIBx1—27 to 43 inches, pale-brown (10YR 6/3) silty clay loam; many, medium, distinct, light-gray (10YR 7/2) and yellowish-brown (10YR 5/6) mottles; moderate, very coarse, prismatic structure that parts to weak, coarse, platy; very firm and brittle; thick light brownish-gray (10YR 6/2) clay films on faces of prisms; light-gray (10YR 7/2) silt coatings on faces of prisms; very strongly acid; clear, wavy boundary.

IIBx2—43 to 66 inches, yellowish-brown (10YR 5/6) silty clay loam; many, medium, distinct, white (10YR 8/1), dark-red (2.5YR 3/6), and strong-brown (7.5YR 5/8) mottles; strong, very coarse, prismatic structure that parts to moderate, thick, platy; firm; discontinuous, thick, gray (10YR 5/1) clay films mainly on faces of prisms; light-gray (10YR 7/2) silt coatings on faces of prisms; very strongly acid; gradual, smooth boundary.

IIC—66 to 150 inches, variegated yellowish-brown (10YR 5/4, 5/6), light-gray (10YR 7/2, 7/1), dark grayish-brown (2.5Y 4/2), and gray (N 5/0) stratified silty clay loam, silt loam, silt, and fine sand that has minor amounts of coarse sand; medium acid in upper part and neutral below a depth of 100 inches.

The solum ranges from 60 to 80 inches in thickness. Depth to the fragipan ranges from 23 to 35 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). Depending on the amount of lime applied, the Ap horizon ranges from strongly acid to neutral. The A2 horizon ranges from gray (10YR 5/1) to light brownish gray (10YR 6/2). A B1 horizon is not present in places. The B2t horizon ranges from light brownish gray (10YR 6/2) to grayish brown (10YR 5/2) and yellowish brown (10YR 5/4). The fragipan ranges from gray (10YR 5/1) to brownish yellow (10YR 6/6).

Dubois soils are in positions on the landscape similar to those that Peoga and Bartle soils are on. Dubois soils have a finer textured subsoil and a finer textured fragipan than Bartle soils. They are not so gray in the upper part of the solum as Peoga soils and they contain a fragipan that Peoga soils do not have.

**Dubois silt loam** (0 to 2 percent slopes) (Du).—This soil is on wide, broad, nearly flat terraces (fig. 14). Areas range from 15 to more than 100 acres in size and in places are ¼ to ½ mile wide or wider.

Included with this soil in mapping are small areas of poorly drained soils and a few small areas of moderately well drained soils. Also included are small areas of gently sloping soils, mainly on toe slopes of the adjoining upland areas, and on breaks around the perimeter of nearly level areas.

Runoff is slow on this soil and wetness is the main limitation to use and management. If an adequate drainage system is established and maintained, this soil is suited to corn, soybeans, and small grain. It is also suited to pasture and to trees. Capability unit IIw–3; woodland group 3w5.

## Eel Series

The Eel series consists of deep, moderately well drained, nearly level soils on bottom lands. These soils formed in loamy, mildly alkaline (calcareous) alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The underlying material is about 52 inches thick. The upper 11 inches is yellowish-brown, friable silt loam; the next 15 inches is mottled, grayish-brown, friable loam; and the lower 26 inches is mottled, light brownish-gray, friable loam.

Eel soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding, mainly in winter or early in spring, but also occasionally during the growing season. The seasonal high water table is at a depth of 3 to 6 feet. Runoff is slow.

Representative profile of Eel silt loam in a cultivated field 20 feet east and 104 feet south of the northwest corner of NE¼SE¼ sec. 3, T. 8 N., R. 6 E.:

Ap–0 to 8 inches, brown (10YR 5/3) silt loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

C1—8 to 16 inches, yellowish-brown (10YR 5/4) silt loam; moderate, medium, granular structure; friable; some dark-brown (10YR 4/3) organic coatings on peds; thin strata of sand; neutral; clear, smooth boundary.

C2—16 to 19 inches, yellowish-brown (10YR 5/4) silt loam; few, medium, faint, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; friable; few sand grains; neutral; clear, smooth boundary.

C3—19 to 34 inches, grayish-brown (10YR 5/2) loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) and brown (10YR 5/3) mottles; weak, coarse, subangular blocky structure; friable; thin strata of sand and silt; neutral; clear, smooth boundary.

C4—34 to 60 inches, light brownish-gray (10YR 6/2) loam; many, medium, distinct, yellowish-brown (10YR 5/4, 5/8) mottles; massive; friable; moderately alkaline (calcareous).

*Figure 14.*—**Broad, flat terrace of Dubois silt loam. Cincinnati silt loam, 6 to 12 percent slopes, eroded, is on uplands in the background.**

Depth to the C4 horizon ranges from 26 to 40 inches. The depth to mottlings associated with wetness ranges from 16 to 24 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). Reaction in this horizon is neutral or slightly acid. The C1 and C2 horizons are dark-brown (10YR 4/3) to yellowish-brown (10YR 5/4) silt loam, loam, light clay loam, or heavy sandy loam. Reaction is neutral to moderately alkaline.

Eel soils formed in material similar to what the moderately well drained Medway and somewhat poorly drained Shoals soils formed in, and they are in similar positions on the landscape. They have similar drainage characteristics but have a lighter colored surface layer and have less clay in the surface layer than Medway soils. Eel soils are not so gray as Shoals soils in the upper part.

**Eel silt loam** (0 to 2 percent slopes) (Ee).—This soil is on flat bottom lands and in long, narrow channels that meander through areas of Genesee soils. Areas of this soil range from 15 to more than 60 acres in size and from 200 feet to more than one-eighth mile in width. In a few areas the surface layer is loam, and in places there is a thin deposit of sandy loam overwash. Included in mapping are small areas of somewhat poorly drained Shoals and areas of well-drained Genesee soils.

Flooding is the major hazard, and moderate wetness is the major limitation to the use and management of this soil. This soil is suited to most crops commonly grown in the county. The main crops are corn and soybeans. Winter wheat is subject to flood damage in winter and early in spring. This soil is also suitable for grasses and legumes for forage and for trees. Capability unit I–2; woodland group 1o8.

## Fincastle Series

The Fincastle series consists of deep, somewhat poorly drained, nearly level or gently sloping soils on uplands. These soils formed in about 2 to 3 feet of loess and the underlying loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsurface layer is grayish-brown, friable silt loam about 5 inches thick. The subsoil is about 35 inches thick. The upper 11 inches is grayish-brown, firm silty clay loam and the lower 24 inches is mottled, brown, firm clay loam. The underlying material, to a depth of 60 inches, is brown and yellowish-brown, friable to firm loam.

Fincastle soils are moderate in content of organic matter. Available water capacity is high and permea-

bility is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Fincastle silt loam, 0 to 2 percent slopes, 40 feet south and 50 feet west of the northeast corner of SE¼NE¼ sec. 13, T. 9 N., R. 7 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable; few black (10YR 2/1) iron-manganese concretions; neutral; abrupt, smooth boundary.

A2—8 to 13 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, yellowish-brown (10YR 5/4) and brown (10YR 5/3) mottles; weak, thin, platy structure; friable; few dark grayish-brown (10YR 4/2) worm casts; few worm holes; few black (10YR 2/1) iron-manganese concretions; neutral; clear, smooth boundary.

B21t—13 to 24 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) and brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; firm; continuous dark grayish-brown (10YR 4/2) clay films on faces of peds; few black (10YR 2/1) iron-manganese concretions; medium acid; clear, smooth boundary.

IIB22t—24 to 39 inches, brown (10YR 5/3) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; continuous grayish-brown (10YR 5/2) clay films on faces of peds; few black (10YR 2/1) iron-manganese concretions; medium acid; clear, wavy boundary.

IIB3t—39 to 48 inches, brown (10YR 5/3) light clay loam; many, medium, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; discontinuous grayish-brown (10YR 5/2) clay films on faces of peds; few black (10YR 2/1) iron-manganese concretions; medium acid; clear, wavy boundary.

IIC—48 to 60 inches, brown (10YR 5/3), yellowish-brown (10YR 5/6), and grayish-brown (10YR 5/2) loam till; massive; friable in the upper part and firm below a depth of 50 inches; few white accumulations of lime in fine, soft, rounded masses in upper part; grayish-brown (10YR 5/2) clay films in a few vertical cleavage planes; moderately alkaline (calcareous).

The solum ranges from 42 to 70 inches in thickness. Thickness of the loess ranges from 20 to 40 inches, but is mainly 24 to 28 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to light brownish gray (10YR 6/2). The A2 horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). A B1 horizon is present in places. The B2 horizon ranges from grayish brown (10YR 5/2) to yellowish brown (10YR 5/4). The lower part of the B2 horizon is clay loam or silty clay loam that commonly is more than 15 to 20 percent sand. The B3 horizon ranges from grayish brown (10YR 5/2) to yellowish brown (10YR 5/4).

Fincastle soils have drainage characteristics and positions on the landscape similar to those of Crosby soils, and are adjacent to or near the moderately well drained Xenia soils. Fincastle soils are deeper to carbonates than Crosby soils. They formed from material similar to Xenia soils, but have a grayer B21t horizon or contain more gray mottles than Xenia soils.

**Fincastle silt loam, 0 to 2 percent slopes** (FcA).—This soil is on uplands on broad flats and ridgetops. Areas of this soil range from 3 to more than 160 acres in size and in places are more than one-half mile wide. This soil has the profile described as representative of the series.

Included with this soil in mapping are small gently sloping areas and a few areas that are moderately sloping. These knolls are mainly Xenia, Russell, and Miami soils. Also included are long narrow areas of Brookston soils.

Runoff is slow on this soil and wetness is the major limitation to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIw–2; woodland group 3w5.

**Fincastle silt loam, 2 to 4 percent slopes, eroded** (FcB2).—This soil is along the upper ends of natural drainageways, on low knolls and ridges, and on broad ridgetops. Areas range from 4 to more than 20 acres in size and from 200 feet to about one-eighth mile in length. This soil has a profile similar to that described as representative of the series, but 4 to 6 inches of the surface layer has been removed through erosion and in places a moderate amount of the subsoil is mixed with the surface layer.

Included with this soil in mapping are small areas that are severely eroded. Also included are a few small areas of Xenia soils.

Runoff is medium on this soil. Wetness is the major limitation but the hazard of further erosion is also a limitation to use and management. If a suitable drainage system is established and maintained and if erosion-control practices are used, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. This soil is also suited to permanent pasture grasses and to trees that tolerate wetness. Capability unit IIe–12; woodland group 3w5.

## Fox Series

The Fox series consists of moderately deep, well-drained, nearly level to moderately sloping soils on terraces. These soils formed in loamy glacial outwash and overlie stratified, loose, moderately alkaline (calcareous) sand and gravel at a depth of 24 to 40 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown loam about 8 inches thick. The subsoil is about 25 inches thick. The upper 4 inches is dark-brown, friable loam; the next 10 inches is dark-brown, firm clay loam; and the lower 11 inches is dark-brown, firm gravelly clay loam. The underlying material, to a depth of about 60 inches, is yellowish-brown, loose, stratified gravel and sand.

Fox soils are moderate in content of organic matter. Available water capacity is low to moderate and permeability is moderate.

Representative profile of Fox loam, 0 to 2 percent slopes, in a cultivated field about 80 feet west and 80 feet north of the southeast corner of NW¼NE¼ sec. 35, T. 10 N., R. 5 E.:

Ap—0 to 8 inches, dark-brown (10YR 4/3) rubbed, loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

B1—8 to 12 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable;

patchy dark yellowish-brown (10YR 4/4) clay films on faces of some peds; neutral; clear, smooth boundary.

B21t—12 to 22 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; continuous dark-brown (7.5YR 4/4) clay films on faces of peds; few ½- to 1-inch pebbles; medium acid; clear, smooth boundary.

B22t—22 to 30 inches, dark-brown (7.5YR 4/4) gravelly clay loam; moderate, coarse, subangular blocky structure; firm; reddish-brown (5YR 4/4) clay films on faces of peds; medium acid; clear, wavy boundary.

B23t—30 to 33 inches, dark-brown (7.5YR 3/2) gravelly clay loam; weak, coarse, subangular blocky structure; firm; dark-brown (7.5YR 3/2) clay bridging sand grains; neutral; abrupt, irregular boundary.

C—33 to 60 inches, yellowish-brown (10YR 5/4) gravel and sand; single grained; loose; moderately alkaline (calcareous).

The solum ranges from 24 to 40 inches in thickness. Depth to loose sand and gravel ranges from 24 to 40 inches.

In the Ap horizon color ranges from dark brown (10YR 4/3) to brown (10YR 5/3). An A2 horizon of brown (10YR 5/3) loam is present in places. A B1 horizon is not present in places. The B2t horizon ranges from reddish brown (5YR 4/4) to dark yellowish brown (10YR 4/4) and from sandy clay loam to gravelly clay loam. A B3 horizon of dark-brown (7.5YR 4/4) loam or gravelly loam is present in places. Tongues of the subsoil extend into the underlying gravel and sand at a depth of 4 to 30 inches and range from 2 feet to more than 10 feet apart.

Fox soils formed from similar material and are in positions on the landscape similar to those of Nineveh and Ockley soils. Fox soils are similar in thickness, but have a lighter colored surface layer and a more acid B horizon than Nineveh soils. They have a thinner solum than Ockley soils. Fox soils are adjacent to or near Rodman soils, but have a thicker solum and contain more clay in the B2 horizon than Rodman soils.

**Fox loam, 0 to 2 percent slopes** (FoA).—This soil is on broad flat terraces (fig. 15) and on bench-like terraces along the major streams. This soil has the profile described as representative of the series. Areas range from 5 to more than 640 acres in size and from 200 feet to more than 1 mile in width.

Included with this soil in mapping are a few small areas of gently sloping soils and small areas that have a gravelly loam surface layer. Where this soil joins the Nineveh soils the subsoil is less acid. Included in narrow, long, old meander channels are areas of somewhat poorly drained and poorly drained soils. Also included are a few small areas of Ockley soils.

Runoff is slow on this soil. The moderate available water capacity is the major limitation to use and management. This soil is suited to most crops commonly grown in the county. Grain sorghum, corn, wheat, and

*Figure 15.*—**Large area of Fox loam, 0 to 2 percent slopes. Fall-seeded winter wheat is in the foreground. A housing area is in the background.**

alfalfa are the major crops. The soil is also suited to grasses and legumes for forage and to trees. In years when rainfall is below average or poorly distributed, crops grown on this soil are subject to damage by drought. This soil is also suitable for irrigation. Capability unit IIs–1; woodland group 1o1.

**Fox loam, 2 to 6 percent slopes, eroded** (FoB2).—This soil is on narrow, long areas along old stream meanders and on narrow long ridges on terraces. Areas range from 3 to 25 acres in size and from less than 100 to more than 300 feet in width. This soil has a profile similar to that described as representative of the series, but 4 to 8 inches of the surface layer has been removed through erosion. The surface layer consists of a mixture of a moderate amount of dark-brown loam and clay loam subsoil mixed with the remaining loam surface layer. In places there are small severely eroded areas where the dark-brown clay loam subsoil is exposed. Some of these areas are indicated on the map by an eroded symbol. In places are small areas that have a gravelly loam surface layer. Included in the bottom of old meander channels are narrow areas of somewhat poorly drained and poorly drained soils.

Runoff is moderate on this soil. The moderate available water capacity is the major limitation, but the major hazard of further erosion is also a limitation to use and management. This soil is suited to most crops commonly grown in the county. Grain sorghum, corn, wheat, and alfalfa are the major crops. The soil is also suited to grasses and legumes for forage and to trees. In years when rainfall is below average or poorly distributed, crops are subject to damage by drought. This soil is suitable for irrigation. Capability unit IIe–9; woodland group 1o1.

**Fox complex, 6 to 12 percent slopes, severely eroded** (FxC3).—These soils are on narrow long breaks around nearly level areas and on side slopes along natural drainageways on terraces. Areas range from 5 to more than 30 acres in size and from less than 100 to more than 300 feet in width. About 40 percent of this mapping unit has a profile similar to that described as representative of the series, but most of the surface soil and part of the subsoil have been removed through erosion. Also, the surface layer is mainly dark-brown clay loam and the depth to the underlying loose gravel and sand is mainly 24 to 30 inches. In about 15 percent of this mapping unit, generally near the center of the slopes, depth to loose gravel and sand is less than 18 inches. In places the loose sand and gravel is exposed on the surface. About 15 percent of this mapping unit is an accumulation of gravelly loam and loam material that was eroded from the upper slopes and deposited near the base of these slopes. About 30 percent of this mapping unit is some Fox soils that are not severely eroded and some that are strongly sloping.

Runoff is rapid on this soil. The low to moderate available water capacity is the major limitation, but the hazard of further erosion and runoff are also limitations to use and management. In areas where the depth to loose gravel is less than 24 inches, the available water capacity is low. This soil has limited suitability for row crops. It is suited to small grains, pasture grasses, and trees. If row crops are grown, such drought-tolerant crops as grain sorghum are better adapted than corn. If the soil is cultivated intensively, erosion-control practices are needed. In years when rainfall is below average or poorly distributed, crops are subject to damage by drought. Capability unit IVe–9; woodland group 1o1.

## Genesee Series

The Genesee series consists of deep, well-drained, nearly level soils on bottom lands. These soils formed in loamy alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown loam about 8 inches thick. The underlying layer is 52 inches thick. The upper 32 inches is dark-brown, friable loam and the lower 20 inches is brown stratified loam, silt loam, and fine sand.

Genesee soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding, mainly in winter or early in spring, but occasionally a damaging overflow occurs during the growing season. Runoff is slow.

Representative profile of Genesee loam in a cultivated field 660 feet south and 660 feet west of the northeast corner of SW¼ sec. 25, T. 9 N., R. 5 E.:

Ap—0 to 8 inches, dark-brown (10YR 4/3) loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

C1—8 to 16 inches, dark-brown (10YR 4/3) loam; moderate, medium, granular structure; friable; neutral; clear, smooth boundary.

C2—16 to 40 inches, dark-brown (10YR 4/3) loam; weak, moderate, subangular blocky structure; friable; thin lenses of sand and silt; moderately alkaline (calcareous); clear, smooth boundary.

C3—40 to 60 inches, brown (10YR 5/3) stratified loam, silt loam, and fine sand; massive; friable; moderately alkaline (calcareous).

Reaction in the Ap and C1 horizons ranges from slightly acid to neutral and in the C2 and C3 horizons from mildly alkaline to moderately alkaline (calcareous). The Ap horizon ranges from dark-brown (10YR 4/3) to dark yellowish-brown (10YR 4/4) loam. The C1 horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4) and is loam or light clay loam that contains small amounts of sandy loam or silt loam. The C2 horizon ranges from clay loam to sandy loam. Loose sand and gravel are below a depth of 40 inches in places.

Genesee soils are in similar positions on the landscape and are adjacent to or near Ross and Stonelick soils. They have a thinner, lighter colored surface layer than Ross soils. Genesee soils have less sand in the upper part of their profile than Stonelick soils.

**Genesee loam** (0 to 2 percent slopes) (Ge).—This soil is on broad flat bottom lands and narrow long bottoms that extend up the valleys between areas of uplands. Areas of this soil range from 10 to more than 640 acres in size and from 200 feet to more than three-fourths mile in width. A few small areas have a silt loam surface layer, and in places there is a thin deposit of sandy loam overwash. Along the Driftwood River, Flatrock River, and East Fork of the White River are some soils that are calcareous throughout. In some of the narrow bottoms near Hartsville, lime-

stone bedrock is at a depth of 20 to 40 inches. Included in mapping are a few small areas of somewhat poorly drained Shoals soils in narrow, long meander channels.

Flooding on this soil is the major hazard to use and management. This soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to damage by winter and early spring overflow. This soil is also suited to grasses and legumes for forage and to trees. Capability unit I–2; woodland group 1o8.

## Gilpin Series

The Gilpin series consists of moderately deep, well-drained, strongly sloping and moderately steep soils on uplands. These soils formed in thin loess and the underlying material that weathered from stratified shale and sandstone. Bedrock is at a depth of 20 to 40 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 4 inches thick. The subsoil is about 29 inches thick. The upper 6 inches is yellowish-brown, friable silt loam and the lower 23 inches is yellowish-brown, firm silty clay loam. The next layer is olive, light olive-gray, and light olive-brown, firm silty clay about 5 inches thick. The underlying bedrock of interbedded standstone and shale is at a depth of about 40 inches.

Gilpin soils are low in content of organic matter. Available water capacity and permeability are moderate.

Representative profile of Gilpin silt loam, 12 to 18 percent slopes, eroded, in woods about 110 feet west and 260 feet north of the southeast corner of NW¼NW¼ sec. 36, T. 9 N., R. 4 E.:

O—½ inch to 0, leaf litter.
A1—0 to 2 inches, dark-brown (10YR 3/3) silt loam; moderate, fine, granular structure; friable; very strongly acid; abrupt, smooth boundary.
A2—2 to 6 inches, brown (10YR 5/3) silt loam, yellowish brown (10YR 5/4) crushed; moderate, medium, granular structure; friable; extremely acid; clear, smooth boundary.
B21t—6 to 12 inches, yellowish-brown (10YR 5/6) heavy silt loam; weak, fine, subangular blocky structure; friable; extremely acid; clear, wavy boundary.
B22t—12 to 22 inches, yellowish-brown (10YR 5/6) light silty clay loam; moderate, medium, subangular blocky structure; firm; about 15 percent sandstone rock fragments; thin, discontinuous, strong-brown (7.5YR 5/6) clay films on faces of peds; extremely acid; clear, wavy boundary.
B23t—22 to 35 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm; thin, discontinuous, strong-brown (7.5YR 5/6) clay films on faces of peds; common, medium, distinct, light brownish-gray (2.5Y 6/2) mottles and some films (mottles are interpreted to be inherited or relic); about 10 percent sandstone rock fragments; very strongly acid; clear, wavy boundary.
C1—35 to 40 inches, olive (5Y 5/3), light olive-gray (5Y 6/2), and light olive-brown (2.5Y 5/4) light silty clay; weak, medium, angular blocky structure; firm; very strongly acid; abrupt, wavy boundary.
C2—40 inches, interbedded fractured sandstone and shale bedrock.

The solum ranges from 20 to 36 inches in thickness. Depth to bedrock is 20 to 40 inches.

In the A1 horizon color ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2). The Ap horizon, in cultivated areas, ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). In some places an A2 horizon is not present and in some places a B1 horizon is present. The B2 horizon ranges from yellowish brown (10YR 5/4) to strong brown (7.5YR 5/6). It is shaly silt loam, silt loam, silty clay loam, or clay loam that is from 5 to 40 percent fragments of shale or sandstone.

Gilpin soils have similar drainage characteristics to Zanesville and Berks soils and are adjacent to or near those soils. Gilpin soils are shallower to bedrock and do not have the fragipan of Zanesville soils. They have a finer B2 horizon and a lower content of sandstone and shale fragments than Berks soils.

**Gilpin silt loam, 12 to 18 percent slopes, eroded** (GpD2).—This soil is on hillsides, side slopes along natural draws, and narrow long ridges extending between steep and very steep areas of Berks and Weikert soils. Areas range from 15 to more than 60 acres in size. This soil, in wooded areas, has the profile described as representative of the series. In cultivated areas the plow layer consists mainly of a mixture of the surface layer and a moderate amount of yellowish-brown subsoil. In a few places are small areas of soils that have a very slowly permeable fragipan.

Included with this soil in mapping are areas of Berks and Zanesville soils. Also included are small severely eroded areas and small moderately steep areas.

Runoff is rapid on this soil. The low to moderate available water capacity is the major limitation, but runoff and the hazard of further erosion are also limitations to use and management. This soil is not suited to row crops. It is suited to permanent pasture grasses and to trees. Capability unit VIe–1; woodland group 3o10.

**Gilpin silt loam, 12 to 18 percent slopes, severely eroded** (GpD3).—This soil is on hillsides and side slopes along natural draws. Areas range from 5 to 20 acres in size. Slopes range from about 100 to 300 feet in length. This soil has a profile similar to that described as representative of the series, but most of the surface layer and part of the subsoil have been removed through erosion. The surface layer consists mainly of yellowish-brown subsoil material. The depth to underlying bedrock generally is 20 to 30 inches, but in a few included areas it is less than 20 inches. A few areas are gullied. Included in mapping are a few deep gullies in the bottoms of which bedrock is exposed.

Runoff is very rapid on this soil. The low to moderate available water capacity is the major limitation, but runoff and the hazard of further erosion are also limitations to use and management. This soil is not suited to row crops. It is suited to permanent pasture grasses and to trees. Some areas that have been abandoned are mainly in povertygrass and broomsedge. Capability unit VIIe–1; woodland group 3o10.

**Gilpin silt loam, 18 to 25 percent slopes** (GpE).—This soil is on hillsides, on side slopes along natural draws, and on long ridges that extend into areas of Berks and Weikert soils. Areas range from 10 to more than 60 acres in size. This soil has a profile similar to that described as representative of the series, but bedrock is at a depth of 20 to 30 inches. In places

the depth to bedrock is less than 20 inches and in a few places the subsoil is 25 to 30 percent fragments of sandstone and shale.

Included with this soil in mapping are a few small severely eroded areas, some of which are indicated on the map by severely eroded symbols. Also included are areas of Berks soils and a few steep areas.

Runoff is very rapid on this soil. The low to moderate available water capacity is the major limitation, but runoff and the hazard of further erosion are also limitations to use and managment. In areas where depth to bedrock is less than 20 inches, the available water capacity is low. This soil is suited to trees and to early spring pasture. Capability unit VIe–1; woodland group 3o10.

## Gullied Land

Gullied land (Gu) is on uplands and is moderately sloping to moderately steep. It consists of a series of gullies that have narrow ridges 3 to 50 feet wide between the gullies. Areas range from 5 to 30 acres in size. Areas of Gullied land associated with Cincinnati, Hickory, and Otwell soils overlie till or lakebed deposits. Areas associated with Zanesville, Gilpin, Rarden, and Berks soils overlie shale or sandstone at a depth of 3 to 6 feet. Runoff is very rapid. The gullies are 3 to 10 feet deep in areas that overlie friable till and are 2 to 5 feet deep in areas that overlie sandstone and shale.

This land type requires a cover of permanent vegetation. It is suited to trees, grasses, and shrubs. Some areas are suited to Christmas trees. Most areas have been abandoned. Weeds, grass, and a few trees are starting to grow. Some areas have been planted to trees. Runoff and erosion are major hazards. A cover of permanent vegetation helps to stabilize the soil material and control runoff and provides cover for wildlife. Most areas that have not been planted to grass or trees are actively eroding. Capability unit VIIe–1; woodland group 4r3.

## Haymond Series

The Haymond series consists of deep, well-drained, nearly level soils on bottom lands. These soils formed in silty medium acid or neutral alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 10 inches thick. The underlying material is about 50 inches thick. The upper 20 inches is yellowish-brown, friable silt loam and the lower 30 inches is brown, friable silt loam.

Haymond soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. These soils are subject to flooding in winter and early in spring, and less frequently during the growing season. Runoff is slow.

Representative profile of Haymond silt loam in a cultivated field about 150 feet east and 550 feet north of the southwest corner of SE¼SW¼ sec. 24, T. 9 N., R. 4 E.:

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

C1—10 to 30 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; friable; some thin depositional layers that have horizontal cleavage; slightly acid; clear, wavy boundary.

C2—30 to 60 inches, brown (10YR 5/3) silt loam; few, fine, faint, light brownish-gray (10YR 6/2) and dark-brown (7.5YR 4/4) mottles; massive; some horizontal cleavage planes between thin depositional layers; friable; slightly acid.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). Reaction in the C1 horizon ranges from medium acid to neutral. The C1 horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4).

Haymond soils formed in material similar to that of the moderately well drained Steff and Wilbur soils and are in similar positions on the landscape. They do not have the gray mottles in the subsoil that Wilbur and Steff soils have and are not as acid throughout as Steff soils.

**Haymond silt loam** (0 to 2 percent slopes) (Ha).—This soil is on long narrow bottom lands adjacent to stream channels. Areas generally range from 10 to 30 acres in size and from 100 to 400 feet in width. Included in mapping are soils that are strongly acid throughout. Also included are small areas of moderately well drained and somewhat poorly drained soils.

Flooding on this soil is the major hazard to use and management. This soil is suited to most crops commonly grown in the county. Corn and soybeans are the main crops. Fall-seeded small grain is subject to damage by flooding in winter and early in spring. This soil is also suited to permanent pasture grasses and to trees. Capability unit I–2; woodland group 1o8.

## Hennepin Series

The Hennepin series consists of deep, well-drained, moderately steep to very steep soils on uplands. These soils formed in loamy glacial till. The native vegetation was hardwoods.

In a representative profile the surface layer is dark grayish-brown loam about 5 inches thick. The subsoil is brown, friable loam about 7 inches thick. The underlying material, to a depth of about 60 inches, is brown, friable to firm loam.

Hennepin soils are moderate in content of organic matter. Available water capacity and permeability are moderate. Runoff is very rapid.

Representative profile of Hennepin loam, 18 to 40 percent slopes, in woods about 10 feet west and 210 feet north of the southeast corner of NE¼NW¼ sec. 5, T. 8 N., R. 7 E.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; few pebbles ¼ to ¾ inch in diameter; mildly alkaline; clear, smooth boundary.

B2—5 to 12 inches, brown (10YR 5/3) loam; moderate, coarse, granular structure; friable; very dark grayish-brown (10YR 3/2) organic coatings on faces of peds; few pebbles ¼ to ¾ inch in diameter; mildly alkaline (calcareous); clear, wavy boundary.

C—12 to 60 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/4) loam; massive; friable in upper 10 inches, massive below; few pebbles; few decompos-

ing rock fragments; moderately alkaline (calcareous).

The solum ranges from 10 to 20 inches in thickness. In the A horizon color is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). The B horizon is 4 to 12 inches thick and is loam or light clay loam. It is dark brown (10YR 4/3), dark yellowish brown (10YR 4/4), or brown (10YR 5/3). The C horizon is mainly loam but ranges from heavy sandy loam to clay loam.

Hennepin soils are in similar positions on the landscape to Rodman and Corydon soils. Hennepin soils have a finer textured solum and have less gravel than Rodman soils. They have less clay and have a deeper rooting zone than Corydon soils. Hennepin soils overlie till, whereas Rodman soils overlie loose gravel and sand and Corydon soils overlie limestone bedrock.

**Hennepin loam, 18 to 40 percent slopes** (HeF).—This soil is on side slopes along natural drainageways and on hillsides along major stream valleys. Areas range from 10 to more than 80 acres in size and from 200 to 500 feet in width.

Included with this soil in mapping, near Hartsville, are small areas of Corydon soils. In places there are small severely eroded areas. Small areas of Miami soils are near the crest of the slopes, and in places near the center of the slopes, calcareous loam till is exposed on the surface. Near the base of some of the slopes is an accumulation of colluvial material that is 30 to 40 inches thick. East of Clifty Creek, east of Columbus, small areas of Princeton and Bloomfield soils are on the crest of the slopes.

On this soil the moderate available water capacity is the major limitation but runoff and the hazard of erosion are also limitations to use and management. In areas of lesser slopes this soil is suited to permanent pasture. The soil is best suited to trees. Capability unit VIIe–1; woodland group 1r2.

## Henshaw Series

The Henshaw series consists of deep, somewhat poorly drained soils on terraces. These soils formed in silty, wind- and water-laid deposits and the underlying lacustrine deposits. The native vegetation was water-tolerant hardwoods.

In a representative profile the surface layer is grayish-brown silt loam about 10 inches thick. The subsurface layer is grayish-brown, friable silt loam about 3 inches thick. The subsoil is about 47 inches thick. The upper 4 inches is mottled, grayish-brown, firm silty clay loam; the next 35 inches is mottled, yellowish-brown, firm silty clay loam; and the lower 8 inches is grayish-brown, friable silt loam. The underlying material, to a depth of about 96 inches, is grayish-brown and brown, stratified silty clay loam, silt loam, and clay.

Henshaw soils are low in content of organic matter. Available water capacity is high and permeability is moderately slow. Runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Henshaw silt loam in a cultivated field about 50 feet west and 728 feet north of the southeast corner of SW¼ sec. 11, T. 8 N., R. 5 E.:

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

A2—10 to 13 inches, grayish-brown (10YR 5/2) silt loam; common, fine, distinct, yellowish-brown (10YR 5/4), gray (N 5/0), and dark yellowish-brown (10YR 4/4) mottles; moderate, medium, platy structure; friable; medium acid; abrupt, smooth boundary.

B21t—13 to 17 inches, grayish-brown (10YR 5/2) light silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, platy structure; friable; few voids less than 1 millimeter in diameter; thin, discontinuous, dark-gray (10YR 4/1) clay films; medium acid; gradual, smooth boundary.

IIB22t—17 to 33 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, dark grayish-brown (10YR 4/2) mottles; weak, medium, subangular blocky structure; firm; dark-gray (10YR 4/1) clay films; medium acid; gradual, smooth boundary.

IIB23t—33 to 52 inches, yellowish-brown (10YR 5/4) silty clay loam; many, medium, distinct, light brownish-gray (2.5Y 6/2), yellowish-brown (10YR 5/6), and grayish-brown (10YR 5/2) mottles; moderate, coarse, subangular blocky structure; firm; thin, continuous, grayish-brown (10YR 5/2) clay films on faces of peds and linings in fine voids; medium acid; gradual, smooth boundary.

IIB3t—52 to 60 inches, grayish-brown (10YR 5/2) silt loam; many, medium, distinct, yellowish-brown (10YR 5/8) and light brownish-gray (2.5Y 6/2) mottles; weak, coarse, subangular blocky structure; friable; thin, discontinuous, dark grayish-brown (10YR 4/2) clay films on faces of some peds and linings in fine voids 1 millimeter in diameter; neutral; abrupt, wavy boundary.

IIC1—60 to 96 inches, grayish-brown (10YR 5/2) and brown (10YR 5/3) stratified silty clay loam, silt loam, and clay; massive; firm; moderately alkaline (calcareous).

The solum ranges from 40 to 60 inches in thickness. Depth to carbonates is 40 to 60 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). In places no A2 horizon is present and in places no B1 horizon is present. The B2 horizon ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/6) and has mottles associated with wetness. The B3 horizon ranges from grayish brown (10YR 5/2) to yellowish brown (10YR 5/6). The C horizon ranges from stratified silt and silty clay loam to stratified silt, silty clay loam, silty clay, and clay.

Henshaw soils have similar drainage characteristics to Whitaker and McGary soils and are in similar positions on the landscape. Henshaw soils have a lower content of sand throughout the solum than Whitaker soils. They have a lower content of clay in the B2, B3, and C horizons than McGary soils.

**Henshaw silt loam** (0 to 2 percent slopes) (Hh).—This soil is on broad flats on terraces. Areas range from 10 to more than 80 acres in size and in places are more than one-fourth mile wide. In section 26, about 2 miles southwest of Columbus, is an area of this soil that has black shale bedrock at a depth of 5 to 8 feet. Included in mapping are small areas of poorly drained soils and small areas of gently sloping soils.

Wetness is the major limitation to use and management of this soil. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIw–2; woodland group 3w5.

## Hickory Series

The Hickory series consists of deep, well-drained, moderately sloping to very steep soils on uplands. These soils formed in thin loess and the underlying loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is very dark grayish-brown silt loam about 4 inches thick. The subsurface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 31 inches thick. The upper 10 inches is yellowish-brown, firm clay loam; the next 15 inches is dark-brown, firm clay loam; and the lower 6 inches is yellowish-brown, firm clay loam. The underlying material, to a depth of about 60 inches, is brown and yellowish-brown, very firm loam till.

Hickory soils are low in content of organic matter. Available water capacity is high and permeability is moderate.

Representative profile of Hickory silt loam, 18 to 25 percent slopes, in woods about 50 feet south and 572 feet east of the northwest corner of sec. 27, T. 9 N., R. 5 E.:

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) silt loam; strong, fine, granular structure; friable; few sand grains; many roots; neutral; abrupt, smooth boundary.

A12—2 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; strong, medium, granular structure; friable; few sand grains; medium acid; abrupt, smooth boundary.

A2—4 to 12 inches, brown (10YR 5/3) silt loam; weak, medium, platy structure that parts to moderate, medium, granular (lower 3 inches is fine, subangular blocky structure); friable; few to common sand grains; medium acid; clear, smooth boundary.

B1—12 to 16 inches, yellowish-brown (10YR 5/4) light clay loam; moderate, fine and medium, subangular blocky structure; friable; thin, discontinuous, dark-brown (10YR 4/3) clay films on faces of some peds; strongly acid; clear, smooth boundary.

IIB21t—16 to 22 inches, yellowish-brown (10YR 5/4) clay loam; strong, fine and medium, subangular and angular blocky structure; firm; thin, continuous, dark-brown (10YR 4/3) clay films on faces of peds; strongly acid; clear, smooth boundary.

IIB22t—22 to 37 inches, dark-brown (10YR 4/3) heavy clay loam; moderate, medium and coarse, subangular blocky structure; firm; thin, continuous, dark yellowish-brown (10YR 3/4) clay loam on faces of peds; strongly acid in the upper part, neutral in the lower part; clear, wavy boundary.

IIB3t—37 to 43 inches, yellowish-brown (10YR 5/6) clay loam; moderate, coarse, subangular blocky structure; firm; dark-brown (7.5YR 4/4) clay films mainly on vertical faces of peds; neutral; clear, discontinuous boundary.

IIC—43 to 60 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/4) very firm and compacted loam till; massive; moderately alkaline (calcareous).

The solum ranges from 42 to 72 inches in thickness. Thickness of loess is less than 20 inches. Depth to carbonates ranges from 42 to 72 inches.

In the A1 horizon color ranges from very dark brown (10YR 2/2) to dark grayish brown (10YR 4/2). In cultivated areas the Ap horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4). In places no A2 horizon is present. The B2 horizon ranges from dark brown (7.5YR 4/4) to yellowish brown (10YR 5/6). It is silty clay loam, clay loam, or heavy clay loam.

Hickory soils are on landscapes that are similar in shape to those the well-drained Cincinnati and Rarden soils are on. They have a thinner loess mantle and have carbonates at shallower depths than Cincinnati soils and they do not have the fragipan of Cincinnati soils. Hickory soils have a thicker solum and contain less clay in the B2 and B3 horizons than Rarden soils. Hickory soils overlie till, whereas Rarden soils overlie clay shale.

**Hickory silt loam, 6 to 12 percent slopes, eroded** (HkC2).—This soil is on ridgetops, hillsides, and side slopes along natural drainageways (fig. 16). Areas range from 5 to more than 30 acres in size and from about 200 feet to more than 600 feet in width. This soil has a profile similar to that described as representative of the series, but it has a thicker mantle of loess, a finer textured layer in the subsoil at a depth of about 2 feet, and a depth to calcareous till that is more than 60 inches. Included with this soil are areas where the loess mantle is about 2 feet thick. In some areas where the till is thin, no calcareous till is present between the subsoil and the underlying gray-green shale. Also included are areas near the base of some slopes where gray-green shale is at a depth of about 36 to 40 inches.

Included with this soil in mapping are some gently sloping and moderately sloping areas that have a loamy more friable subsoil and overlie stratified loamy material. Also included are severely eroded areas where the dark-brown silty clay loam subsoil is exposed on the surface. Some of these areas are indicated on the map by a severely eroded symbol.

Runoff is medium on this soil. Runoff and the hazard of further erosion are the major limitations to use and management. If erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. This soil is mainly used for pasture and trees. Lesser acreages are in crops. Capability unit IIIe–1; woodland group 1r2.

**Hickory silt loam, 12 to 18 percent slopes, eroded** (HkD2).—This soil is on ridgetops, hillsides, and side slopes along natural drainageways. Areas range from 2 to 20 acres in size. This soil has a profile similar to that described as representative of the series, but it has a thicker mantle of loess, a finer-textured layer in the subsoil at a depth of about 18 to 24 inches, and a depth to calcareous till that is more than 50 inches. Included are areas near the base of some slopes where gray-green shale is at a depth of about 30 to 40 inches.

Included with this soil in mapping are some areas where the till is thin and no calcareous till is between the subsoil and the underlying gray-green shale. Also included are small areas of soils that have a more friable subsoil and have stratified friable underlying materials.

Runoff is rapid on this soil. Runoff and the hazard of further erosion are major limitations to use and management. This soil has limited suitability for row crops. If adequate erosion-control practices are established and maintained, this soil is suited to small grain and hay crops. This soil is mainly used for permanent pasture and trees. Capability unit IVe–1; woodland group 1r2.

**Hickory silt loam, 18 to 25 percent slopes, eroded** (HkE2).—This soil is on hillsides, on side slopes along natural drainageways, and on long breaks along some

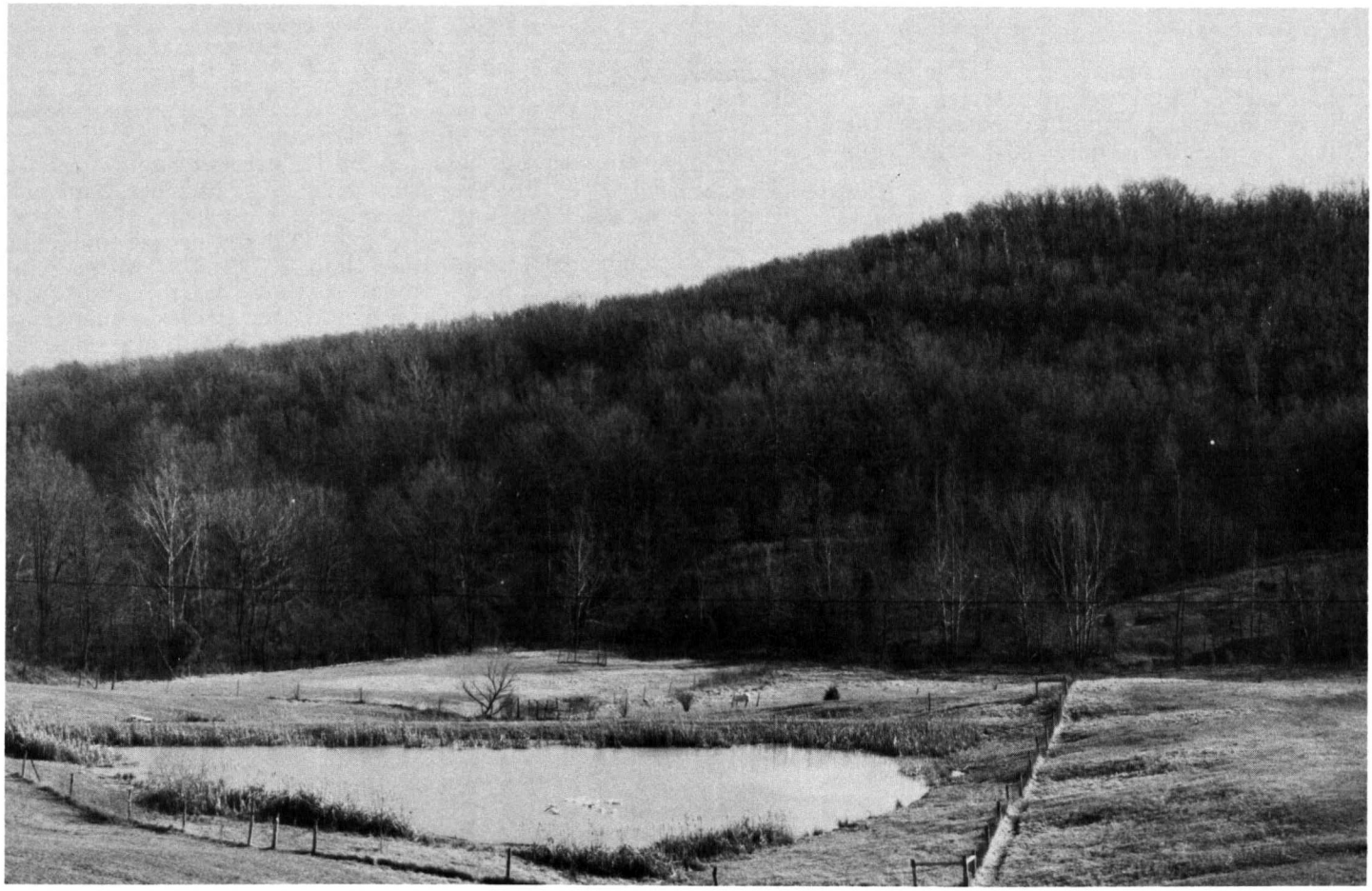

*Figure 16.*—**Area of Hickory silt loam, 6 to 12 percent slopes, eroded, in foreground around wildlife pond. Berks and Weikert soils, 25 to 50 percent slopes, are on the wooded hill in the background.**

of the major stream valleys that have entrenched into the till. Areas range from 10 to more than 100 acres in size. The length of the slope on the breaks is mainly 100 to 300 feet. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few severely eroded areas, some of which are indicated on the map by a severely eroded symbol. Also included are a few areas where the slope is more than 25 percent.

Runoff is rapid on this soil. Runoff and the hazard of further erosion are the major limitations to use and management. This soil is suited to permanent pasture and trees. Capability unit VIe–1; woodland group 1r2.

**Hickory silt loam, 25 to 50 percent slopes** (HkF).—This soil is on hillsides, on side slopes along drainageways, and on long breaks along some of the major stream valleys that have entrenched into the till. Areas range from 30 to more than 60 acres in size. The length of the breaks is mainly less than 300 feet.

Included with this soil in mapping are places mainly in the steeper areas that have a loam surface layer and the calcareous till is at a depth of 30 to 42 inches. Also included, in section 19 about 5 miles west of Columbus, and in sections 5 and 32 about 4 miles southwest of Taylorsville, are areas of soils that have a loam surface layer and a more friable subsoil, and that overlie stratified loamy and sandy material.

Runoff is very rapid on this soil. Runoff and the hazard of erosion are the major limitations to use and management. This soil is best suited to trees, and most areas are in woodland. Under good management, trees of good quality grow well. Improperly planned logging roads and trails can cause and increase erosion. Capability unit VIIe–1; woodland group 1r2.

**Hickory silty clay loam, 6 to 12 percent slopes, severely eroded** (HoC3).—This soil is on hillsides and on side slopes along natural drainageways. Areas range from 5 to more than 40 acres in size and from about 200 to 400 feet in width. This soil has a profile similar to that described as representative of the series, but it has a thicker mantle of loess, a finer-textured layer in the subsoil at a depth of about 20 to 24 inches, and a depth to calcareous till that is more than 55 inches. Also, the surface layer mainly consists of dark-brown silty clay loam. Included are areas near the base of some slopes, where gray-green shale is at a depth of about 30 to 40 inches.

Included with this soil in mapping are small less severely eroded areas. Also included are some areas where the till is thin and no calcareous till is between the subsoil and the underlying gray-green shale.

Runoff is rapid on this soil. Runoff and the hazard of further erosion are the major limitations to use and management. This soil has limited suitability for row crops. If adequate erosion-control practices are established and maintained, this soil is suited to small grain and hay crops. This soil is mainly used for pasture. Lesser acreages are in crops. Some areas are abandoned and are mainly in broomsedge and brush. Capability unit IVe–1; woodland group 1r2.

**Hickory silty clay loam, 12 to 18 percent slopes, severely eroded.** (HoD3).—This soil is on hillsides and side slopes along natural drainageways. Areas range from 5 to more than 40 acres in size. The soil has a profile similar to that described as representative of the series, but a finer-textured layer in the subsoil is at a depth of about 16 to 24 inches and the depth to calcareous till is more than 50 inches. Also, the surface layer mainly consists of dark-brown or strong-brown silty clay loam. Included are areas near the base of some slopes where gray-green shale is at a depth of less than 30 inches. In some areas, where the till is thin, no calcareous till is between the subsoil and the underlying gray-green shale.

Included with this soil in mapping are small less severely eroded areas. Also included are small areas of soils that have a more friable subsoil and have stratified friable underlying material.

Runoff is very rapid on this soil. Runoff and the hazard of further erosion are the major limitations to use and management. This soil is not suited to row crops, but it is suited to small grain and hay crops. It is suited to pasture and trees. This soil is mainly used for pasture or is abandoned and is in broomsedge and brush. Capability unit VIe–1; woodland group 1r2.

## Landes Series

The Landes series consists of moderately deep, well-drained soils on bottom lands. These soils formed in moderately coarse textured alluvium overlying loose sand and gravel at a depth of 24 to 40 inches. The native vegetation was mixed hardwoods and grasses.

In a representative profile the surface layer is gravelly sandy loam about 14 inches thick that is very dark grayish brown in the upper part and dark brown in the lower part. The subsoil is about 14 inches thick. The upper 9 inches is dark-brown sandy loam and the lower 5 inches is dark-brown gravelly loam. The underlying material, to a depth of about 60 inches, is yellowish-brown and pale-brown gravel and sand.

Landes soils are high in content of organic matter. Available water capacity is low to moderate and permeability is moderately rapid. The soils are subject to flooding mainly in winter or early in spring. Runoff is slow.

Representative profile of Landes gravelly sandy loam, gravelly substratum, in a cultivated field about 120 feet east and 265 feet north of the southwest corner of NE¼NE¼ sec. 11, T. 9 N., R. 5 E.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) gravelly sandy loam; weak, medium, granular structure; friable; few pebbles ½ to 1 inch in diameter; few worm holes and worm casts; neutral; abrupt, smooth boundary.

A12—7 to 14 inches, dark-brown (10YR 3/3) sandy loam; weak, medium, granular structure; very friable; approximately 10 to 15 percent gravel; neutral; clear, wavy boundary.

B21—14 to 23 inches, dark-brown (10YR 4/3) sandy loam; weak, medium and coarse, subangular blocky structure; very friable; dark-brown (10YR 3/3) coatings on some faces of peds; approximately 10 to 15 percent gravel; neutral; clear, wavy boundary.

B22—23 to 28 inches, dark-brown (10YR 4/3) heavy gravelly loam; weak, very coarse, subangular blocky structure; friable; thin, discontinuous, dark-brown (10YR 3/3) clay coatings on pebbles; neutral; clear, irregular boundary.

IIC—28 to 60 inches, yellowish-brown (10YR 5/4) and pale-brown (10YR 6/3) gravel and sand; stratified; single grained; loose; moderately alkaline (calcareous).

The solum ranges from 24 to 36 inches in thickness. In the Ap horizon color ranges from very dark brown (10YR 2/2) to dark brown (10YR 3/3). The A horizon is 10 to 20 inches thick. The B horizon ranges from dark brown (7.5YR 4/4) to dark yellowish brown (10YR 4/4), and from sandy loam to heavy gravelly loam.

Landes soils are in landscape positions similar to those of Ross and Stonelick soils and have surface colors similar to those of Ross soils. They have a thinner A horizon, are coarser textured throughout, and have gravel at a shallower depth than Ross soils. Landes soils have a higher content of gravel and have a darker colored surface layer than Stonelick soils.

**Landes gravelly sandy loam, gravelly substratum** (0 to 2 percent slopes) (La).—This is on broad flats of bottom lands and on some long natural levee deposits. Areas range from 5 to more than 80 acres in size and from 300 feet to more than one-fourth mile in width. In places loose gravel is at a depth of 18 to 24 inches and in places the soil is calcareous throughout. Some areas of this soil are 5 to 10 feet higher than the adjoining bottom lands. These areas are not flooded so frequently as the lower lying areas. Included in mapping are small areas of Ross soils.

On this soil the low to moderate available water capacity is the major limitation, but the major hazard of flooding is also a limitation to use and management. This soil is suited to most crops commonly grown in the county. Grain sorghum, corn, and soybeans are the major crops. The soil is also suited to grasses and legumes for forage and to trees. In years when rainfall is below average or poorly distributed, crops are subject to damage by drought. This soil is suitable for irrigation. Capability unit IIs–7; woodland group o23.

## Martinsville Series

The Martinsville series consists of deep, well-drained, nearly level and gently sloping soils on terraces. These soils formed in loamy outwash material that overlies sand and stratified sand and silt at a depth of about 42 to 60 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown loam about 11 inches thick. The subsurface layer is dark yellowish-brown loam about 3 inches thick. The subsoil is about 41 inches thick. The upper 25 inches is dark-brown and reddish-brown, firm clay loam; the next 11 inches is reddish-brown, friable sandy loam; and the lower 5 inches is dark reddish-

brown, firm clay loam. The underlying material, to a depth of about 72 inches, is pale-brown and light-gray stratified sand, fine sand, and silt.

Martinsville soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. Runoff is slow.

Representative profile of Martinsville loam, 0 to 2 percent slopes, in a cultivated field about 572 feet south and 50 feet west of the northeast corner of SW¼ sec. 2, T. 8 N., R. 5 E.:

Ap—0 to 11 inches, dark-brown (10YR 4/3) loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—11 to 14 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine, granular structure; friable; neutral; clear, smooth boundary.

B21t—14 to 17 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; thin, discontinuous, reddish-brown (5YR 4/4) clay films on faces of peds; medium acid; clear, smooth boundary.

B22t—17 to 39 inches, reddish-brown (5YR 4/4) clay loam; weak, medium and coarse, subangular blocky structure; firm; thin, continuous, dark reddish-brown (5YR 3/3) clay films on faces of peds; slightly acid; clear, smooth boundary.

B23t—39 to 50 inches, reddish-brown (5YR 4/4) heavy sandy loam; weak, coarse, subangular blocky structure; friable; dark reddish-brown (5YR 3/3) clay bridging sand grains; neutral; clear, wavy boundary.

B3—50 to 55 inches, dark reddish-brown (5YR 3/3) clay loam; massive; firm; neutral; abrupt, wavy boundary.

C—55 to 72 inches, pale-brown (10YR 6/3) and light-gray (10YR 7/2) stratified sand, fine sand, and silt; moderately alkaline (calcareous).

The solum ranges from 42 to 60 inches in thickness. In the Ap horizon color is dark grayish brown (10YR 4/2), brown (10YR 5/3), or dark brown (10YR 4/3). The A horizon is loam or sandy loam. Some solums have a thin A2 horizon. The B2 horizon ranges from dark reddish brown (5YR 3/4) and dark brown (7.5YR 4/4) to dark yellowish brown (10YR 4/4). It is sandy clay to silty clay loam. The B3 horizon ranges from dark reddish brown (5YR 3/2) to strong brown (7.5YR 4/4). It is sandy loam to loam and clay loam.

Martinsville sandy loam, 0 to 2 percent slopes (MaA), is sandier throughout its profile than the defined range of the Martinsville series but this difference does not alter its use and behavior.

Martinsville soils have drainage characteristics, thickness of the solum, and positions on the landscape similar to those of Camden and Ockley soils. They have a higher content of sand in the upper part of the solum than Camden soils. Martinsville soils have a lower content of pebbles or gravel in the subsoil than Ockley soils.

**Martinsville sandy loam, 0 to 2 percent slopes** (MaA).—This soil is on wide level terraces that overlie stratified sand and small amounts of gravel. Areas range from 25 to more than 640 acres in size and in places are more than 1 mile wide (fig. 17). This soil has a profile similar to that described as representative of the series, but the surface layer is sandy loam and the subsoil has less clay and more sand and is mainly sandy clay loam or heavy sandy loam. In places near areas of Nineveh soils, this soil has a darker colored surface layer and a subsoil that is neutral in reaction. In areas where it adjoins Princeton soils, it has a fine sandy loam surface layer.

Included with this soil in mapping are small areas that have gravelly loam or gravelly clay loam in the lower part of the subsoil. Also included are small areas of Whitaker soils in low swales.

*Figure 17.*—**Area of Martinsville sandy loam, 0 to 2 percent slopes, near Jonesville.**

This soil has slight limitations to use and management. It is suited to most crops commonly grown in the county. Corn, grain sorghum, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Such deep-rooted crops as alfalfa and such deep-rooted trees as black walnut grow well on this soil. Such specialty crops as melons and vegetables are grown on this soil. Capability unit I–1; woodland group 1o1.

**Martinsville loam, 0 to 2 percent slopes** (MbA).—This soil is on wide flat terraces and terrace benches along the major stream valleys. It overlies stratified sand and small amounts of silt and gravel. Areas range from 10 to more than 640 acres in size and in places are more than one-half mile wide. This soil has the profile described as representative of the series. In places near areas of Nineveh soils, this soil has a darker colored surface layer and a subsoil that is neutral in reaction. In areas where it adjoins Princeton soils, it has a fine sandy loam surface layer.

Included with this soil in mapping are small areas of well-drained Ockley soils and some long gently sloping ridges. Also included are small areas of somewhat poorly drained Whitaker soils in low swales.

This soil has slight limitations to use and management. It is suited to most crops commonly grown in the county. Corn, grain sorghum, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Such deep-rooted crops as alfalfa, and such deep-rooted trees as black

walnut grow well on this soil. Capability unit I–1; woodland group 1o1.

**Martinsville loam, 2 to 6 percent slopes, eroded** (MbB2).—This soil is on long convex ridges and narrow, long breaks adjoining areas of level Martinsville soils. Areas range from 3 to 15 acres in size and are generally less than 200 feet wide. This soil has a profile similar to that described as representative of the series, but 5 to 8 inches of the surface layer has been removed through erosion. The plow layer consists of a mixture of loam and a small amount of clay loam subsoil. In a few small places dark-brown or reddish-brown clay loam subsoil is exposed on the surface. In areas near Princeton soils and sandy loam Martinsville soils the surface layer is fine sandy loam. Included in mapping are narrow long areas of Whitaker soils in low swales.

Runoff is medium on this soil. The hazard of further erosion is the major limitation to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grains are the major crops. The soil is also suited to grasses and legumes for forage and to trees. Such deep-rooted crops as alfalfa, and such deep-rooted trees as black walnut grow well on this soil. Such specialty crops as melons and vegetables are grown on this soil. Capability unit IIe–1; woodland group 1o1.

## McGary Series

The McGary series consists of deep, somewhat poorly drained, nearly level or gently sloping soils on terraces. These soils formed in thin loess and the underlying fine-textured lacustrine deposits. The native vegetation was mixed water-tolerant hardwoods.

In a representative profile the surface layer is grayish-brown silt loam about 6 inches thick. The subsoil is about 32 inches thick. The upper 5 inches is mottled, light brownish-gray, firm silty clay loam; the next 8 inches is grayish-brown and brown, firm silty clay; the next 13 inches is grayish-brown, firm silty clay; and the lower 6 inches is gray, firm silty clay. The underlying material, to a depth of about 60 inches, is gray, firm stratified silty clay and clay.

McGary soils are low in content of organic matter. Available water capacity is moderate and permeability is very slow. Runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of McGary silt loam in a cultivated field about 750 feet south and 20 feet west of the northeast corner of NW¼NW¼ sec. 21, T. 9 N., R. 5 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) heavy silt loam; few, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

B1g—6 to 11 inches, light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) and grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; firm; strongly acid; abrupt, smooth boundary.

B21tg—11 to 19 inches, grayish-brown (10YR 5/2) and brown (10YR 5/3) silty clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very firm; grayish-brown (10YR 5/2) clay films on faces of peds; strongly acid; clear, smooth boundary.

B22tg—19 to 32 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct, yellowish-brown (10YR 5/4) and brown (10YR 5/3) mottles; weak, coarse, subangular blocky structure; very firm; light brownish-gray (2.5Y 6/2) clay films on faces of peds; neutral; clear, wavy boundary.

B3tg—32 to 38 inches, gray (10YR 5/1) silty clay; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very firm; light brownish-gray (2.5Y 6/2) clay films on faces of peds; moderately alkaline (calcareous) inside peds and neutral in films and outer edges of peds; clear, wavy boundary.

Cg—38 to 60 inches, gray (10YR 5/1) stratified silty clay and clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; very firm; few accumulations of lime in fine soft to hard rounded masses; moderately alkaline (calcareous).

The solum ranges from 24 to 50 inches in thickness. In the Ap horizon color ranges from dark gray (10YR 4/1) to light brownish gray (10YR 6/2). An A2 horizon of thin gray (10YR 5/1) silt loam is present in places. The B2 horizon ranges from gray (10YR 5/1) to brown (10YR 5/3) and from heavy silty clay loam to silty clay.

McGary soils have drainage characteristics and are in positions on the landscape similar to those of Whitaker and Henshaw soils. They have a thinner solum, higher clay content, and contain less sand in the subsoil and underlying material than Whitaker soils. McGary soils have a thinner solum and have a higher clay content in the subsoil and underlying material than Henshaw soils.

**McGary silt loam** (0 to 2 percent slopes) (Mc).—This soil is on flat terraces along the larger stream valleys. Areas range from 15 to 40 acres in size.

Included with this soil in mapping are a few small areas of well-drained soils and a few small areas of Zipp soils. Also included are areas that have gentle slopes, mainly breaks between the level areas and adjacent bottom lands and some moderately eroded areas.

Runoff is slow on this soil. Wetness and the very slowly permeable subsoil are major limitations to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Because the fine-textured subsoil restricts the downward penetration of roots, the soil is not well suited to such deep-rooted crops as alfalfa. The soil is also suited to permanent pasture grasses and to trees that tolerate wetness. Capability unit IIIw–6; woodland group 3w5.

## Medway Series

The Medway series consists of deep, moderately well drained, nearly level soils on bottom lands. These soils formed in loamy alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown silty clay loam about 23 inches thick. The subsoil is mottled, grayish-brown, firm clay loam about 20 inches thick. The underlying material, to a depth of about 60 inches, is grayish-brown, very dark grayish-brown, and dark yellowish-brown, firm clay loam.

Medway soils are high in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding in winter and early in spring, but also occasionally during the growing season. Runoff is slow. Depth to the seasonal high water table is 3 to 6 feet.

Representative profile of Medway silty clay loam in a cultivated field about 1,196 feet east and 676 feet north of the southwest corner of NW¼ sec. 9, T. 7 N., R. 6 E.:

Ap—0 to 7 inches, dark-brown (10YR 3/3) silty clay loam; cloddy; firm; neutral; abrupt, smooth boundary.

A12—7 to 11 inches, dark-brown (10YR 3/3) silty clay loam; moderate, medium, subangular blocky structure; firm; very dark grayish-brown (10YR 3/2) organic coatings on peds and in fine voids; neutral; clear, smooth boundary.

A13—11 to 23 inches, dark-brown (10YR 3/3) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; neutral; clear, smooth boundary.

B21—23 to 32 inches, grayish-brown (2.5Y 5/2) light clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; very dark grayish-brown (10YR 3/2) organic coatings on faces of peds; few pebbles; neutral; clear, smooth boundary.

B22—32 to 43 inches, grayish-brown (2.5Y 5/2) clay loam; many, medium, distinct, brown (10YR 5/3) mottles; subangular blocky structure; firm; very dark gray (10YR 3/1) coatings on faces of some peds; neutral; few pebbles; clear, smooth boundary.

C—43 to 60 inches, variegated grayish-brown (2.5Y 5/2), very dark grayish-brown (2.5Y 3/2), and dark yellowish-brown (10YR 4/4) clay loam; massive; firm; neutral; clear, smooth boundary.

The solum ranges from 28 to 45 inches in thickness. Depth to mottling associated with wetness is 16 to 28 inches.

In the A horizon color ranges from dark brown (10YR 3/3), very dark brown (10YR 2/2), and very dark gray (10YR 3/1) to very dark grayish brown (10YR 3/2). This horizon ranges from 14 to 24 inches in thickness. The B horizon ranges from grayish brown (10YR 5/2) to yellowish brown (10YR 5/4), and is loam, clay loam, or silty clay loam. The underlying material is loam, clay loam, or sandy loam.

Medway soils are adjacent to, and are in positions on the landscape similar to those of the well-drained Ross soils and the moderately well drained Eel soils. They have a thinner, dark-colored surface layer and have mottles higher in the profile than Ross soils. Medway soils have a darker colored and thicker surface layer than Eel soils.

**Medway silty clay loam** (0 to 2 percent slopes) (Md).—This soil is on flat bottom lands and in long narrow channels that meander mainly through areas of Ross soils. Areas range from 5 to more than 30 acres in size and from less than 100 feet in width in the meander channels to more than one-eighth mile in width on flats. In a few places a thin smear of lighter colored alluvium is on the surface. A few small areas have a silt loam surface layer. Included in mapping are small areas of somewhat poorly drained Shoals and very poorly drained Saranac soils.

Flooding is the major hazard, and moderate wetness is the major limitation to use and management. This soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to flood damage in winter and early in spring. This soil is also suited to grasses and legumes for forage and to trees. Capability unit I–2; woodland group o23.

## Miami Series

The Miami series consists of deep, well-drained, gently sloping to strongly sloping soils on uplands. These soils formed in as much as 18 inches of loess and the underlying loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 10 inches thick. The subsoil is about 29 inches thick. The upper 8 inches is dark-brown, firm silty clay loam; the next 12 inches is dark yellowish-brown, firm clay loam; the lower 9 inches is dark-brown, firm clay loam. The underlying material, to a depth of about 60 inches, is brown and yellowish-brown, firm loam.

Miami soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate.

Representative profile of Miami silt loam, 2 to 6 percent slopes, eroded, in a cultivated field about 130 feet west and 370 feet north of the southeast corner of SW¼NE¼ sec. 12, T. 10 N., R. 7 E.:

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

B21t—10 to 18 inches, dark-brown (10YR 4/3) silty clay loam; weak, fine and medium, subangular blocky structure; firm; dark-brown (7.5YR 4/4) clay films on faces of peds; medium acid; clear, smooth boundary.

IIB22t—18 to 30 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; dark-brown (7.5YR 4/4) clay films on faces of peds; strongly acid; clear, wavy boundary.

IIB3—30 to 39 inches, dark-brown (10YR 4/3) clay loam; moderate, subangular blocky structure; firm; discontinuous dark-brown (7.5YR 4/4) clay films on faces of peds; slightly acid; clear, wavy boundary.

IIC—39 to 60 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/4) heavy loam till; massive; firm; moderately alkaline (calcareous).

The solum ranges from 24 to 42 inches in thickness. The loess ranges from 0 to 18 inches in thickness.

In the Ap horizon color is brown (10YR 5/3), dark brown (10YR 4/3), or dark yellowish brown (10YR 4/4). In forested areas an A1 horizon which is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2) is present. An A2 horizon of 2 to 6 inches of brown (10YR 5/3) or yellowish-brown (10YR 5/4) silt loam is present in places. In places a B1 horizon that is 1 to 6 inches thick and is loam or silt loam is present. The B2 horizon is clay loam or silty clay loam that is 15 to 20 percent sand and ranges from dark brown (7.5YR 4/4) to yellowish brown (10YR 5/4). The C horizon is loam or light clay loam.

Miami soils are adjacent to or near the moderately well drained Celina soils and have drainage characteristics similar to those of Russell soils. They formed from the same kind of material as, and have a solum that is similar in thickness to Celina soils, but they lack the gray mottles in the upper part of the subsoil of Celina soils. Miami soils have thinner loess, a thinner solum, and are shallower to carbonates than Russell soils.

**Miami silt loam, 2 to 6 percent slopes, eroded** (MmB2).—This soil is on side slopes along natural draws and on convex knolls and ridgetops. Areas are usually irregularly shaped and range from about 5 to 35 acres

in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small severely eroded areas. For some of these areas a severely eroded symbol is used on the maps. These severely eroded areas plow up cloddy. Seedbeds are difficult to prepare, and good stands are sometimes difficult to establish. Also included are small areas of moderately well drained Celina soils and areas of moderately sloping soils.

The hazard of further erosion on this soil is the major limitation to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grains are the major crops. The soil is also suited to grasses and legumes for forage and to trees. Capability unit IIe–1; woodland group 1o1.

**Miami silt loam, 6 to 12 percent slopes, eroded** (MmC2).—This soil is on knolls, hillsides, and side slopes along natural drainageways. Areas range from 3 to more than 20 acres in size. Some of the knolls are 100 to 250 feet wide. This soil has a profile similar to that described as representative of the series, but the upper part of the subsoil is clay loam and the depth to calcareous till is dominantly about 30 inches.

Included with this soil in mapping are a few small severely eroded areas where the dark yellowish-brown clay loam is exposed on the surface. Some of these areas are indicated on the map by a severely eroded symbol. Also included are a few small areas of strongly sloping soils.

Runoff is medium on this soil. Runoff and the hazard of further erosion are the major limitations to use and management. If adequate erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county (fig. 18). The soil is also suited to pasture grasses and to trees. Capability unit IIIe–1; woodland group 1o1.

**Miami silt loam, 12 to 18 percent slopes, eroded** (MmD2).—This soil is on hillsides and side slopes along natural drainageways. Areas range from about 5 to more than 20 acres in size. This soil has a profile similar to that described as representative of the series, but the subsoil is clay loam throughout and the loam till is at a depth of about 24 to 30 inches. In wooded areas the upper 2 or 3 inches of the surface layer is darker colored.

Included with this soil in mapping are small severely eroded areas. Some of these areas are indicated on the map by a severely eroded symbol. Also included are a few small areas of moderately steep Hennepin soils. A few included steep areas are indicated on the map by an escarpment symbol. Near areas of Milton

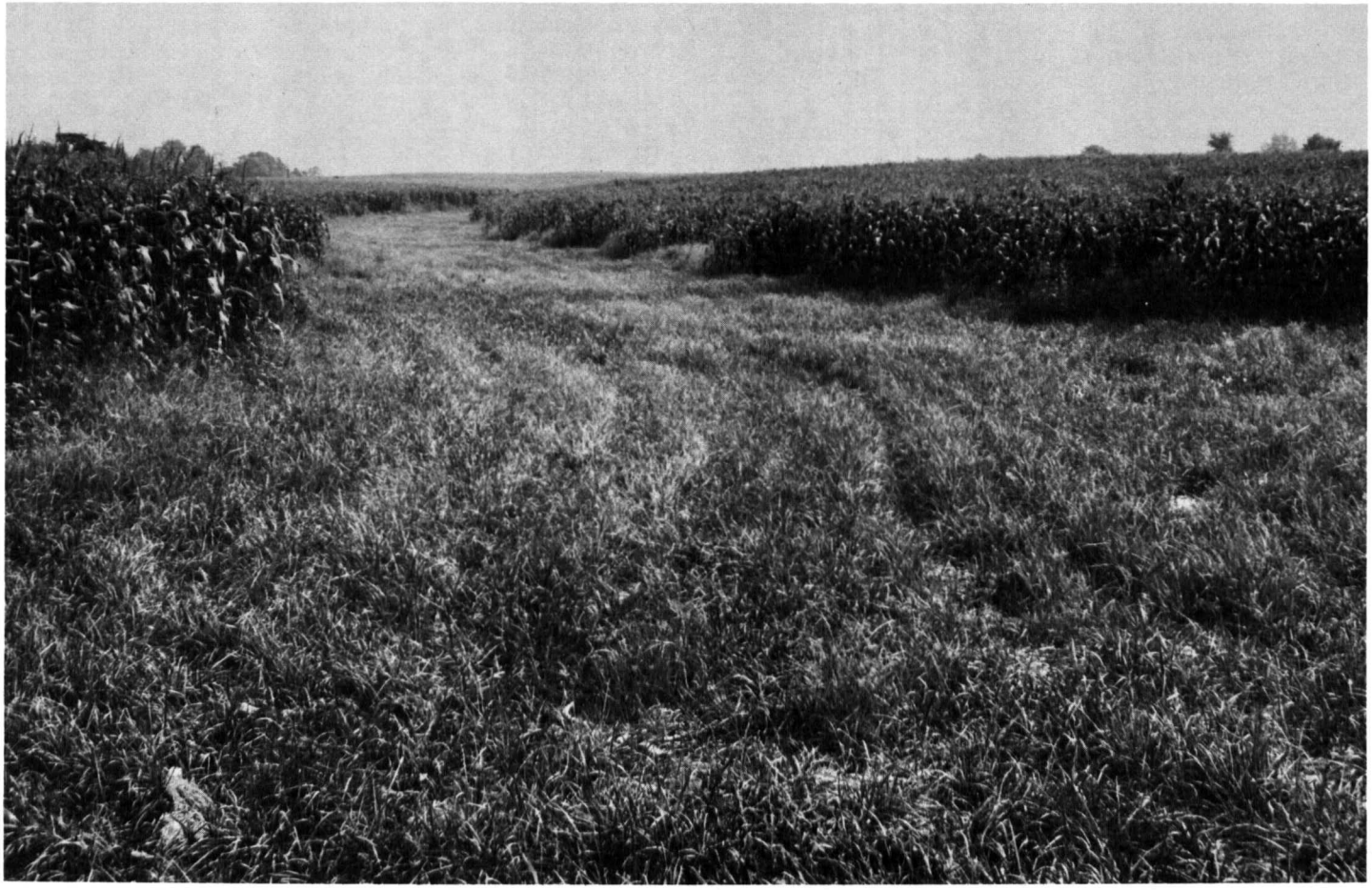

*Figure 18.*—**Grassed waterway on Miami silt loam, 6 to 12 percent slopes, eroded.**

soils are small areas that have limestone bedrock at a depth of 30 to 50 inches.

Runoff is rapid on this soils. Runoff and the hazard of further erosion are the major limitations to use and management. This soil is suited to small grains, to grasses and legumes for forage, and occasionally to row crops. It is also suited to trees. If the soil is cultivated, adequate erosion-control practices need to be established and maintained. Capability unit IVe–1; woodland group 1o1.

**Miami clay loam, 2 to 6 percent slopes, severely eroded** (MoB3).—This soil in on knolls, ridges, and on the upper ends of the side slopes around natural draws. Areas range from 3 to more than 20 acres in size. Some of the knolls and ridges are only 100 to 250 feet wide. This soil has a profile similar to that described as representative of the series, but the surface layer has been removed through erosion and the present plow layer consists mainly of dark yellowish-brown clay loam mixed with a small amount of the described surface layer. The depth to calcareous till is mainly 36 to 40 inches. On the lower positions on the slopes, there is a 12- to 18-inch accumulation of loamy material that eroded from the upper part of the slopes. Included in mapping are a few small areas of Celina soils.

Runoff is rapid on this soil. Runoff and the hazard of further erosion are the major limitations to use and management. If adequate erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. The soil is also suited to pasture grasses and to trees. This soil, if plowed wet, becomes cloddy and good seedbeds are difficult to prepare. Capability unit IIIe–1; woodland group 1o1.

**Miami clay loam, 6 to 12 percent slopes, severely eroded** (MoC3).—This soil is on knolls, hillsides, and side slopes along natural draws. Areas range from 3 to more than 60 acres in size. The knolls range from 100 to 250 feet in width. The side slopes along natural drainageways are usually irregularly shaped and range from 100 to 300 feet in width. This soil has a profile similar to that described as representative of the series, but the surface layer has been removed through erosion and the present plow layer consists mainly of dark yellowish-brown clay loam mixed with a small amount of the described surface layer. Depth to the calcareous till is mainly 24 to 30 inches. In places, generally near the center of the slopes, small areas of calcareous till are exposed on the surface. In places on the lower parts of the slope is a 12- to 20-inch accumulation of loamy material that eroded from the upper part of the slopes. Included in mapping are a few small areas in Celina soils and some narrow areas of somewhat poorly drained soils in the bottoms of natural draws.

Runoff is rapid on this soil. Runoff and the hazard of further erosion are the major limitations to use and management. If adequate erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. This soil is not as well suited to row crops as it is to small grains and hay. This soil is also suited to pasture grasses and to trees. This soil, if plowed wet, becomes cloddy and good seedbeds are difficult to prepare. Capability unit IVe–1; woodland group 1o1.

**Miami clay loam, 12 to 18 percent slopes, severely eroded** (MoD3).—This soil is on hillsides and side slopes along natural drainageways. Areas range from 10 to more than 25 acres in size. This soil has a profile similar to that described as representative of the series, but the subsoil is clay loam throughout and the loam till is at a depth of about 24 to 30 inches. Most of the surface layer has been removed through erosion. The present surface layer consists mainly of a mixture of dark yellowish-brown clay loam and a small amount of the described surface layer. Small areas of calcareous till are exposed on the surface, generally near the center of the slope. In places on the lower parts of the slopes is a 12- to 24-inch accumulation of loamy material that eroded from the upper parts of the slopes.

Included with this soil in mapping are a few less-eroded areas and a few moderately steep areas of Hennepin soils. A few steep areas are indicated on the map by an escarpment symbol. Near areas of Milton soils are small areas that have limestone bedrock at a depth of 30 to 50 inches.

Runoff is very rapid on this soil. Runoff and the hazard of further erosion are major limitations to use and management. Erosion-control practices need to be established and maintained, particularly where runoff water accumulated. This soil is suited to hay or pasture and occasionally to a small grain crop. This soil is also suited to permanent pasture grasses and to trees. Capability unit VIe–1; woodland group 1o1.

## Milton Series

The Milton series consists of moderately deep, well-drained, nearly level to strongly sloping soils on uplands and terraces. These soils formed in thin loess and the underlying glacial drift that overlies limestone bedrock at a depth of about 20 to 40 inches. The native vegetation was mainly mixed hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 9 inches thick. The subsoil is about 20 inches thick. The upper 4 inches is dark yellowish-brown silt loam; the next 6 inches is dark-brown, firm clay loam; and the lower 10 inches is dark yellowish-brown, firm clay loam. The underlying bedrock is at a depth of about 31 inches.

Milton soils are moderate in content of organic matter. Available water capacity is low to moderate and permeability is moderately slow.

Representative profile of Milton silt loam, 0 to 2 percent slopes, in a cultivated field about 100 feet west of the road and 265 feet north of the southeast corner of NE¼NW¼ sec. 17, T. 9 N., R. 7 E.:

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

B1—9 to 13 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine, subangular blocky structure; friable; patchy dark-brown (10YR 3/3) clay films on faces of some peds; neutral; clear, smooth boundary.

B21t—13 to 19 inches, dark-brown (7.5YR 4/4) clay loam; moderate, fine and medium, subangular blocky

structure; firm; dark-brown (7.5YR 3/2) clay films on faces of peds; neutral; clear, smooth boundary.

B22t—19 to 29 inches, dark yellowish-brown (10YR 4/4) heavy clay loam; moderate, medium, subangular blocky structure; firm; dark-brown (10YR 3/3) clay films on faces of peds; slightly acid; clear, wavy boundary.

IIC—29 to 31 inches, dark-brown (7.5YR 3/2) silty clay; massive; very firm; neutral; abrupt, wavy boundary.

R—31 inches, limestone bedrock material from the IIC horizon extending into solution channels and cracks.

The solum ranges from 20 to 40 inches in thickness. The depth to bedrock ranges from 20 to 40 inches.

In the Ap horizon color is dark brown (10YR 4/3), dark grayish brown (10YR 4/2), or brown (10YR 5/3). A thin A2 horizon of brown (10YR 5/3) or pale brown (10YR 6/3) silt loam is present in places. A B1 horizon is not present in places. The B2 horizon is dark brown (7.5YR 4/4), reddish brown (5YR 5/4, 4/4), or dark yellowish brown (10YR 4/4). It is clay loam or clay. The thin clay C horizon is not present in places.

Milton soils have positions on the landscape similar to the well-drained Corydon soils. They have a lighter colored surface layer that contains fewer stones and they are deeper over limestone bedrock than Corydon soils.

**Milton silt loam, 0 to 2 percent slopes** (MtA).—This soil is on level terraces and uplands. Areas range from 5 to 20 acres in size. The larger areas are on terraces. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas that are deeper than 40 inches to limestone bedrock. In places are pieces of flaggy limestone 5 to 20 inches in diameter just above the bedrock. Also included are a few narrow areas of somewhat poorly drained soils where this soil is adjacent to foot slopes.

Runoff is slow on this soil. The low to moderate available water capacity and depth to bedrock are major limitations to use and management. This soil is suited to most crops commonly grown in the county. During years when rainfall is below normal or poorly distributed, crops are subject to damage by drought. This soil is also suited to permanent pasture grasses and to trees. Capability unit IIs–4; woodland group 3o10.

**Milton silt loam, 2 to 6 percent slopes, eroded** (MtB2).—This soil is on narrow, long breaks and side slopes along natural drains on terraces and uplands. Areas range from 3 to 10 acres in size and from 100 to 250 feet in width. This soil has a profile similar to that described as representative of the series, but the surface layer consists of a mixture of the original surface layer and a moderate amount of dark-brown clay loam subsoil.

Included with this soil in mapping are a few small severely eroded areas. Also included are places where the depth to the limestone bedrock is less than 20 inches and, in places, pieces of chert and limestone are on the surface of the soil.

Runoff is medium on this soil. The low to moderate available water capacity and depth to bedrock are the major limitations, but runoff and the hazard of further erosion are also limitations to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. During years when rainfall is below normal or poorly distributed, crops are subject to damage by drought. This soil is also suited to permanent pasture grasses and to trees. Capability unit IIIe–8; woodland group 3o10.

**Milton silt loam, 6 to 12 percent slopes, eroded** (MtC2).—This soil is on narrow long breaks between the level terrace areas and the adjacent bottom lands. It is also on hillsides and side slopes on long natural drains on uplands. Areas range from 5 to 20 acres in size and from 100 to 300 feet in width. This soil has a profile similar to that described as representative of the series but the surface layer consists mainly of a mixture of the original surface layer and a moderate amount of dark-brown clay loam subsoil.

Included with this soil in mapping are a few small severely eroded areas. Also included are places where the depth to limestone bedrock is less than 20 inches and places where pieces of chert and limestone are on the soil surface.

Runoff is medium on this soil. The low to moderate available water capacity and depth to bedrock are the major limitations, but runoff and the hazard of further erosion are also limitations to use and management. This soil is suited to such crops as winter wheat that do not receive a large amount of water during the summer. Crops such as corn that need a large amount of water during the summer are subject to damage during years of poor rainfall or poor rainfall distributions. This soil is suited to permanent pasture and trees. It is better suited to early spring pasture than summer pasture. Capability unit IVe–8; woodland group 3o10.

## Nineveh Series

The Nineveh series consists of moderately deep, well-drained, nearly level and gently sloping soils on terraces. These soils formed in loamy glacial outwash and overlie stratified loose gravel and sand at a depth of 24 to 40 inches. The native vegetation was mixed hardwoods and grasses.

In a representative profile the surface layer is loam about 14 inches thick that is very dark grayish brown in the upper part and dark-brown in the lower part. The subsoil is about 24 inches thick. The upper 16 inches is dark-brown, firm gravelly clay loam and the lower 8 inches is dark-brown, firm sandy clay loam. The underlying material, to a depth of about 60 inches, is yellowish-brown and pale-brown, loose gravel and sand.

Nineveh soils are high in content of organic matter. Available water capacity is moderate and permeability is moderate.

Representative profile of Nineveh loam, 0 to 2 percent slopes, in a cultivated field about 120 feet north and 212 feet east of the southwest corner of SE¼ sec. 15, T. 10 N., R. 5 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, granular structure; friable; few ¼- to ¾-inch pebbles; slightly acid; abrupt, smooth boundary.

A12—8 to 14 inches, dark-brown (7.5YR 3/2) loam; weak, coarse, granular structure; friable; few ½- to ¾-

inch pebbles; few worm holes and casts; slightly acid; clear, smooth boundary.

B21t—14 to 30 inches, dark-brown (7.5YR 4/4) gravelly clay loam; moderate, medium, subangular blocky structure; firm; few ½- to ¾-inch pebbles; dark-brown (7.5YR 3/2) clay films on faces of peds and coatings on pebbles; slightly acid; clear, wavy boundary.

B22t—30 to 36 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, coarse, subangular blocky structure; firm; about 10 percent gravel; dark-brown (7.5YR 3/2) clay films on faces of peds; neutral; abrupt, irregular boundary.

B3t—36 to 38 inches, dark reddish-brown (5YR 3/2) sandy clay loam; weak, coarse, subangular blocky structure; firm; dark reddish-brown (5YR 3/2) clay films on faces of peds or bridging sand grains and as coatings on pebbles; about 15 percent gravel; neutral; abrupt, irregular boundary.

IIC—38 to 60 inches, yellowish-brown (10YR 5/4) and pale-brown (10YR 6/3) loose stratified gravel and sand; tongues of B3t horizon extend to a depth of 48 inches and are 3 to 4 feet apart; moderately alkaline (calcareous).

The solum ranges from 24 to 40 inches in thickness. Color of the Ap horizon is dark brown (7.5YR 3/2, 10YR 3/3) or very dark grayish brown (10YR 3/2). The A horizon is 10 to 15 inches thick. It is loam or gravelly loam. A B1 horizon of brown (7.5YR 5/4) loam 2 to 4 inches thick is present in places. The B horizon is clay loam to gravelly clay loam and ranges from reddish brown (5YR 4/4) to dark yellowish brown (10YR 4/4). Tongues of the B3 horizon extend 6 to 20 inches into the C horizon and range from 12 to more than 48 inches apart.

Nineveh soils have positions on the landscape similar to those of Fox and Ockley soils. They have a solum that is similar in thickness, but they have a darker colored surface layer, and a less acid subsoil, than Fox soils. Nineveh soils have a thinner solum, a darker surface layer, and a less acid subsoil than Ockley soils.

**Nineveh loam, 0 to 2 percent slopes** (NgA).—This soil is on broad flat terraces and on bench-like terraces along the stream valleys. Areas range from 10 to more than 640 acres in size and from 200 feet to more than 1 mile in width. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of gently sloping soils and a few areas that have a gravelly loam surface layer. Also included are small areas of Fox soils, areas of somewhat poorly drained soils in narrow, long, old stream meander channels, and a few places where the depth to loose gravel is more than 40 inches.

Runoff is slow on this soil, and the moderate available water capacity is the major limitation to use and management. This soil is suited to most crops commonly grown in the county. Grain sorghum, corn, wheat, and alfalfa are the major crops. The soil is also suited to grasses and legumes for forage and to trees. In years when rainfall is below average or poorly distributed, crops are subject to damage by drought. This soil is suitable for irrigation. Capability unit IIs–1; woodland group 1o1.

**Nineveh loam, 2 to 6 percent slopes, eroded** (NgB2).—This soil is in narrow long areas along old stream meanders and on short breaks around nearly level areas and on narrow long ridges on the terraces. Areas range from 3 to 15 acres in size and from less than 100 to more than 300 feet in width. This soil has a profile similar to that described as representative of the series, but about 6 inches of the surface layer has been removed through erosion. The surface layer consists of a mixture of a moderate amount of dark-brown loam and gravelly clay loam. In places the surface layer is gravelly loam.

Included with this soil in mapping are a few small severely eroded areas where the dark-brown clay subsoil is exposed on the surface. Also included in the bottom of old meander channels are narrow areas of somewhat poorly drained and poorly drained soils.

Runoff is medium on this soil. The moderate available water capacity is the major limitation, but the hazard of further erosion is also a limitation to use and management. This soil is suited to most crops commonly grown in the county. Grain sorghum, corn, wheat, and alfalfa are the major crops. The soil is also suited to grasses and legumes for forage and to trees. In years when rainfall is below average or poorly distributed, crops are subject to damage by drought. This soil is suitable for irrigation. Capability unit IIe–9; woodland group 1o1.

**Nineveh gravelly loam, 0 to 2 percent slopes** (NnA).—This soil is on broad flat terraces. Areas range from about 10 to 60 acres in size and from 200 feet to more than one-fourth mile in width. This soil has a profile similar to that described as representative of the series, but it has a gravelly loam surface layer and subsurface layer.

Included with this soil in mapping are a few small areas of gently sloping soils and, in places, small areas that have a loam surface layer. Also included are areas that have a lighter surface color.

Runoff is slow on this soil, and the moderate available water capacity is the major limitation to use and management. This soil is suited to most crops commonly grown in the county. Grain sorghum, corn, wheat, and alfalfa are the major crops. The soil is also suited to grasses and legumes for forage and to trees. In years when rainfall is below average or poorly distributed, crops are subject to damage by drought. This soil is suitable for irrigation. Capability unit IIs–1; woodland group 1r2.

## Ockley Series

The Ockley series consists of deep, well-drained, nearly level soils on terraces. These soils formed in loamy glacial outwash and overlie stratified loose gravel and sand at a depth of 42 to 60 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown loam about 9 inches thick. The subsoil is about 36 inches thick. The upper 7 inches is dark-brown, friable loam; the next 24 inches is dark-brown, firm clay loam; and the lower 5 inches is dark-brown, firm gravelly clay loam. The underlying material, to a depth of about 60 inches, is brown, loose gravel and sand.

Ockley soils are moderate in content of organic matter. Available water capacity is moderate to high and permeability is moderate. Runoff is slow.

Representative profile of Ockley loam, 0 to 2 percent slopes, near a shopping center about 620 feet north

and 240 feet west of the southeast corner of NE¼ sec. 17, T. 9 N., R. 6 E.:

Ap—0 to 9 inches, dark brown (10YR 4/3) loam; moderate, medium, subangular blocky structure; friable; few very dark grayish-brown (10YR 3/2) worm casts; medium acid; abrupt, smooth boundary.

B1—9 to 16 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable; few very dark grayish-brown (10YR 3/2) organic coatings; strongly acid; clear, smooth boundary.

B21t—16 to 26 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; dark-brown (7.5YR 3/2) clay films on faces of peds and coatings on pebbles; few ¼-inch pebbles; strongly acid; clear, smooth boundary.

B22t—26 to 40 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; dark reddish-brown (5YR 3/4) clay films on faces of peds and as coatings on pebbles; common ¼- to ½-inch pebbles; medium acid; clear, smooth boundary.

B3t—40 to 45 inches, dark-brown (7.5YR 3/2) gravelly clay loam; weak, coarse, subangular blocky structure; firm; dark reddish-brown (5YR 3/2) clay films on faces of some peds and as coatings on pebbles; neutral; abrupt, irregular boundary.

C—45 to 60 inches, brown (10YR 5/3) stratified gravel and sand; single grained; loose; moderately alkaline (calcareous).

The solum ranges from 42 to 60 inches in thickness. In the Ap horizon color is dark brown (10YR 4/3), yellowish brown (10YR 5/4), or dark yellowish brown (10YR 4/4). A thin A2 horizon of brown (10YR 5/3) loam is present in places. A B1 horizon is not present in places. The B2 horizon is dark reddish brown (5YR 3/4), reddish brown (5YR 4/3), or dark brown (7.5YR 4/4). The upper part of the B2 horizon is clay loam or sandy clay loam. The lower part of the B2 horizon is clay loam or gravelly clay loam. The B3 horizon ranges from dark brown (7.5YR 3/2) to dark reddish brown (5YR 3/4) and is gravelly loam, gravelly clay loam, or clay loam. The tongues of subsoil extending into the underlying loose gravel and sand range from 2 to 3 feet apart to more than 10 feet apart. The depth to which the tongues extend into the underlying gravel and sand ranges from a few inches to 3 or 4 feet.

Ockley soils are in landscape positions similar to those of Fox, Nineveh, Camden, and Martinsville soils. They have a thicker solum than Fox soils. Ockley soils have a thicker solum, a lighter colored surface layer, and a more acid subsoil than Nineveh soils. They are similar in thickness to Camden soils, but have a higher content of sand and pebbles in the upper part of the solum. Ockley soils have a solum similar in thickness to Martinsville soils, but they contain a higher content of pebbles or gravel.

**Ockley loam, 0 to 2 percent slopes** (OcA).—This soil is on level terraces, generally between areas of Nineveh and Fox soils and the adjoining uplands. Areas range from 20 to more than 60 acres in size. In places near areas of Nineveh soils this soil has a darker colored surface layer and a subsoil that is neutral in reaction.

Included with this soil in mapping are small areas of Fox, Nineveh, and Martinsville soils. Also included are small areas of somewhat poorly drained Sleeth soils in low swales.

This soil has slight limitations to use and management. It is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Such deep-rooted crops as alfalfa and such deep-rooted trees as black walnut grow well on this soil. Capability unit I–1; woodland group 1o1.

## Otwell Series

The Otwell series consists of deep, well-drained, gently sloping to strongly sloping soils on terraces. These soils formed in about 2 to 3 feet of loess and the underlying lacustrine deposits. They have a very firm and brittle fragipan beginning at a depth of about 2 to 3 feet. The native vegetation was mainly mixed water-tolerant hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsoil is about 72 inches thick. The upper 15 inches is yellowish-brown, firm silty clay loam; the next 25 inches is a fragipan that is mottled, yellowish-brown, very firm silty clay loam and loam; and the lower 32 inches is yellowish-brown and light brownish-gray, firm stratified silt loam and silty clay loam. The underlying material, to a depth of about 120 inches, is yellowish-brown and grayish-brown, firm stratified silty clay loam, silt loam, some fine sand, and silty clay.

Otwell soils are low in content of organic matter. Available water capacity is moderate and permeability in the fragipan is very slow.

Representative profile of Otwell silt loam, 2 to 6 percent slopes, eroded, in a cultivated field 740 feet east and 285 feet south of the northwest corner of SW¼NE¼ sec. 25, T. 8 N., R. 4 E.:

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

B1t—8 to 11 inches, yellowish-brown (10YR 5/6) heavy silt loam; weak, medium, subangular blocky structure; friable; thin, patchy, yellowish-brown (10YR 5/4) clay films on faces of some peds; very fine voids less than 1 millimeter in diameter inside peds; strongly acid; clear, smooth boundary.

B21t—11 to 17 inches, yellowish-brown (10YR 5/4) light silty clay loam; moderate, medium, subangular blocky structure; firm; thin dark yellowish-brown (10YR 4/4) clay films on faces of peds; very fine voids inside peds; very strongly acid; clear, smooth boundary.

B22t—17 to 23 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm; thin dark yellowish-brown (10YR 4/4) clay films on faces of peds; few, thin, light brownish-gray (10YR 6/2) silt coatings; very fine voids less than 1 millimeter in diameter inside of peds; very strongly acid; clear, wavy boundary.

IIBx1—23 to 27 inches, yellowish-brown (10YR 5/6) light silty clay loam; many, medium, distinct, brown (10YR 5/3), light brownish-gray (10YR 6/2), and strong-brown (7.5YR 5/6) mottles; moderate, very coarse, prismatic structure that parts to weak, medium, platy; very firm and brittle; brown (10YR 4/3) clay films, some more than 1 millimeter thick, on faces of peds; light-gray (10YR 7/2) silt coatings on tops and sides of prisms; few black (10YR 2/1) iron-manganese concretions; common, very fine, discontinuous voids less than 1 millimeter in diameter inside of peds; common sand grains and a few small pebbles 1 to 3 millimeters in diameter; few, fine, somewhat flattened roots extending into clay-filled cracks; very strongly acid; clear, wavy boundary.

IIBx2—27 to 48 inches, yellowish-brown (10YR 5/6) heavy loam; many, medium, distinct, brown (10YR 5/3), yellowish-brown (10YR 6/6), and light brownish-gray (10YR 6/2) mottles; moderate to strong, very coarse, prismatic structure that parts to weak, thick, platy; very firm and brittle; brown (10YR 5/3) clay films, some more than 1 millime-

ter thick on faces of peds and in cracks; exterior of prisms coated with white (10YR 8/2) silt and fine sand; common very fine voids less than 1 millimeter in diameter inside peds; few black (10YR 2/1) iron-manganese concretions and blotches; very strongly acid; clear, smooth boundary.

IIB3—48 to 80 inches, yellowish-brown (10YR 5/4, 5/6) and light brownish-gray (10YR 6/2) stratified silt loam and silty clay loam that has minor amounts of silty clay; weak, very coarse, subangular blocky structure; light-gray (10YR 6/1) clay-filled vertical cracks; strongly acid in upper part and slightly acid in lower part; diffuse, smooth boundary.

IIC—80 to 120 inches, yellowish-brown (10YR 5/4) and grayish-brown (10YR 5/2) stratified silty clay loam, silt loam that has minor amounts of fine sand, and silty clay; firm; neutral in upper part and moderately alkaline (calcareous) in lower part.

The solum ranges from 40 to 90 inches in thickness. Depth to the fragipan ranges from 20 to 32 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). A thin A2 horizon of brown (10YR 5/3), pale-brown (10YR 6/3), or yellowish-brown (10YR 5/4) silt loam is present in places. The B2t horizon ranges from dark brown (7.5YR 4/4) to yellowish brown (10YR 5/6) and is heavy silt loam or silty clay loam. The Bx horizon ranges from dark brown (7.5YR 4/4) to brownish yellow (10YR 6/6) and from heavy silt loam to light silty clay loam.

Otwell soils formed in similar material to and are adjacent to or near the somewhat poorly drained Dubois soils. They do not have the gray mottles in the upper part of the solum of Dubois soils.

**Otwell silt loam, 2 to 6 percent slopes, eroded** (OtB2).—This soil is on broad convex ridges on terraces, on short side slopes along natural draws, and on short breaks between areas of level terrace soils and bottom lands. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small severely eroded areas. Some of these severely eroded areas are shown on the map by a special symbol. Also included are small areas of moderately well drained soils that have mottling in the upper part of the subsoil. A few small slightly eroded areas are also included.

Runoff is medium on this soil. The very slowly permeable fragipan, moderate available water capacity, runoff, and hazard of further erosion are limitations to use and management. If erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grain are the major crops. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa and other deep-rooted crops. In years when rainfall is less than normal or is poorly distributed, crops are subject to drought damage. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIe–7; woodland group 3d9.

**Otwell silt loam, 6 to 12 percent slopes, eroded** (OtC2).—This soil is on short side slopes along natural draws and on short breaks between areas of level and gently sloping terrace soils and bottom lands. Areas range from 5 to 30 acres in size.

Included with this soil in mapping are a few small severely eroded areas. Some of these severely eroded areas are shown on the map by a special symbol. Also included are small seepy spots, and some slightly eroded areas that have mainly been in trees or permanent pasture.

Runoff is medium on this soil. The very slow permeability of the fragipan, moderate available water capacity, runoff, and hazard of further erosion are limitations to use and management. If erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, small grains, and grasses and legumes for forage are the major crops. Because the fragipan restricts the downward penetration of roots, alfalfa and other deep-rooted crops are not well suited to this soil. In years when rainfall is less than normal or is poorly distributed, crops are subject to drought damage. This soil is also suited to pasture grasses and to trees. Capability unit IIIe–7; woodland group 3d9.

**Otwell silt loam, 6 to 12 percent slopes, severely eroded** (OtC3).—This soil is on short side slopes along natural draws and on short breaks between areas of level and gently sloping terrace soils and bottom lands. It has a profile similar to that described as representative of the series, but erosion has removed most of the surface layer and in places part of the subsoil. The plow layer is mainly yellowish brown. It is not as friable and is more difficult to prepare into a good seedbed than less eroded areas. Near the toe of some slopes is an accumulation of soil material that eroded from upper parts of the slopes. In places a few small gullies and in some places small seepy areas are present. Included in mapping are a few areas of strongly sloping soils.

Runoff is rapid on this soil. The very slowly permeable fragipan, moderate available water capacity, runoff, and the hazard of further erosion are limitations to use and management. This soil is suited to most crops commonly grown in the county, but it has limited suitability for row crops. Because the fragipan restricts the downward penetration of roots, the soil is not well suited to alfalfa or other deep-rooted crops. In years when rainfall is less than normal or is poorly distributed, crops are subject to drought damage. This soil is also suited to pasture grasses and to trees. Capability unit IVe–7; woodland group 3d9.

**Otwell silt loam, 12 to 18 percent slopes, eroded** (OtD2).—This soil is mainly on short breaks between areas of level and gently sloping terraces and bottom lands. The slopes generally are less than 200 to 300 feet in length. Areas range from 10 to 40 acres in size. This soil has a profile similar to that described as representative of the series, but the fragipan is not so well developed and is somewhat thinner.

Included with this soil in mapping are severely eroded areas. Some of these severely eroded areas are shown on the map by a special symbol. These severely eroded areas are not so friable and are more difficult to prepare into a good seedbed. In places the fragipan is near the surface or is exposed on the surface. In places a few small gullies and in some other places small seepy areas are present. Also included are a few small areas of strongly sloping soils.

Runoff is rapid on this soil. The very slow permea-

bility of the fragipan, moderate available water capacity, runoff, and hazard of further erosion are limitations to use and management. This soil has limited suitability for row crops. If erosion-control practices are established and maintained, this soil is suited to small grains and pasture. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa and other deep-rooted crops. In years when rainfall is less than normal or is poorly distributed, crops and pasture are subject to drought damage. This soil is also suited to pasture grasses and to trees. Capability unit IVe–7; woodland group 3d9.

## Peoga Series

The Peoga series consists mainly of deep, poorly drained, nearly level soils on terraces. These soils formed in loess and in the underlying silty alluvium. The native vegetation was mixed water-tolerant hardwoods.

In a representative profile the surface layer is grayish-brown silt loam about 10 inches thick. The subsurface layer is mottled, light-gray, friable silt loam about 4 inches thick. The subsoil is about 51 inches thick. The upper 10 inches is light-gray, friable silt loam; the next 10 inches is mottled, gray, firm silt loam; the next 14 inches is mottled, gray, very firm silty clay loam; and the lower 17 inches is brown and yellowish-brown, firm silt loam. The underlying material, to a depth of about 85 inches, is brown and yellowish-brown stratified silt loam and silty clay loam.

Peoga soils are low in content of organic matter. Available water capacity is high and permeability is very slow. Runoff is very slow or is ponded. Depth to the seasonal high water table is 0 to 1 foot.

Representative profile of Peoga silt loam in a cultivated field about 265 feet east and 210 feet south of the northwest corner of NE¼ sec. 6, T. 7 N., R. 5 E.:

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

A2g—10 to 14 inches, light-gray (10YR 7/1) silt loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, thick, platy structure; friable; common black (10YR 2/1) iron-manganese concretions; very strongly acid; clear, wavy boundary.

B1g—14 to 24 inches, light-gray (10YR 7/1) silt loam; common, coarse, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; common black (10YR 2/1) iron-manganese concretions; extremely acid; clear, irregular boundary.

Bx1g—24 to 34 inches, gray (10YR 6/1) heavy silt loam; many, medium, distinct, light yellowish-brown (2.5Y 6/4) mottles; moderate, medium, prismatic structure that parts to moderate, medium, subangular blocky; firm; 30 to 35 percent brittle material; common black (10YR 2/1) iron-manganese concretions; few gray (10YR 6/1) and light brownish-gray (10YR 6/2) clay films in voids; light-gray (10YR 7/2) silt coatings on faces of prisms; very strongly acid; gradual, wavy boundary.

Bx2g—34 to 48 inches, gray (10YR 6/1) light silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) and light yellowish-brown (2.5Y 6/4) mottles; strong, coarse, prismatic structure that parts to weak, coarse, subangular blocky; very firm; 40 to 50 percent brittle material; thin to moderately thick light-gray (10YR 7/2) clay films in voids and pores; light-gray (10YR 7/1) silt coatings on faces of prisms; many black (10YR 2/1) iron-manganese concretions; very strongly acid; gradual, wavy boundary.

B3—48 to 65 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, light-gray (10YR 7/1) mottles; weak, coarse, prismatic structure; firm and brittle; very strongly acid; gradual, wavy boundary.

C—65 to 85 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/4) stratified silt loam and silty clay loam; common, medium, distinct, light-gray (10YR 7/1) mottles; massive; firm; strongly acid.

The solum ranges from 48 to 72 inches in thickness. In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to gray (10YR 6/1). The Ap horizon is strongly acid to neutral depending on the amount of lime applied. The A2 horizon ranges from gray (10YR 5/1) to light gray (10YR 7/1). The B2 horizon ranges from gray (10YR 5/1) to light gray (10YR 7/1) and is silt loam or silty clay loam. The B3 horizon ranges from gray (10YR 6/1) and gray (10YR 5/1) to yellowish brown (10YR 5/4) and is loam, silt loam, or silty clay loam.

Peoga soils are adjacent to and formed in material similar to that of the somewhat poorly drained Bartle and Dubois soils. They are grayer in the upper part of the subsoil than Bartle soils. Peoga soils are grayer in the upper part of the subsoil and contain less clay than Dubois soils. They do not have the fragipan of Bartle and Dubois soils.

**Peoga silt loam** (0 to 2 percent slopes) (Pe).—This soil is on broad flat terraces, generally between areas of Bartle and Dubois soils and the toe slopes of the adjacent uplands. Areas range from 5 to 80 acres in size and from 400 feet to one-fourth mile in width. Included in mapping are small areas of somewhat poorly drained soils.

Wetness is the major limitation to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and hay are the major crops. This soil is also suited to permanent pasture grasses and to trees that tolerate wetness. When worked wet this soil tends to crust and become cloddy, thus making it difficult to prepare a good seedbed. This soil tends to dry out slowly in the spring, thus delaying tillage operations. Capability unit IIIw–12; woodland group 2w11.

## Princeton Series

The Princeton series consists of deep, well-drained, gently sloping and moderately sloping soils on uplands. These soils formed in wind-deposited sand. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown fine sandy loam about 10 inches thick. The subsurface layer is dark yellowish-brown, very friable fine sandy loam about 4 inches thick. The subsoil is about 41 inches thick. The upper 8 inches is dark-brown, friable sandy loam; the next 25 inches is reddish-brown, firm sandy clay loam. The next 8 inches is reddish-brown, friable sandy loam. The underlying material, to a depth of about 96 inches, is reddish-brown and strong-brown stratified sandy loam and fine sand to pale-brown, loose fine sand.

Princeton soils are moderate in content of organic matter. Available water capacity is moderate to high

and permeability is moderate. Depth to the seasonal high water table is more than 6 feet.

Representative profile of Princeton fine sandy loam, 6 to 12 percent slopes, eroded, about 10 feet south and 75 feet west of the northeast corner of sec. 17, T. 9 N., R. 6 E.:

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

A2—10 to 14 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; weak, thin, platy structure that parts to weak, coarse, granular; very friable; dark-brown (10YR 3/3) organic coatings in pores and cleavage plains; neutral; clear, smooth boundary.

B21t—14 to 22 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; friable; patchy reddish-brown (5YR 4/4) clay films on faces of peds; light brownish-gray (10YR 6/2) sand coatings on faces of some peds; slightly acid; clear, wavy boundary.

B22t—22 to 47 inches, reddish-brown (5YR 5/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; reddish-brown (5YR 4/4) clay films on faces of peds; medium acid; clear, wavy boundary.

B3t—47 to 55 inches, reddish-brown (5YR 4/4) sandy loam; weak, coarse, subangular blocky structure; friable; reddish-brown (5YR 4/4) clay bridging sand grains and on faces of some peds; yellowish-red (5YR 4/6) sand coatings on faces of some peds; neutral; clear, wavy boundary.

C1—55 to 74 inches, reddish-brown (5YR 4/4) and strong-brown (7.5YR 5/6) stratified sandy loam and fine sand; single grained; loose; neutral to mildly alkaline (calcareous).

C2—74 to 96 inches, pale-brown (10YR 6/3) fine sand; single grained; loose; moderately alkaline (calcareous).

The solum ranges from 40 to 60 inches in thickness. In the Ap horizon color is dark brown (10YR 4/3), brown (10YR 5/3), or dark grayish brown (10YR 4/2). In uncultivated areas a 1- to 4-inch A1 horizon of very dark grayish-brown (10YR 3/2) sandy loam is present. In places a B1 horizon of brown (10YR 5/3) fine sandy loam or loam is present. The B2 horizon is dark brown (7.5YR 4/4), reddish brown (5YR 5/4, 4/4), or yellowish brown (10YR 5/4, 5/6). It is sandy loam, sandy clay loam, or clay loam in the upper part and sandy loam or sandy clay loam in the lower part. In places an A&Bt horizon is below the B22t horizon. The underlying fine sand is neutral or calcareous.

Princeton soils are adjacent to, or near, and formed from material similar to that of Bloomfield and Ayrshire soils. They have positions on the landscape similar to those of Bloomfield soils, but they have a higher content of clay in the subsoil. Princeton soils have a B2t horizon, whereas Bloomfield soils have an A&Bt horizon containing lamellae of fine sand. They lack the mottled, gray colors of Ayrshire soils.

**Princeton fine sandy loam, 2 to 6 percent slopes** (PrB).—This soil has short slopes on ridgetops adjacent to steeper areas and on side slopes along natural draws. Areas range from 3 to more than 40 acres in size, and are irregularly shaped.

Included with this soil in mapping are a few small moderately sloping areas and some level areas mainly between dune-shaped hills. Also included are a few small areas of Ayrshire soils in low areas between ridges.

Runoff is slow on this soil. Where available water capacity is moderate it is the major limitation, but the hazard of erosion is also a limitation to use and management. If adequate erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. The soil is suited to permanent pasture grasses and to trees, and to such specialty crops as melons. Capability unit IIe–11; woodland group 1r2.

**Princeton fine sandy loam, 6 to 12 percent slopes, eroded** (PrC2).—This soil is on rolling dune-shaped hills and on side slopes along natural drainageways. Areas range from 3 to more than 30 acres in size. This soil has the profile described as representative of the series. In places some hills consist of sandy material on the upper part and till on the lower part, and on these hills there generally are seepy areas where the sand and till come in contact.

Included with this soil in mapping are moderately sloping areas and areas of Bloomfield soils. Also included are severely eroded areas, some of which are shown on the map by a severely eroded symbol.

Runoff is medium on this soil. The moderate available water capacity in places, runoff, and the hazard of further erosion are limitations to use and management. If adequate erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Grain sorghum, corn, and wheat are the major crops. This soil is suited to permanent pasture grasses, to trees, and to such specialty crops as melons. Capability unit IIIe–13; woodland group 1r2.

## Rarden Series

The Rarden series consists of moderately deep, well-drained, moderately sloping and strongly sloping soils on uplands. These soils formed in thin loess and the underlying fine-textured material that weathered from gray-green shale. The underlying clay shale bedrock is at a depth of 20 to 40 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is brown silt loam about 3 inches thick. The subsoil is about 23 inches thick. The upper 5 inches is reddish-yellow, firm silty clay loam; the next 10 inches is yellowish-red, firm silty clay; and the lower 8 inches is strong-brown and gray, firm silty clay. The underlying material is yellowish-brown, strong-brown, and light olive-gray, firm, weathered shale about 12 inches thick. The underlying bedrock, to a depth of about 44 inches, is gray-green clay shale.

Rarden soils are low in content of organic matter. Available water capacity is low to moderate and permeability is slow.

Representative profile of Rarden silt loam, 12 to 18 percent slopes, eroded, in an abandoned cultivated field about 676 feet west and 468 feet north of the southeast corner of NW¼ sec. 34, T. 8 N., R. 4 E.:

Ap—0 to 3 inches, brown (10YR 5/3) silt loam; weak, fine and medium, granular structure; friable; abundant fine roots; medium acid; abrupt, smooth boundary.

B1—3 to 8 inches, reddish-yellow (7.5YR 6/6) light silty clay loam; moderate, medium, subangular blocky structure; firm; thin, discontinuous, strong-brown (7.5YR 5/6) clay films on faces of peds and fine pore linings; common fine pores less than 1 millimeter in diameter in ped interiors; many fine roots; strongly acid; clear, smooth boundary.

IIB2t—8 to 18 inches, yellowish-red (5YR 4/6) silty clay; moderate, fine and medium, angular and subangular blocky structure; firm; thin, continuous, reddish-brown (5YR 4/4) clay films on faces of peds; common fine pores that have reddish-brown (5YR 4/4) and light brownish-gray (2.5Y 6/2) pore linings; extremely acid; clear, wavy boundary.

IIB3t—18 to 26 inches, strong-brown (7.5YR 5/6) and gray (2.5Y 5/1) silty clay; moderate, medium, coarse, angular blocky structure; firm; thin, discontinuous, dark-brown (7.5YR 4/4) clay films on faces of some peds and linings in fine pores; few fine pores less than 1 millimeter in diameter; extremely acid; clear, wavy boundary.

IIC1—26 to 38 inches, variegated yellowish-brown (10YR 5/4), strong-brown (7.5YR 5/6), and light olive-gray (5Y 6/2) weathered gray-green shale; massive; firm; extremely acid; abrupt, smooth boundary.

IIC2—38 to 44 inches, gray-green clay shale.

The solum ranges from 20 to 40 inches in thickness. Depth to soft clay shale bedrock ranges from 28 to 40 inches.

In the Ap horizon color ranges from grayish brown (10YR 5/2) to dark yellowish brown (10YR 4/4). In uncultivated areas a thin A1 horizon of very dark grayish-brown (10YR 3/2) silt loam is present. In places an A2 horizon of pale-brown (10YR 6/3) or yellowish-brown (10YR 6/4) silt loam is present. The B2t horizon ranges from reddish brown (2.5YR 4/4) to reddish yellow (7.5YR 6/6) and is silty clay or clay.

Rarden soils have positions on the landscape similar to those of Zanesville, Cincinnati, and Gilpin soils. They do not have the fragipan of Zanesville and Cincinnati soils and they have a thinner solum and have more clay in the subsoil than those soils. Rarden soils have more clay in the subsoil than Gilpin soils.

These soils do not exhibit the wetness characteristics as defined for the series, but this difference does not alter their usefulness and behavior.

**Rarden silt loam, 6 to 12 percent slopes, eroded** (RaC2).—This soil is on ridges, hillsides, and side slopes along natural drainageways, on uplands. Areas range from less than 5 to more than 20 acres in size. This soil has a profile similar to that described as representative of the series, but gray-green shale is at a greater depth.

Included with this soil in mapping are a few small severely eroded areas, some of which are shown on the map by a severely eroded symbol. These severely eroded areas have yellowish-red silty clay exposed on the surface. Also included are small areas where the depth to bedrock is more than 40 inches.

Runoff is medium on this soil. The low to moderate available water capacity is the major limitation, but runoff and the hazard of further erosion are also limitations to use and management. This soil has limited suitability for row crops, but it is suited to hay and small grains. Because the fine-textured subsoil and shale restrict the penetration of roots, the soil is not well suited to such deep-rooted crops as alfalfa. If this soil is cultivated, erosion-control practices are needed. The soil is also suited to trees. During seasons when rainfall is low or poorly distributed, crops and pastures are subject to drought damage. Capability unit IVe–8; woodland group 5d22.

**Rarden silt loam, 12 to 18 percent slopes, eroded** (RaD2).—This soil is on hillsides and side slopes along natural drainageways on uplands. Areas range from 10 to more than 40 acres in size. This soil has the profile described as representative of the series. Included in mapping are a few small severely eroded areas and a few areas that are only slightly eroded.

Runoff is rapid on this soil. The low to moderate available water capacity is the major limitation, but runoff and the hazard of further erosion are also limitations to use and management. This soil is suited to hay crops, permanent pasture, and to trees. Because the fine-textured subsoil and shale restrict the penetration of roots, the soil is not well suited to such deep-rooted crops as alfalfa. During seasons when rainfall is low or poorly distributed, crops and pastures are subject to drought damage. Capability unit VIe–1; woodland group 5d22.

**Rarden silty clay loam, 12 to 18 percent slopes, severely eroded** (ReD3).—This soil is on hillsides and side slopes along natural drainageways on uplands. Areas range from 10 to more than 20 acres in size. This soil has a profile similar to that described as representative of the series, but the upper 8 to 10 inches has been removed through erosion, the surface layer consists mainly of reddish-yellow silty clay loam, and the depth to underlying bedrock is mainly 20 to 28 inches.

Included with this soil in mapping are small areas of Rockcastle soils and places where the depth to the underlying shale is less than 20 inches. Also included are a few areas that have bedrock exposed in the bottoms of gullies.

Runoff is very rapid on this soil. The low to moderate available water capacity is the major limitation, but runoff and the hazard of further erosion are also limitations to use and management. This soil generally is suited to permanent pasture grasses and to trees. During seasons when rainfall is low or poorly distributed, permanent pasture is subject to drought damage. Capability unit VIIe–1; woodland group 5d22.

## Rensselaer Series

The Rensselaer series consists of deep, very poorly drained, nearly level soils on terraces. These soils are slightly depressional. They formed in loamy outwash material that overlies stratified sand and silt at a depth of about 42 to 60 inches. The native vegetation was water-tolerant hardwoods, sedges, and grasses.

In a representative profile the surface layer is very dark grayish-brown clay loam about 15 inches thick. The subsoil is about 32 inches of firm clay loam that is mottled, dark grayish brown in the upper 10 inches and mottled, grayish brown in the lower 22 inches. The underlying material, to a depth of about 72 inches, is pale-brown, dark-gray, and gray stratified sand, sandy loam, fine sand, and silt.

Rensselaer soils are high in content of organic matter. Available water capacity is high and permeability is slow. Runoff is very slow or ponded. Depth to the seasonal high water table is 0 to 1 foot.

Representative profile of Rensselaer clay loam in a cultivated field about 156 feet east and 830 feet north of the southwest corner of sec. 1, T. 10 N., R. 5 E.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) rubbed, grayish-brown (10YR 5/2) dry, light clay loam; moderate, fine, granular structure; firm; neutral; abrupt, smooth boundary.

A12—7 to 15 inches, very dark grayish-brown (10YR 3/2) rubbed, clay loam; few olive-gray (5Y 4/2) mottles in some ped interiors; moderate, medium and coarse, granular structure; firm; black (10YR 2/1) coatings on faces of peds; neutral; clear, wavy boundary.

B21tg—15 to 25 inches, dark grayish-brown (2.5Y 4/2) clay loam; common, medium, distinct, olive-brown (2.5Y 4/4) mottles; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; firm; black (10YR 2/1) organic coatings on some vertical cleavage planes; thin, discontinuous, dark-gray (N 4/0) clay films on faces of peds; few voids less than 1 millimeter in diameter that have dark-gray (N 4/0) linings; neutral; clear, wavy boundary.

B22tg—25 to 38 inches, grayish-brown (2.5Y 5/2) clay loam; many, medium, distinct, light olive-brown (2.5Y 5/4) and olive-brown (2.5Y 4/4) mottles; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; firm; thin, continuous, dark-gray (10YR 4/1) clay films on faces of peds; few voids less than 1 millimeter in diameter that have dark-gray (10YR 4/1) linings; neutral; clear, smooth boundary.

B3tg—38 to 47 inches, grayish-brown (2.5Y 5/2) clay loam; many, medium, distinct, dark grayish-brown (2.5Y 4/2) and strong-brown (7.5YR 5/6) mottles; weak, very coarse, subangular blocky structure; firm; thin, discontinuous, gray (10YR 5/1) clay films on faces of some peds; few fine voids less than 1 millimeter in diameter that have gray (10YR 5/1) linings; neutral; clear, smooth boundary.

Cg—47 to 72 inches, stratified pale-brown (10YR 6/3) sand, dark-gray (10YR 4/1) sandy loam, and gray (10YR 5/1) fine sand and silt; moderately alkaline (calcareous).

The solum ranges from 40 to 48 inches in thickness. The Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). It ranges from 12 to 20 inches in thickness, but is mainly 12 to 15 inches, and is loam or clay loam. In places a B1 horizon of dark-gray (10YR 4/1) clay loam 3 to 5 inches thick is present. The B2 horizon ranges from dark gray (10YR 4/1) to light brownish gray (10YR 6/2). The B2 horizon is dominantly clay loam, but is sandy clay loam in places. A B3 horizon is not present in places.

Rensselaer soils have solum thickness and positions on the landscape similar to those of Westland and Brookston soils. They have no pebbles in the solum and they have finer textured underlying material than Westland soils. Rensselaer soils have stratification in the underlying material, whereas Brookston soils have compacted till.

**Rensselaer loam** (0 to 2 percent slopes) (Rf).—This soil is in long swales and depressions intermingled with areas of Ayrshire and Princeton soils. Areas are irregularly shaped and range from 5 to more than 100 acres in size and from 100 feet to more than one-fourth mile in width. This soil has a profile similar to that described as representative of the series, but the surface layer is loam and the subsoil has layers of sandy clay loam.

Included with this soil in mapping are small areas that have a surface layer of fine sandy loam and clay loam. Also included are areas of somewhat poorly drained Ayrshire soils.

Wetness is the major limitation to use and management. If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. This soil is also suited to grasses and legumes for forage and to trees that tolerate wetness. Capability unit IIw–1; woodland group 2w11.

**Rensselaer clay loam** (0 to 2 percent slopes) (Rg).—This soil is in wide depressions and in long swales on terraces. Areas are irregularly shaped and range from 10 to more than 80 acres in size, and in places they are more than one-half mile wide. This soil has the profile described as representative of the series. Some low-lying areas are subject to ponding and flooding during periods of high water. Included in mapping are small areas that have a loam surface layer, a few small areas of Westland soils, and a few small areas of somewhat poorly drained Whitaker soils.

Wetness and maintaining the structure of this soil are the major limitations to use and management. If worked wet, this soil becomes puddled; it plows up cloddy, and good seedbeds are difficult to prepare. If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. This soil is also suited to grasses and legumes for forage and to trees that tolerate wetness. Capability unit IIw–1; woodland group 2w11.

## Riverwash

Riverwash (Rh) is on small islands, gravel and sand bars, and natural levees along the Driftwood River, the Flatrock River, and the East Fork of the White River. It consists of sand and gravel mixed with silty material. Most areas are only a few feet above normal streamflow. A single flood can change the size and shape of an area considerably or even remove an area entirely.

Riverwash supports a poor growth of willows, osage-orange, and shrubs. It is not suitable for farming. Capability unit VIIIs–1; woodland group 4r16.

## Rockcastle Series

The Rockcastle series consists of moderately deep, well-drained, steep soils on uplands. These soils formed in fine-textured material that weathered from clay shale. The underlying clay shale is at a depth of 20 to 40 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 1 inch thick. The subsurface layer is light olive-brown silty clay loam 1 inch thick. The subsoil is about 20 inches thick. The upper 9 inches is light olive-brown, firm silty clay loam; and the lower 11 inches is light olive-brown, grayish-brown, and gray, firm silty clay. The underlying material is grayish-brown, yellowish-brown, and gray, very firm, partly weathered shale. The underlying bedrock, to a depth of about 60 inches, is clay shale.

Rockcastle soils are low in content of organic matter. Available water capacity is low and permeability is slow. Runoff is very rapid.

Representative profile of Rockcastle silty clay loam 18 to 35 percent slopes, in woods about 1,140 feet north and

920 feet east of the southeast corner of NW¼ sec. 34, T. 8 N., R. 4 E.:

A1—0 to 1 inch, dark grayish-brown (10YR 4/2) silty clay loam; weak, fine, granular structure; firm; very strongly acid; abrupt, smooth boundary.

A2—1 to 2 inches, light olive-brown (2.5Y 5/4) silty clay loam; weak, fine, subangular blocky structure; firm; strongly acid; abrupt, smooth boundary.

B21—2 to 11 inches, light olive-brown (2.5Y 5/4) heavy silty clay loam; weak, coarse, angular blocky structure; firm; extremely acid; abrupt, smooth boundary.

B22—11 to 22 inches, variegated light olive-brown (2.5Y 5/4), grayish-brown (2.5Y 5/2), and gray (5Y 6/1 silty clay; weak, coarse, subangular blocky structure; firm; small dark grayish-brown (2.5Y 4/2) fragments of partly decomposed gray-green shale; very strongly acid; gradual, wavy boundary.

C1—22 to 36 inches, variegated grayish-brown (2.5Y 5/2), yellowish-brown (10YR 5/8), and gray (5Y 6/1) decomposing shale; relic platy structure; very firm; strongly acid; gradual, smooth boundary.

C2—36 to 60 inches, light olive-brown (2.5Y 5/4), olive (5Y 5/3), and light olive-gray (5Y 6/2) clay shale; very firm; neutral.

The solum ranges from 10 to 22 inches in thickness. Depth to clay shale is 20 to 40 inches.

In the A horizon color ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The B horizon ranges from olive gray (5Y 4/2) to yellowish brown (10YR 5/4) and is silty clay loam, silty clay, or clay.

Rockcastle soils have positions on the landscape similar to those of Berks and Weikert soils. They have a finer textured subsoil, a thinner solum, and contain fewer rock fragments throughout than Berks soils. Rockcastle soils have a finer textured subsoil and contain fewer rock fragments throughout than Weikert soils.

**Rockcastle silty clay loam, 18 to 35 percent slopes** (RkF).—This soil is on hillsides and side slopes along drainageways. Areas range from 15 to more than 100 acres in size. Slopes range from less than 100 feet to more than 300 feet in length. In places, mainly on the upper slopes, the surface layer is silt loam.

Included with this soil in mapping are areas of Rarden soils on narrow ridges, areas of Burnside soil in small narrow bottoms, and a few outcroppings of gray-green shale bedrock. Also included, in areas where this soil joins them, are small areas of Berks and Weikert soils, 25 to 50 percent slopes.

The low available water capacity and depth to bedrock are major limitations, but runoff and the hazard of erosion are also limitations to use and management. This soil is suited to trees. Capability unit VIIe–2; woodland group 5d22.

## Rodman Series

The Rodman series consists of very shallow to shallow, excessively drained, steep soils on terraces. These soils formed in glacial outwash gravel and sand that are loose at a depth of 8 to 15 inches. The native vegetation was mixed drought-tolerant hardwoods.

In a representative profile the surface layer is very dark grayish-brown gravelly loam about 6 inches thick. The subsoil is brown gravelly loam about 6 inches thick. The underlying material, to a depth of about 60 inches, is light brownish-gray and brown, loose gravel and sand.

Rodman soils are moderate in content of organic matter. Available water capacity is very low and permeability is very rapid. Runoff is rapid.

Representative profile of Rodman gravelly loam, 25 to 45 percent slopes, in woods about 150 feet west and 210 feet south of the northeast corner of sec. 36, T. 10 N., R. 5 E.:

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) gravelly loam; weak, moderate, granular structure; friable; moderately alkaline (calcareous); clear, smooth boundary.

B2—6 to 12 inches, brown (10YR 5/3) gravelly loam; weak, coarse, granular structure; friable; very dark grayish-brown (10YR 3/2) organic coatings on faces of some peds; approximately 30 percent of material is more than 2 millimeters in diameter; moderately alkaline (calcareous); clear, smooth boundary.

C—12 to 60 inches, light brownish-gray (10YR 6/2) and brown (10YR 5/3) sand and gravel; single grained; loose; the upper 8 inches has dark-brown (10YR 4/3) coatings on pebbles; moderately alkaline (calcareous).

The solum ranges from 8 to 15 inches in thickness. The surface layer is dark brown (7.5YR 3/2, 10YR 3/3) or very dark grayish brown (10YR 3/2). The B horizon is gravelly loam or loam. The B horizon is dark brown (7.5YR 4/4, 10YR 4/3), brown (10YR 5/3), or dark yellowish brown (10YR 3/4, or 4/4).

Rodman soils have positions on the landscape similar to those of Hennepin soils and are adjacent to or near Fox soils. They have a coarser textured subsoil and underlying material than Hennepin soils. Rodman soils overlie loose gravel and sand, whereas Hennepin soils overlie till. They have a thinner solum and a coarser textured thinner subsoil than Fox soils.

**Rodman gravelly loam, 25 to 45 percent slopes** (RnF).—This soil is on steep narrow, long breaks between areas of nearly level terraces and the adjacent bottom lands. These breaks mainly are along the large outwash plains. Areas generally are 100 to 200 feet wide. Near the crest of some slopes, this soil has a gravelly clay loam subsoil about 10 inches thick. Included in mapping are small areas where the surface layer has been removed and in places loose gravel is exposed on the surface.

The very low available water capacity is the major limitation, but runoff and the hazard of erosion are also limitations to use and management. This soil is best suited to trees. A permanent plant cover should be maintained to help control runoff and erosion. Capability unit VIIs–1; woodland group 4f19.

## Ross Series

The Ross series consists of deep, well-drained, nearly level soils on bottom lands. These soils formed in medium-textured and moderately fine textured neutral alluvium. The native vegetation was mixed hardwood trees and grasses.

In a representative profile the surface layer is dark-brown silty clay loam about 30 inches thick. The underlying material is dark yellowish-brown, friable loam about 15 inches thick. Below this, to a depth of about 72 inches, is dark yellowish-brown stratified sand and sandy loam.

Ross soils are high in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding, mainly in

winter and early in spring, but also occasionally during the growing season. Runoff is slow.

Representative profile of Ross silty clay loam in a cultivated field about 10 feet north and 460 feet west of the southeast corner of NW¼ sec. 9, T. 7 N., R. 6 E.:

Ap—0 to 7 inches, dark-brown (10YR 3/3) rubbed, light silty clay loam; moderate, medium, granular structure; firm; neutral; abrupt, smooth boundary.

A12—7 to 13 inches, dark-brown (10YR 3/3) silty clay loam; moderate, medium, subangular blocky structure; firm; continuous very dark grayish-brown (10YR 3/2) and very dark brown (10YR 2/2) organic coatings on faces of peds; neutral; clear, smooth boundary.

A13—13 to 30 inches, dark-brown (10YR 3/3) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; continuous very dark grayish-brown (10YR 3/2) organic coatings on faces of peds; neutral; clear, smooth boundary.

C1—30 to 37 inches, dark yellowish-brown (10YR 4/4) loam; weak, medium and coarse, subangular blocky structure; friable; discontinuous very dark grayish-brown (10YR 3/2) organic coatings mainly on vertical faces of peds; neutral; clear, smooth boundary.

C2—37 to 45 inches, dark yellowish-brown (10YR 4/4) loam; massive; friable; neutral; abrupt, wavy boundary.

C3—45 to 72 inches, dark yellowish-brown (10YR 3/4) stratified sand and sandy loam; massive; loose; neutral in upper part and moderately alkaline (calcareous) below a depth of 65 inches.

The A horizon ranges from 24 to 40 inches in thickness but is mainly 24 to 30 inches. It is very dark brown (10YR 2/2), dark brown (10YR 3/3), and very dark grayish brown (10YR 3/2). The A horizon is silt loam or silty clay loam that is more than 15 percent sand. The C3 horizon is loam, clay loam, or sandy loam and has gravel and sand layers in places.

Ross soils have positions on the landscape similar to those of the moderately well drained Medway, the well drained Genesee, and the well drained Landes soils. They have a thicker A horizon than Medway soils and do not have the gray mottlings of those soils. Ross soils have a thicker and darker colored A horizon than Genesee soils. They have a thicker A horizon and are finer textured throughout than Landes soils.

**Ross silt loam** (0 to 2 percent slopes) (Ro).—This soil is on broad flat bottom lands mainly in the larger river valleys. This soil has a profile similar to that described as representative of the series, but the surface layer is silt loam and is more friable, thus a seedbed is easier to prepare. This soil generally is at slightly higher elevations, between the well-drained Genesee soils, adjacent to streams, and areas of soils that are not so well drained. Areas range from 30 to more than 640 acres in size.

Included with this soil in mapping are areas that have a surface layer of loam and small areas that have a surface layer of silty clay loam. Also included are areas of Shoals and Medway soils in some of the very narrow, long, old stream meanders; and in a few places there are small areas that have loose gravel at a depth of less than 40 inches.

Flooding is the major hazard to use and management. This soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to overflow damage in winter and early in spring. Some areas are somewhat higher and are not flooded so frequently, thus are better suited to winter wheat. This soil is also suited to grasses and legumes for forage and to trees. Capability unit I–2; woodland group o23.

**Ross silty clay loam** (0 to 2 percent slopes) (Rp).—This soil is on broad flat bottom lands mainly in the larger river valleys. This soil has the profile described as representative of the series. It is usually at a slightly higher elevation, between the well-drained Genesee soils, which are adjacent to the streams, and areas of soils that are not so well drained. Areas range from 30 to more than 600 acres in size.

Included with this soil in mapping are small areas that have a surface layer of silt loam. Also included are areas of Shoals and Medway soils in some of the very narrow, long, old stream meanders.

Flooding is the major hazard to use and management. This soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to overflow damage in winter and early in spring. Some areas are somewhat higher and are not flooded so frequently, thus are better suited to winter wheat. This soil is also suited to grasses and legumes for forage and to trees. If cultivated or pastured when wet, the surface layer is subject to puddling and plows up cloddy, thus making a good seedbed difficult to prepare. Capability unit I–2; Woodland group o23.

## Rossmoyne Series

The Rossmoyne series consists of deep, moderately well drained, gently sloping soils on uplands. These soils formed in 2 to 4 feet of loess and in the underlying loamy glacial till. They have a very firm and brittle fragipan beginning at a depth of about 2 to 3 feet. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark yellowish-brown silt loam about 7 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 108 inches thick. The upper 13 inches is mottled, yellowish-brown, friable to firm silt loam; the next 33 inches is a mottled, dark yellowish-brown, very firm and brittle silty clay loam and silt loam fragipan; and the lower 62 inches is mottled, strong-brown, firm clay loam. The underlying material, to a depth of about 130 inches, is brown, very firm clay loam.

Rossmoyne soils are low in content of organic matter. Available water capacity is moderate and permeability in the fragipan is very slow. Runoff is medium. Depth to the seasonal high water table is 3 to 6 feet.

Representative profile of Rossmoyne silt loam, 2 to 6 percent slopes, eroded, in a cultivated field about 600 feet west and 100 feet south of the northeast corner of sec. 28, T. 9 N., R. 5 E.:

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

A2—7 to 12 inches, brown (10YR 5/3) silt loam; few, medium, distinct, very pale brown (10YR 7/3) mottles; weak, medium, platy structure; friable; few black (10YR 2/1) concretions; common roots; com-

mon very fine voids less than 1 millimeter in diameter; strongly acid; clear, wavy boundary.

B1t—12 to 17 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, light-gray (10YR 7/2) and pale-brown (10YR 6/3) mottles; weak, medium to fine, subangular blocky structure; friable; few black (10YR 2/1) concretions; common roots; few very fine voids less than 1 millimeter in diameter; very strongly acid; clear, wavy boundary.

B2t—17 to 25 inches, yellowish-brown (10YR 5/6) heavy silt loam; common, medium, distinct, light-gray (10YR 7/2), very pale brown (10YR 7/3), and brownish-yellow (10YR 6/8) mottles; moderate, medium, subangular blocky structure; firm; thin patches of light-gray (10YR 7/2) silt coatings mainly on vertical faces of peds; discontinuous dark-brown (7.5YR 4/4) clay films; few small roots; very small voids in ped interiors; very strongly acid; abrupt, irregular boundary.

IIBx1—25 to 35 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) and light-gray (10YR 7/2) mottles; moderate, very coarse, prismatic structure that parts to weak, thick, platy; very firm and brittle; continuous dark-brown (7.5YR 4/4) clay films on faces of prisms; light-gray (10YR 7/2) to very pale brown (10YR 7/3) silt coatings on faces of prisms; thin, very fine, sand coatings on some prism faces; few medium sand grains; few black (10YR 2/1) iron-manganese concretions; very strongly acid; gradual, wavy boundary.

IIBx2—35 to 58 inches, dark yellowish-brown (10YR 4/4) and strong-brown (7.5YR 5/6) silt loam; common, medium, distinct, light-gray (10YR 7/2) mottles; weak, very coarse, prismatic structure that parts to weak, thick, platy; very firm and brittle; thick, continuous, brown (10YR 5/3) clay films on faces of prisms; few black (10YR 2/1) concretions; light-gray (10YR 7/2) to very pale brown (10YR 7/3) silt coatings on faces of prisms; 15 percent fine sand; very strongly acid; gradual, wavy boundary.

IIB3—58 to 120 inches, strong-brown (7.5YR 5/6) heavy clay loam; common, medium, distinct, light-gray (10YR 7/2) and very pale brown (10YR 7/4) mottles; weak, very coarse, subangular blocky structure in upper 20 inches, massive below; firm; grayish-brown (10YR 5/2) clay films; light-gray (10YR 7/2) silt streaks; strongly acid; gradual, wavy boundary.

IIC—120 to 130 inches, brown (10YR 5/3) light clay loam till; massive; very firm; 10 percent fine pebbles; moderately alkaline (calcareous) till.

The solum ranges from 90 to 120 inches in thickness. The loess ranges from 24 to 40 inches in thickness. Depth to the fragipan ranges from 24 to 32 inches.

In the Ap horizon color is dark grayish brown (10YR 4/2) to light yellowish brown (10YR 6/4). This horizon is strongly acid to neutral depending on the amount of lime applied. A B1 horizon is not present in places. The B2 horizon ranges from brown (10YR 5/3) to yellowish brown (10YR 5/6) and is silt loam or light silty clay loam. The Bx horizon is gray (10YR 5/1) to brownish yellow (10YR 6/6) and is silt loam, light silty clay loam, loam, or clay loam. The B3 horizon ranges from strong brown (7.5YR 5/6) to brownish yellow (10YR 6/6) and is loam or clay loam.

Rossmoyne soils are adjacent to the well-drained Cincinnati soils and the somewhat poorly drained Avonburg soils and formed in materials similar to the materials those soils formed in. They have gray mottles in the upper part of the subsoil that Cincinnati soils do not have. Rossmoyne soils are not so gray in the upper part of the subsoil as Avonburg soils.

**Rossmoyne silt loam, 2 to 6 percent slopes, eroded** (RsB2).—This soil is on the upper ends of natural drainageways, on hillsides, and on ridgetops between areas of steeper soils. Areas range from 5 to more than 50 acres in size and from less than 100 to more than 400 feet in width. In places are small severely eroded areas. Wooded areas are very slightly eroded. Included in mapping are small areas of Cincinnati and Avonburg soils.

The moderate available water capacity and the very slow permeability of the fragipan are major limitations, but runoff and the hazard of further erosion are also limitations to use and management. If adequate erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, wheat, and grasses and legumes for forage are the major crops. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to such deep-rooted crops as alfalfa. This soil is also suited to permanent pasture grasses and to trees. Capability unit IIe–7; woodland group 3d9.

## Russell Series

The Russell series consists of deep, well-drained, gently sloping soils on uplands. These soils formed in 2 to 3 feet of loess and in the underlying loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 9 inches thick. The subsoil is about 39 inches thick. The upper 6 inches is yellowish-brown silt loam; the next 11 inches is dark yellowish-brown silty clay loam; and the lower 22 inches is yellowish-brown, firm to friable clay loam. The underlying material, to a depth of about 72 inches, is brown, very firm loam till.

Russell soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. Runoff is medium.

Representative profile of Russell silt loam, 2 to 6 percent slopes, eroded, in a cultivated field about 580 feet west and 795 feet south of the northeast corner of NW¼NE¼ sec. 28, T. 9 N., R. 6 E.:

Ap—0 to 9 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; pieces of yellowish-brown (10YR 5/4) B1 material intermixed; neutral; abrupt, smooth boundary.

B1—9 to 15 inches, yellowish-brown (10YR 5/4) silt loam; moderate, fine, subangular blocky structure; friable; patchy brown (10YR 4/3) clay films on faces of some peds; medium acid; clear, smooth boundary.

B21t—15 to 26 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; continuous dark-brown (7.5YR 4/4) clay films on faces of peds; strongly acid; clear, smooth boundary.

IIB22t—26 to 40 inches, yellowish-brown (10YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm; continuous dark-brown (7.5YR 4/4) clay films on faces of peds; strongly acid; gradual, smooth boundary.

IIB3t—40 to 48 inches, yellowish-brown (10YR 5/4) light clay loam; weak, coarse, subangular blocky structure; friable; discontinuous dark-brown (10YR 4/3) clay films on faces of peds; strongly acid in upper part and neutral in lower part; clear, smooth boundary.

IIC—48 to 72 inches, brown (10YR 5/3) loam till; massive;

very firm; few ½- to 1-inch pebbles; moderately alkaline (calcareous).

The solum ranges from 42 to 60 inches in thickness. The loess ranges from 22 to 40 inches in thickness, but is mainly 24 to 30 inches thick.

In the Ap horizon color is dark brown (10YR 4/3), brown (10YR 5/3), or yellowish brown (10YR 5/4). In uncultivated areas a thin A1 horizon of very dark grayish-brown (10YR 3/2) silt loam is present. An A2 horizon of dark grayish-brown (10YR 4/2) or grayish-brown (10YR 5/2) silt loam is present in places. The B2t horizon is strong brown (7.5YR 5/6), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). The IIB22t horizon is dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4) and is clay loam or silty clay loam that commonly has more than 15 to 20 percent sand.

Russell soils have positions on the landscape and formed in material similar to those of the moderately well drained Xenia soils. They have drainage characteristics similar to those of Miami soils. Russell soils do not have the gray mottles in the upper part of the subsoil that Xenia soils have. They have a thicker solum and a lower content of sand and pebbles in the upper part of the subsoil than Miami soils.

**Russell silt loam, 2 to 6 percent slopes, eroded** (RuB2).—This soil is on side slopes along natural draws and on convex knolls and ridgetops. Areas generally are irregularly shaped and range from about 5 to 20 acres in size.

Included with this soil in mapping are small severely eroded areas. Some of these areas are shown by a severely eroded symbol on the map. These severely eroded areas plow up cloddy; seedbeds are difficult to prepare, and good stands of crops are sometimes difficult to establish. Also included are small areas of moderately well drained Xenia soils and well-drained Miami soils.

Erosion is the major hazard to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grains are the major crops. The soil is also suited to grasses and legumes for forage, and to trees. Capability unit IIe–1; woodland group 1o1.

## Saranac Series

The Saranac series consists of deep, very poorly drained, nearly level soils on bottom lands. These soils formed in fine-textured alluvium. The native vegetation was water-tolerant hardwoods, sedges, and grasses.

In a representative profile the surface layer is very dark grayish-brown to very dark gray silty clay loam about 15 inches thick. The subsoil is dark-gray, firm silty clay about 10 inches thick. The underlying material, about 14 inches thick, is light brownish-gray and gray friable to firm silt loam and silty clay. Below this, to a depth of about 61 inches, is dark-gray stratified silt loam, clay loam, and sandy loam.

Saranac soils are high in content of organic matter. Available water capacity is high and permeability is moderately slow. The soils are subject to flooding, mainly in winter or early in spring, but some areas are flooded during the growing season. Runoff is very slow or ponded. Depth to the seasonal high water table is 0 to 1 foot.

Representative profile of Saranac silty clay loam in a cultivated field about 520 feet east and 936 feet south of the northwest corner of NE¼ sec. 34, T. 10 N., R. 5 E.:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) rubbed, silty clay loam; weak, coarse, angular blocky structure; firm; mildly alkaline; abrupt, smooth boundary.

A12—10 to 15 inches, very dark gray (10YR 3/1) heavy silty clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and grayish-brown (2.5Y 5/2) mottles; weak, coarse, subangular and angular blocky structure; firm; very dark brown (10YR 2/2) organic coatings on pressure faces; mildly alkaline; clear, smooth boundary.

B2g—15 to 25 inches, dark-gray (10YR 4/1) light silty clay; many, medium, distinct, olive-brown (2.5Y 4/4) and dark yellowish-brown (10YR 4/4) mottles; moderately fine, subangular blocky structure; firm; moderately alkaline (calcareous); abrupt, wavy boundary.

C1g—25 to 27 inches, light brownish-gray (10YR 6/2) silt loam; massive; friable; common small snail shells; moderately alkaline (calcareous); abrupt, wavy boundary.

C2g—27 to 39 inches, gray (10YR 5/1) silty clay; massive; firm; moderately alkaline (calcareous); clear, smooth boundary.

C3g—39 to 61 inches, dark-gray (5Y 4/1) stratified silt loam, clay loam, and sandy loam; massive; firm; moderately alkaline (calcareous).

The solum ranges from 20 to 50 inches in thickness. In the Ap horizon color is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The A12 horizon is very dark gray (10YR 3/1) or black (10YR 2/1). Total thickness of the A horizon is 10 to 18 inches. The Bg horizon is dark gray (10YR 4/1, N 4/0), gray (10YR 5/1, N 5/0), or grayish brown (10YR 5/2). The B horizon is silty clay, heavy clay loam, or light clay. The C horizon is stratified layers of silty clay, clay, or heavy clay loam that has strata of silt loam, silt, or sand.

Saranac soils have positions on the landscape similar to those of the somewhat poorly drained Shoals soils. They have a fine-textured solum similar to that of Zipp soils. Saranac soils have a darker colored surface layer and contain more clay throughout than Shoals soils. They have a darker colored surface layer, a thinner solum, and contain less clay and more sand and pebbles in the underlying material than Zipp soils.

**Saranac silt loam, overwash** (0 to 2 percent slopes) (Sa).—This soil is on wide level areas in some valleys and in other valleys it is in low swales and old stream meanders. Areas range from 5 to more than 80 acres in size. They range from less than 200 feet in width in the swales to more than one-fourth mile in width on wide level areas. This soil has a profile similar to that described as representative of the series, but there is 10 to 20 inches of silty overwash on the surface, and the plow layer is more friable; thus the soil is somewhat easier to cultivate. Included in mapping are small areas where the overwash is more than 20 inches thick and a few places where overwash is not present.

Flooding is the major hazard, and wetness is the major limitation to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to flood damage in winter and early in spring. This soil is also suited to permanent

pasture grasses and to trees. Capability unit IIIw–9; woodland group 2w11.

**Saranac silty clay loam** (0 to 2 percent slopes) (Sc).—This soil is on wide level areas in some valleys and in other valleys it is in low swales, backwater areas, and in old stream meanders. Areas range from 10 to more than 360 acres in size and from less than 200 feet in width in the swales to more than one-half mile in width on wide level areas. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas in a valley in section 8 northeast of Hope and in a valley in sections 12 and 13 northeast of Rugby that have limestone bedrock at a depth of less than 40 inches. Included in section 10 northwest of Columbus and adjacent to the Driftwood River Valley is a small area that has shale bedrock at a depth of less than 40 inches. Included in sections 5 and 8 northwest of St. Louis Crossing are narrow long areas of muck soils. These are shown on the map by a muck symbol. Included in some of the major stream valleys are areas of this soil that have a slightly lighter surface color. Also included are areas that have a thin layer of overwash material.

Flooding is the major hazard, and wetness is the major limitation to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Winter wheat is subject to flood damage in winter and early in spring. In places adequate outlets for drainage systems are difficult to develop. If worked or pastured when wet, the surface layer of this soil becomes puddled and plows up cloddy, making a good seedbed difficult to prepare. This soil is also suited to permanent pasture grasses and to trees. Capability unit IIIw–9; woodland group 2w11.

## Shoals Series

The Shoals series consists of deep, somewhat poorly drained, nearly level soils on bottom lands. These soils formed in neutral loamy alluvium. The native vegetation was water-tolerant hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The underlying material is 35 inches thick. The upper 6 inches is mottled, dark grayish-brown, friable silt loam; the next 13 inches is mottled, dark-brown, friable silt loam; and the lower 16 inches is mottled, dark grayish-brown loam. Below this, to a depth of about 60 inches, is grayish-brown, brown, and yellowish-red stratified loam, silt loam, and sandy loam.

Shoals soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding. Runoff is very slow to slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Shoals silt loam, in a slough area, in a cultivated field about 20 feet south and 844 feet east of the northwest corner of SE¼ sec. 28, T. 8 N., R. 6 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; few, medium, distinct, light brownish-gray (10YR 6/2) and brown (10YR 5/3) mottles; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

C1—8 to 14 inches, dark grayish-brown (10YR 4/2) silt loam; few, medium, distinct, grayish-brown (2.5Y 5/2) mottles; moderate, fine, subangular blocky structure; friable; fine voids less than 1 millimeter in diameter that have very dark grayish-brown (10YR 3/2) linings; neutral; clear, smooth boundary.

C2—14 to 27 inches, dark-brown (10YR 4/3) silt loam; common, medium, distinct, grayish-brown (2.5Y 5/2) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, granular structure; friable; few small pieces of charcoal; common sand grains; neutral; gradual, smooth boundary.

C3—27 to 43 inches, dark grayish-brown (10YR 4/2) loam common, medium, distinct, brown (10YR 5/3) and yellowish-red (5YR 4/6) mottles; weak, coarse, subangular blocky structure; friable; neutral; gradual, smooth boundary.

C4—43 to 60 inches, variegated grayish-brown (10YR 5/2, 2.5Y 5/2), brown (10YR 5/3), and yellowish-red (5YR 4/6) stratified loam, silt loam, and sandy loam; massive; friable; moderately alkaline (calcareous).

Mottles or other characteristics related to wetness are below the Ap horizon. Reaction is neutral to moderately alkaline throughout.

In the Ap horizon color is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). In uncultivated areas an A1 horizon 1 to 4 inches thick that is very dark grayish brown (10YR 3/2) is present. The C horizon, extending from the Ap horizon to a depth of 40 inches, ranges from dark brownish gray (10YR 4/2) to yellowish brown (10YR 5/4). It ranges from silt loam that commonly has more than 15 percent sand to light clay loam.

Shoals soils are adjacent to or near the moderately well drained Eel soils and have positions on the landscape similar to those of Saranac soils. They have a grayer C1 horizon than Eel soils. Shoals soils have a lighter colored surface layer and are not so fine textured throughout as Saranac soils.

**Shoals silt loam** (0 to 2 percent slopes) (Sh).—This soil is on broad flat bottom lands and in old channels that meander through areas of better drained soils. It is also on narrow long bottoms that extend up the valleys through areas of uplands. Areas range from less than 200 feet in width in the narrow bottoms to more than one-fourth mile in width in the broad flat areas.

Included with this soil in mapping are a few small areas that have a loam surface layer. Included in some narrow bottoms near Hartsville are areas where limestone bedrock is at a depth of 20 to 40 inches. Also included are small areas of Eel soils.

Flooding is the major hazard and wetness the major limitation to use and management. If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to flood damage in winter and early in spring. Some of the narrow bottoms, too small to cultivate with large equipment, are mainly used for pasture. This soil is also suited to trees that tolerate wetness. Capability unit IIw–7; woodland group 2w13.

## Sleeth Series

The Sleeth series consists of deep, somewhat poorly drained, nearly level soils on terraces. These soils formed in loamy outwash that overlies loose gravel

and sand at a depth of about 40 to 60 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown loam about 9 inches thick. The subsurface layer is grayish-brown, friable loam about 5 inches thick. The subsoil is about 36 inches thick. The upper 8 inches is mottled, pale-brown, firm clay loam; the next 16 inches is mottled, light brownish-gray, firm clay loam; the next 7 inches is mottled, light brownish-gray, firm gravelly clay loam; and the lower 5 inches is grayish-brown, firm gravelly clay loam. The underlying material, to a depth of about 60 inches, is gray, loose gravel and sand.

Sleeth soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. Runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Sleeth loam in a cultivated field about 70 feet south and 400 feet east of the northwest corner of sec. 26, T. 9 N., R. 5 E.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; few worm holes and casts; neutral; abrupt, smooth boundary.

A2—9 to 14 inches, grayish-brown (10YR 5/2) loam; common, medium, distinct, pale-brown (10YR 6/3) mottles; moderate, medium, granular structure; friable; root and worm holes filled with dark grayish-brown (10YR 4/2) material; neutral; clear, smooth boundary.

B21t—14 to 22 inches, pale-brown (10YR 6/3) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; discontinuous grayish-brown (10YR 5/2) clay films; root and worm holes filled with dark grayish-brown (10YR 4/2) material; medium acid; clear, wavy boundary.

B22tg—22 to 38 inches, light brownish-gray (10YR 6/2) clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) and pale-brown (10YR 6/3) mottles; moderate, medium, subangular blocky structure; firm; grayish-brown (10YR 5/2) clay films on faces of peds; common ¼- to ¾-inch pebbles; neutral; clear, smooth boundary.

B23tg—38 to 45 inches, light brownish-gray (10YR 6/2) gravelly clay loam; many, medium, distinct, brown (10YR 5/3) and yellowish-red (5YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; grayish-brown (10YR 5/2) clay films on faces of peds; neutral; clear, wavy boundary.

B3g—45 to 50 inches, grayish-brown (10YR 5/2) gravelly clay loam; few, medium, distinct, brownish-yellow (10YR 6/6) and gray (N 5/0) mottles; weak, coarse, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

C—50 to 60 inches, gray (10YR 5/1) gravel and sand; single grained; loose; moderately alkaline (calcareous).

The solum ranges from 40 to 60 inches in thickness. In the Ap horizon color is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The A2 horizon is light brownish gray (10YR 6/2) or grayish brown (10YR 5/2). In places an A2 horizon is not present. The B2 horizon is mainly dark gray (10YR 4/1), dark grayish brown (10YR 4/2, 2.5Y 4/2), grayish brown (10YR 5/2, 2.5Y 5/2), brown (10YR 5/3), light brownish gray (10YR 6/2), or pale brown (10YR 6/3).

Sleeth soils are similar in drainage and thickness of the solum to Whitaker and Fincastle soils. They have a higher content of pebbles in the lower part of the solum than Whitaker soils. Sleeth soils have a higher content of sand in the upper part of the solum than Fincastle soils. They formed in loamy sediment and the underlying gravel and sand, whereas Whitaker soils formed in stratified sandy and silty sediment and Fincastle soils formed in loess and the underlying till.

**Sleeth loam** (0 to 2 percent slopes) (Sm).—This soil is on flat broad terraces and in long old channels that meander through areas of Fox, Nineveh, and Ockley soils. Areas range from 15 to more than 80 acres in size and from 200 or 300 feet to more than one-fourth mile in width.

Included with this soil in mapping are narrow long areas of very poorly drained Westland soils and a few areas of well-drained Fox, Ockley, and Nineveh soils. Also included, where this soil adjoins areas of Martinsville soils, are small areas of Whitaker soils.

Wetness is the major limitation to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIw–2; woodland group 3w5.

## Steff Series

The Steff series consists of deep, moderately well drained, nearly level soils on bottom lands. These soils formed in silty acid alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The underlying material, to a depth of about 62 inches, is friable silt loam that is mottled, yellowish brown in the upper 14 inches; mottled, brown in the next 20 inches; and mottled, light brownish gray in the lower 21 inches.

Steff soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding. Runoff is slow. Depth to the seasonal high water table is 3 to 6 feet.

Representative profile of Steff silt loam in a cultivated field about 50 feet north and 1,040 feet east of the southwest corner of SE¼ sec. 11, T. 7 N., R. 4 E.:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

C1—7 to 15 inches, yellowish-brown (10YR 5/4) silt loam; few, medium, distinct, brown (10YR 5/3) and grayish-brown (10YR 5/2) mottles; weak, medium, granular structure; friable; medium acid; clear, smooth boundary.

C2—15 to 21 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, grayish-brown (2.5Y 5/2) and dark yellowish-brown (10YR 4/4) mottles; weak, coarse, subangular blocky structure; friable; few black (10YR 2/1) iron-manganese concretions; few fine voids less than 1 millimeter in diameter that have dark yellowish-brown (10YR 4/4) linings; strongly acid; clear, smooth boundary.

C3—21 to 41 inches, brown (10YR 5/3) silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) (2.5Y 6/2) and yellowish-brown (10YR 5/6) mottles; massive; friable; few black (10YR 2/1) iron-manganese concretions; few fine voids less than 1 millimeter in diameter that have dark yellowish-brown (10YR 4/4) linings; strongly acid; clear, smooth boundary.

C4—41 to 62 inches, light brownish-gray (2.5Y 6/2) silt loam; many, medium, distinct, yellowish-brown

(10YR 5/8) and dark yellowish-brown (10YR 4/4) mottles; massive; friable; strongly acid.

Mottles are at a depth of 16 to 24 inches. Below the Ap horizon the solum is strongly acid or very strongly acid.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3, 4/3). The C1, C2, and C3 horizons are brown (10YR 5/3) to light yellowish brown (10YR 6/4). The C horizon is mainly medium to heavy silt loam; however, in some places, strata of silty clay loam and fine sand are present.

Steff soils have positions on the landscape similar to those of the moderately well drained Wilbur soils and the well drained Haymond soils. They are more acid than Wilbur soils. Steff soils have gray mottles at lesser depth in the solum and are more acid than Haymond soils.

Fine stratification below the surface layer of this soil is not within the defined range of the Steff series, but this difference does not alter its usefulness and behavior.

**Steff silt loam** (0 to 2 percent slopes) (St).—This soil is on bottom lands. It is mainly in long narrow areas adjacent to the stream channels and in places it is in narrow areas between somewhat poorly drained and well-drained soils. Areas generally range from 5 to 15 acres in size and from 100 to 300 feet in width. This soil is mainly in the valleys that drain areas of Illinoian till uplands and unglaciated areas. Included in mapping are small areas of well-drained and somewhat poorly drained soils.

Flooding is the major hazard and moderate wetness is the major limitation to use and management. This soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to flood damage in winter and early in spring. This soil is also suited to grasses and legumes for forage and to trees. Capability unit I–2; woodland group 1o8.

## Stendal Series

The Stendal series consists of deep, somewhat poorly drained soils on bottom lands. These soils formed in silty acid alluvium. The native vegetation was water-tolerant hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 5 inches thick. The underlying material, to a depth of about 60 inches, is friable silt loam that is mottled, brown in the upper 10 inches, mottled, grayish brown in the next 8 inches, and mottled, gray in the lower 37 inches.

Stendal soils are low in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding, mainly in winter and early in spring, but also occasionally during the growing season. Runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Stendal silt loam in a cultivated field about 640 feet north and 20 feet east of the southwest corner of sec. 4, T. 7 N., R. 5 E.:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam; common, medium, distinct, brown (10YR 5/3) mottles; weak, thin, platy structure; friable; few black (10YR 2/1) iron-manganese concretions; few dark grayish-brown (10YR 4/2) worm casts; neutral; abrupt, smooth boundary.

C1—5 to 15 inches, brown (10YR 5/3) silt loam; many, medium, faint, grayish-brown (10YR 5/2) mottles; weak, medium, platy structure; friable; few black (10YR 2/1) iron-manganese concretions; strongly acid; clear, smooth boundary.

C2g—15 to 23 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; few black (10YR 2/1) iron-manganese concretions; strongly acid; gradual, smooth boundary.

C3g—23 to 36 inches, gray (10YR 5/1) silt loam; common, medium, distinct, brown (10YR 5/3) and strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; few black (10YR 2/1) iron-manganese concretions; strongly acid; gradual, smooth boundary.

C4g—36 to 60 inches, gray (10YR 5/1) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/4) mottles; massive; friable; common black (10YR 2/1) iron-manganese concretions; medium acid in lower part.

Below the A horizon this soil is mostly strongly acid or very strongly acid. It has mottles or other characteristics related to wetness.

In the Ap horizon color is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2). The C horizon, below the Ap horizon and to a depth of about 40 inches, ranges from gray (10YR 5/1) to brown (10YR 5/3), and from medium to heavy silt loam.

Stendal soils formed in material similar to that of the poorly drained Bonnie soils and have positions on the landscape and drainage characteristics similar to those of Wakeland soils. They are not so gray in the upper part of the C horizon as Bonnie soils. Stendal soils are more acid throughout than Wakeland soils.

**Stendal silt loam** (0 to 2 percent slopes) (Sx).—This soil is on broad flat areas on bottom lands. Areas range from 10 to more than 160 acres in size and in places are more than one-half mile wide.

Included with this soil in mapping are small areas of poorly drained Bonnie soils on low-lying backwater areas and in old sloughs. Near some of the streams small areas of the moderately well drained Steff soils are included. Also included in places, mainly adjacent to areas of Hickory soils, are small areas of Wakeland soils.

Wetness is the major limitation and flooding the major hazard to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Fall-seeded small grain is subject to flood damage in winter and early in spring, but only occasionally during the growing season do floods damage crops. This soil is also suited to grasses and legumes for pasture and to trees that tolerate wetness. Capability unit IIw–7; woodland group 2w13.

## Stonelick Series

The Stonelick series consists of deep, well-drained, nearly level soils on bottom lands. These soils formed in moderately coarse textured alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown sandy loam about 10 inches thick. The underlying material extends to a depth of 60 inches. The upper 13 inches is dark yellowish-brown, friable loam. The next 11 inches is brown, very friable sandy loam and the lower 26 inches is pale-brown and yellowish-brown, loose sand.

Stonelick soils are moderate in content of organic

matter. Available water capacity is low to moderate and permeability is moderately rapid. The soils are subject to flooding, mainly in winter or early in spring, but also occasionally during the growing season. Runoff is slow.

Representative profile of Stonelick sandy loam in a cultivated field about 270 feet east and 470 feet north of the southwest corner of NE¼ sec. 28, T. 8 N., R. 6 E.:

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

C1—10 to 23 inches, dark yellowish-brown (10YR 4/4) light loam; weak, medium, subangular blocky structure; friable; thin, discontinuous, dark-brown (10YR 4/3) coatings on faces of some peds; moderately alkaline (calcareous); clear, wavy boundary.

C2—23 to 34 inches, brown (10YR 5/3) sandy loam; weak, coarse, subangular blocky structure; very friable; few small snail shells; moderately alkaline (calcareous); clear, wavy boundary.

C3—34 to 60 inches, pale-brown (10YR 6/3) and yellowish-brown (10YR 5/4) sand; single grained; loose; moderately alkaline (calcareous).

Depth to loose sand ranges from 30 to 45 inches. In the Ap horizon color ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4). The C1 and C2 horizons range from dark brown (10YR 4/3) to yellowish brown (10YR 5/4). These horizons range from light loam to loamy sand, but are mainly sandy loam.

Stonelick soils have positions on the landscape similar to those of Genesee and Landes soils. They have a higher content of sand throughout than Genesee soils. Stonelick soils have a lighter colored surface layer and a lower content of gravel throughout than Landes soils.

**Stonelick sandy loam** (0 to 2 percent slopes) (Sz).—This soil is on long, narrow, natural levee areas and on some broad flats mainly on the inside bend of large horseshoe-shaped river meanders. Areas range from 15 to 75 acres in size and in places are more than one-fourth mile in width.

Included with this soil in mapping are a few areas where loose sand is at a depth of 20 to 30 inches, and in places, a thin deposit of loose sand is on the surface. Also included are a few small areas of Riverwash and areas of Genesee soils.

Flooding is the major hazard and the low to moderate available water capacity is the major limitation to use and management. This soil is suited to most crops commonly grown in the county. Grain sorghum, corn, and soybeans are the major crops. The soil is also suited to grasses and legumes for forage and to trees. In years when rainfall is below average or poorly distributed, crops are subject to drought damage. This soil is suitable for irrigation. Capability unit IIs–7; woodland group 1o8.

## Wakeland Series

The Wakeland series consists of deep, somewhat poorly drained, nearly level soils on bottom lands. These soils formed in silty medium acid or neutral alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown silt loam about 7 inches thick. The underlying material, to a depth of 60 inches, is friable silt loam that is mottled, brown in the upper 5 inches, mottled, grayish brown in the next 18 inches, and mottled, gray in the lower 30 inches.

Wakeland soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding, mainly in winter and early in spring, but also occasionally during the growing season. Runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Wakeland silt loam in an abandoned cultivated field about 40 feet west and 400 feet north of the southeast corner of NE¼SE¼ sec. 23, T. 8 N., R. 4 E.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint, grayish-brown (2.5Y 5/2) mottles; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

C1—7 to 12 inches, brown (10YR 4/3) silt loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure; friable; few fine voids less than 1 millimeter in diameter; few black (10YR 2/1) concretions; medium acid; clear, smooth boundary.

C2g—12 to 30 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; few black (10YR 2/1) iron-manganese concretions; few fine voids less than 1 millimeter in diameter that have grayish-brown (10YR 5/2) linings; medium acid; gradual, smooth boundary.

C3g—30 to 60 inches, gray (10YR 6/1) silt loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; massive; friable; few black (10YR 2/1) iron-manganese concretions; few fine voids that have grayish-brown (10YR 5/2) and dark-brown (7.5YR 4/4) linings; thin lenses of sand; medium acid; gradual, smooth boundary.

Reaction below the A horizon is medium acid to neutral. The Ap horizon ranges in color from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The C horizon, below the Ap horizon and to a depth of about 40 inches, ranges from dark gray (10YR 4/1) to brown (10YR 5/3). It ranges to loam in the lower part in places.

Wakeland soils have drainage characteristics and positions on the landscape similar to those of Stendal soils. They formed in material similar to that of the moderately well drained Wilbur soils. Wakeland soils are not as acid throughout and contain somewhat less clay than Stendal soils. They are grayer in the upper part or have more gray mottles nearer to the surface than Wilbur soils.

**Wakeland silt loam** (0 to 2 percent slopes) (Wa).—This soil is on broad flat areas on bottom lands and on narrow long bottoms extending up the valleys between areas of uplands. Areas range from 10 to more than 80 acres in size and in places they are more than one-fourth mile in width.

Included with this soil in mapping are small areas of poorly drained soils in low-lying backwater areas and old sloughs. Also included are small areas of moderately well drained Wilbur soils near some of the streams.

Wetness is the major limitation and flooding is the major hazard to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Fall-seeded small grain is subject to damage

by flooding in winter and early in spring, but occasionally crops are damaged during the growing season. The soil is also suited to grasses and legumes for forage and to trees that tolerate wetness. Capability unit IIw–7; woodland group 2w13.

## Weikert Series

The Weikert series consists of shallow, well-drained very steep soils on uplands. These soils formed in channery and shaly material that weathered from sandstone and shale. The underlying bedrock is at a depth of 10 to 20 inches. The native vegetation was drought-tolerant hardwoods.

In a representative profile the surface layer is dark grayish-brown channery silt loam about 2 inches thick. The subsoil is about 10 inches thick. The upper 4 inches is yellowish-brown, friable channery silt loam and the lower 6 inches is light yellowish-brown, friable channery silt loam. The underlying material is light yellowish-brown channery silt loam about 7 inches thick. The underlying bedrock, at a depth of about 19 inches, is interbedded sandstone and shale.

Weikert soils are low in content of organic matter. Available water capacity is very low and permeability is moderately rapid.

Representative profile of Weikert channery silt loam from an area of Berks and Weikert soils, 25 to 50 percent slopes, in woods about 424 feet west and 20 feet north of the southeast corner of NW¼NW¼ sec. 36, T. 9 N., R. 4 E.:

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) channery silt loam; moderate, fine, granular structure; friable; strongly acid; abrupt, wavy boundary.

B21—2 to 6 inches, yellowish-brown (10YR 5/6) channery silt loam; weak, fine, subangular blocky structure; friable; common fragments of sandstone; patchy clay and silt coatings on fragments; strongly acid; clear, wavy boundary.

B22—6 to 12 inches, light yellowish-brown (10YR 6/4) channery silt loam; weak, fine, subangular blocky structure; friable; very strongly acid; clear, wavy boundary.

C—12 to 19 inches, light yellowish-brown (10YR 6/4) channery silt loam; massive; friable; about 40 percent sandstone and shale fragments; very strongly acid; abrupt, irregular boundary.

R—19 inches, interbedded brown shale and sandstone bedrock.

The solum ranges from 8 to 20 inches in thickness. Depth to bedrock ranges from 10 to 20 inches. The solum is strongly acid or very strongly acid. Shale fragments in the solum below the A horizon range from 20 to 80 percent by volume.

In the A1 horizon color is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2). The B horizon ranges from dark brown (7.5YR 4/4) to light yellowish brown (10YR 6/4). It is shaly silt loam or channery silt loam. The C horizon ranges from brown (7.5YR 5/4) to light yellowish brown (10YR 6/4). It is channery silt loam, shaly silt loam, or shaly silty clay loam. It is not present in places.

Weikert soils developed in materials similar to and are adjacent to Berks soils. They have positions on the landscape similar to those of Rockcastle soils. Weikert soils have a thinner solum and are shallower over bedrock than Berks soils. They are similar in thickness to Rockcastle soils, but have a higher content of shale and sandstone fragments and contain less clay than Rockcastle soils.

## Westland Series

The Westland series consists of deep, very poorly drained, nearly level soils on terraces. These soils are slightly depressional. They formed in loamy glacial outwash material that overlies loose gravel and sand at a depth of 40 to 60 inches. The native vegetation was mixed water-tolerant hardwood trees, grasses, and sedges.

In a representative profile the surface layer is very dark grayish-brown clay loam about 12 inches thick. The subsoil is about 38 inches thick. The upper 34 inches is mottled, gray, firm clay loam and the lower 4 inches is dark-gray, light-gray, and olive-gray, friable gravelly clay loam. The underlying material, to a depth of about 65 inches, is gray, loose gravel and sand.

Westland soils are high in content of organic matter. Available water capacity is high and permeability is slow. Runoff is very slow or ponded. Depth to the seasonal high water table is 0 to 1 foot.

Representative profile of Westland clay loam in a cultivated field about 20 feet north and 100 feet west of the southeast corner of sec. 29, T. 10 N., R. 6 E.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) and grayish-brown (10YR 5/2) dry, clay loam; moderate, medium, granular structure; few ¼- to ½-inch pebbles; neutral; abrupt, smooth boundary.

A12—7 to 12 inches, very dark grayish-brown (10YR 3/2) clay loam; moderate, medium, subangular blocky structure; firm; few ¼- to ½-inch pebbles; neutral; clear, wavy boundary.

B21tg—12 to 27 inches, gray (5Y 5/1) clay loam; few, medium, distinct, light olive-brown (2.5Y 5/4) mottles; weak, coarse, prismatic structure that parts to weak, coarse, subangular blocky; firm; discontinuous, thin, dark-gray (10YR 4/1) clay films; few rounded ¼- to ½-inch pebbles; neutral; gradual, wavy boundary.

B22tg—27 to 46 inches, gray (10YR 5/1) clay loam; common, light olive-brown (2.5Y 5/4, 5/6) mottles; weak, coarse, subangular blocky structure; firm; discontinuous, thin, dark-gray (10YR 4/1) clay films; few fine voids less than 1 millimeter in diameter that have dark-gray (10YR 4/1) linings; few rounded pebbles; neutral; clear, wavy boundary.

B3g—46 to 50 inches, variegated dark-gray (10YR 4/1), light-gray (10YR 7/1), and olive-gray (5Y 5/2) gravelly clay loam; massive; friable; moderately alkaline (calcareous); abrupt, wavy boundary.

Cg—50 to 65 inches, gray (N 5/0) stratified gravel and sand; single grained; loose; moderately alkaline (calcareous).

The solum ranges from 40 to 60 inches in thickness. In the A horizon color is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The A horizon is 12 to 18 inches in thickness. A B1 horizon of dark gray (10YR 4/1) clay loam is present in places. The B2 horizon is mainly gray (10YR 5/1, N 5/0), dark gray (N 4/0, 10YR 4/1), or grayish brown (10YR 5/2, 2.5Y 5/2). It is clay loam or gravelly clay loam. A B3 horizon is not present in places.

Westland soils have positions on the landscape similar to those of Rensselaer and Brookston soils. They have a higher content of pebbles or gravel in the subsoil and have coarser textured underlying material than Rensselaer and Brookston soils.

**Westland clay loam** (0 to 2 percent slopes) (Wc).—This soil is in wide depressions and long swales on

terraces. Areas are irregularly shaped and range from 10 to more than 100 acres in size, and in places are more than one-half mile in width.

Included with this soil in mapping are areas that have a loam surface layer, a few small areas where the depth to the underlying sand and gravel is less than 42 inches, and small areas of muck. These areas are shown on the map by a muck symbol. The muck areas are in low-lying long swales. Also included are small areas of Sleeth and Saranac soils.

Wetness and maintenance of soil structure are the major limitations to use and management. Some low-lying areas are subject to flooding during periods of high water. If worked wet, this soil becomes puddled, plows up cloddy, and good seedbeds are difficult to prepare. If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. This soil is also suited to grasses and legumes for forage and to trees that tolerate wetness. Capability unit IIw–1; woodland group 2w11.

## Whitaker Series

The Whitaker series consists of deep, somewhat poorly drained, nearly level soils on terraces. These soils formed in loamy glacial outwash material that overlies stratified sand and silt at a depth of 40 to 60 inches. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is mottled, grayish-brown, friable loam about 4 inches thick. The subsoil is about 31 inches thick. The upper 18 inches is mottled, brown clay loam and the lower 13 inches is mottled, grayish-brown sandy clay loam. The underlying material, to a depth of about 60 inches, is gray and grayish-brown stratified sandy loam and sandy clay loam.

Whitaker soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. Runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

Representative profile of Whitaker loam in a cultivated field 30 feet north and 583 feet west of the southeast corner of SW¼SE¼ sec. 5, T. 9 N., R. 6 E.:

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

A2—8 to 12 inches, grayish-brown (10YR 5/2) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, granular structure; friable; few black (10YR 2/1) iron-manganese concretions; slightly acid; clear, smooth boundary.

B21t—12 to 30 inches, brown (10YR 5/3) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) and dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; grayish-brown (10YR 5/2) clay films on faces of peds; few black (10YR 2/1) iron-manganese concretions; medium acid; clear, smooth boundary.

B22tg—30 to 43 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) and gray (N 5/0) mottles; weak, medium, subangular blocky structure; firm; grayish-brown (10YR 5/2) clay films on faces of peds; slightly acid; clear, irregular boundary.

Cg—43 to 60 inches, gray (10YR 5/1) and grayish-brown (10YR 5/2) stratified sandy loam and sandy clay loam; massive; friable; moderately alkaline (calcareous).

The solum ranges from 40 to 60 inches in thickness. In the Ap horizon color is brown (10YR 5/3), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2). A B1 horizon of brown (10YR 5/3) or grayish brown (10YR 5/2) loam is present in places. The B2 horizon is mainly grayish brown (10YR 5/2), brown (10YR 5/3), yellowish brown (10YR 5/4), or dark grayish brown (10YR 4/2). It is clay loam or sandy clay loam. The C horizon ranges from loose stratified sand that has minor amounts of silt, to stratified silt that has lenses of sand, and stratified sandy loam and sandy clay loam.

Whitaker soils have positions on the landscape and drainage characteristics similar to those of Sleeth, Henshaw, and McGary soils. They have a lower content of pebbles or gravel throughout the solum than Sleeth soils. Whitaker soils have a higher content of sand throughout the solum than Henshaw soils. They have a higher content of sand and a lower content of clay throughout the solum than McGary soils. Whitaker soils formed in stratified silty material, whereas Sleeth soils formed in loamy material and the underlying gravel and sand, and McGary soils formed in fine-textured lacustrine material.

**Whitaker loam** (0 to 2 percent slopes) (Wh).—This soil is on flat broad terraces and in long old channels that meander throughout areas of Martinsville soils. Areas range from 15 to more than 160 acres in size and from 200 feet to more than one-half mile in width.

Included with this soil in mapping are narrow long areas of very poorly drained Rensselaer soils and a few areas of well-drained Martinsville soils. Also included are a few small areas where the surface layer is silt loam.

Wetness is the major limitation to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and wheat are the major crops. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIw–2; woodland group 3w5.

## Wilbur Series

The Wilbur series consists of deep, moderately well drained, nearly level soils on bottom lands. These soils formed in silty, strongly acid alluvium. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 8 inches thick. The underlying material, to a depth of about 43 inches, is friable silt loam that is dark brown in the upper 9 inches; mottled, brown in the next 13 inches; and mottled, yellowish brown in the next 13 inches. The next 17 inches is light brownish-gray, yellowish-brown, and gray, friable loam.

Wilbur soils are moderate in content of organic matter. Available water capacity is high and permeability is moderate. The soils are subject to flooding, mainly in winter and early in spring. Depth to the seasonal high water table is 3 to 6 feet.

Representative profile of Wilbur silt loam in a cultivated field 150 feet east and 50 feet north of the southwest corner of SE¼NW¼ sec. 24, T. 9 N., R. 4 E.:

Ap—0 to 8 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

C1—8 to 17 inches, dark-brown (10YR 4/3) silt loam; weak, coarse, subangular blocky structure; friable; neutral; clear, smooth boundary.

C2—17 to 30 inches, brown (10YR 5/3) silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; few fine voids less than 1 millimeter in diameter that have dark-brown (7.5YR 4/4) linings; neutral; clear, smooth boundary.

C3—30 to 43 inches, yellowish-brown (10YR 5/4) silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) and dark yellowish-brown (10YR 4/4) mottles; massive; friable; thin depositional strata that have horizontal cleavage; few fine voids less than 1 millimeter in diameter that have grayish-brown (10YR 5/2) linings; neutral; clear, smooth boundary.

IIC4—43 to 60 inches, variegated light brownish-gray (10YR 6/2), yellowish-brown (10YR 5/6), and gray (10YR 6/1) loam; massive; friable; medium acid.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). Reaction in this horizon is medium acid to neutral, depending on the amount of lime applied. The C1, C2, and C3 horizons have matrix colors of dark brown (10YR 4/3) to yellowish brown (10YR 5/4) and have mottles of chroma 2 or less at a depth of less than 24 inches. The C4 horizon is loam in places, or is stratified silt loam, loam, silty clay loam, fine sand, and gravel. Reaction in the C horizon ranges from medium acid to neutral.

Wilbur soils are adjacent to and formed in material similar to that of the well-drained Haymond soils. They have positions on the landscape and drainage characteristics similar to those of Steff soils. Wilbur soils have gray mottles in the upper part of the C horizon that Haymond soils do not have. They are not as acid and contain somewhat more clay than Steff soils.

**Wilbur silt loam** (0 to 2 percent slopes) (Wu).—This soil is on long narrow bottom lands mainly adjacent to stream channels and in places it is in narrow areas between somewhat poorly drained and well-drained soils. Areas generally range from 10 to 20 acres in size and from 100 to 300 feet in width. Included in mapping are small areas of well-drained and somewhat poorly drained soils.

Runoff is slow on this soil. Flooding is the major hazard and moderate wetness is the major limitation to use and management. This soil is suited to most crops commonly grown in the county. Corn and soybeans are the major crops. Winter wheat is subject to flood damage in winter and early in spring. This soil is also suited to grasses and legumes for forage and to trees. Capability unit I–2; woodland group 1o8.

## Xenia Series

The Xenia series consists of deep, moderately well drained, gently sloping soils on uplands. These soils formed in 2 to 3 feet of loess and the underlying loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The subsoil is about 53 inches thick. The upper 21 inches is mottled, brown and yellowish-brown, silty loam and firm silty clay loam; the next 16 inches is mottled, dark-brown, firm clay loam; the next 7 inches is mottled, yellowish-brown, firm clay loam; and the lower 9 inches is dark yellowish-brown, dark-brown, and grayish-brown, firm clay loam. The underlying material, to a depth of about 86 inches, is yellowish-brown and brown, firm loam.

Xenia soils are moderate in content of organic matter. Available water capacity is high and permeability is moderately slow. Runoff is medium. Depth to the seasonal high water table is 3 to 6 feet.

Representative profile of Xenia silt loam, 2 to 6 percent slopes, eroded, in a cultivated field 50 feet west and 50 feet north of the southeast corner of sec. 27, T. 10 N., R. 5 E.:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; some brown (10YR 5/3) material mixed in; neutral; abrupt, smooth boundary.

B1—8 to 11 inches, brown (10YR 5/3) heavy silt loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine and medium, subangular blocky structure; thin, discontinuous, dark yellowish-brown (10YR 4/4) clay films; few fine voids less than 1 millimeter in diameter that have dark yellowish-brown (10YR 4/4) linings; medium acid; clear, smooth boundary.

B21t—11 to 18 inches, yellowish-brown (10YR 5/4) light silty clay loam; common, medium, distinct, brown (10YR 5/3) and light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; thin, continuous, dark yellowish-brown (10YR 4/4) clay films; few voids less than 1 millimeter in diameter that have dark yellowish-brown (10YR 4/4) linings; few black (10YR 2/1) iron-manganese concretions; strongly acid; gradual, smooth boundary.

B22t—18 to 29 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium and coarse, subangular blocky structure; firm; thin, continuous, dark yellowish-brown (10YR 4/4) clay films; few black (10YR 2/1) iron-manganese concretions; strongly acid; clear, wavy boundary.

IIB23t—29 to 45 inches, dark-brown (10YR 4/3) clay loam; many, medium, distinct, brown (10YR 5/3) and light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; continuous brown (10YR 5/3) and dark yellowish-brown (10YR 4/4) clay films; few light-gray (10YR 7/2) silt coatings on vertical faces of peds; some fine uncoated sand grains on few vertical faces of peds; few fine voids less than 1 millimeter in diameter that have black (10YR 2/1) and dark yellowish-brown (10YR 4/4) linings; strongly acid; gradual, smooth boundary.

IIB31t—45 to 52 inches, yellowish-brown (10YR 5/4) clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, coarse, subangular blocky structure; firm; few fine voids less than 1 millimeter in diameter that have black (10YR 2/1) and dark yellowish-brown (10YR 4/4) linings; thin, discontinuous, dark yellowish-brown (10YR 4/4) clay films; strongly acid; gradual, smooth boundary.

IIB32—52 to 61 inches, variegated dark yellowish-brown (10YR 4/4), dark-brown (7.5YR 4/4), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/4) clay loam; weak, coarse, subangular blocky structure; firm; few black (10YR 2/1) iron-manganese concretions; medium acid; clear, wavy boundary.

IIC—61 to 86 inches, yellowish-brown (10YR 5/4) and brown (10YR 5/3) heavy loam; massive; firm; moderately alkaline (calcareous).

The solum ranges from 40 to 65 inches in thickness. Depth to carbonates ranges from 40 to 65 inches. Thickness of the loess ranges from 22 to 40 inches, but is mainly 22 to 27 inches.

The Ap horizon color ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). A thin A2 horizon of grayish-brown (10YR 5/2) silt loam is present in places. A B1 horizon is not present in places. The B2 horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4), and has few to many mottles. This horizon is silty clay loam in the upper part and clay loam or silty clay loam that commonly has more than 15 or 20 percent sand in the lower part. The B3 horizon ranges from brown (10YR 5/3) to yellowish brown (10YR 5/4). The C horizon is loam or light clay loam.

Xenia soils have positions on the landscape and drainage characteristics similar to those of Celina soils. They formed in similar material to, and are adjacent to or near the somewhat poorly drained Fincastle soils and the well-drained Russell soils. Xenia soils have a lower content of sand in the upper part of the subsoil and are deeper to carbonates than Celina soils. They have gray mottles in the upper part of the subsoil that Russell soils do not have. Xenia soils are not so gray in the upper part of the subsoil or contain fewer gray mottles than Fincastle soils.

**Xenia silt loam, 2 to 6 percent slopes, eroded** (XeB2).—This soil is on the upper ends of the side slopes along natural draws and on convex knolls and ridges. Areas are irregularly shaped and range from 4 to 25 acres in size.

Included with this soil in mapping are small severely eroded areas. Some of these areas are shown on the map by a severely eroded symbol. These severely eroded areas plow up cloddy. Seedbeds are difficult to prepare, and good stands are sometimes difficult to establish. Included on the lower parts of slopes and in bottoms of draws are small areas of somewhat poorly drained Fincastle soils. In these areas some type of drainage system is generally needed. Also included are small areas of Russell and Miami soils.

Erosion is the major hazard to use and management. If suitable erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grains are the major crops. The soil is also suited to grasses and legumes for forage and to trees. Capability unit IIe–1; woodland group 1o1.

## Zanesville Series

The Zanesville series consists of deep, well-drained, gently sloping and moderately sloping soils on uplands. These soils formed in 2 to 3 feet of loess and in the underlying material that weathered from sandstone and shale. They have a very firm and brittle fragipan beginning at a depth of about 2 to 3 feet. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is dark-brown silt loam about 5 inches thick. The subsoil is about 52 inches thick. The upper 12 inches is strong-brown, friable silt loam; the next 9 inches is strong-brown, firm silty clay loam; and the lower 31 inches is a fragipan that is mottled, yellowish-brown, very firm and brittle silty clay loam to silt loam. The underlying material, about 11 inches thick, is yellowish-brown loam. The underlying bedrock, at a depth of about 68 inches, is brown and yellowish-brown interbedded sandstone and siltstone.

Zanesville soils are low in content of organic matter. Available water capacity is moderate and permeability in the fragipan is very slow. Depth to interbedded shale and sandstone bedrock is 40 to 80 inches.

Representative profile of Zanesville silt loam, 2 to 6 percent slopes, eroded, in an abandoned cultivated field 50 feet south and 364 feet east of the northwest corner of NE¼ sec. 22, T. 9 N., R. 4 E.:

Ap—0 to 5 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; many roots; few pieces of strong-brown (7.5YR 5/6) material mixed in; medium acid; abrupt, smooth boundary.

B1—5 to 9 inches, strong-brown (7.5YR 5/6) silt loam; weak, moderate, subangular blocky structure; friable; patchy, thin, discontinuous, dark-brown (7.5YR 4/4) clay films; strongly acid; clear, smooth boundary.

B21t—9 to 17 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable; thin, discontinuous, dark-brown (7.5YR 4/4) clay films; few fine voids less than 1 millimeter in diameter that have dark-brown (7.5YR 4/4) linings; strongly acid; clear, smooth boundary.

B22t—17 to 26 inches, strong-brown (7.5YR 5/6) light silty clay loam; moderate, medium, subangular blocky structure; firm; thin, continuous, dark-brown (7.5YR 4/4) clay films; few fine voids less than 1 millimeter in diameter that have dark-brown (7.5YR 4/4) linings; very strongly acid; clear, wavy boundary.

IIBx1—26 to 37 inches, yellowish-brown (10YR 5/4) light silty clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) and pale-brown (10YR 6/3) mottles; moderate, very coarse, prismatic structure that parts to weak, medium, subangular blocky; very firm and brittle; medium and thick, continuous, dark-brown (7.5YR 4/4) clay films on faces of prisms and peds; white (10YR 8/2) silt coatings on faces of prisms; few fine voids less than 1 millimeter in diameter that have dark-brown (7.5YR 4/4) linings; very strongly acid; gradual, smooth boundary.

IIBx2—37 to 46 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, medium, distinct, light brownish-gray (10YR 6/2, 2.5Y 6/2) and strong-brown (7.5YR 5/6) mottles; strong, very coarse, prismatic structure that parts to weak, thick, platy; very firm and brittle; medium and thick, discontinuous, dark-brown (7.5YR 4/4) clay films on faces of prisms; light brownish-gray (10YR 6/2) coatings on faces of prisms; few fine voids less than 1 millimeter in diameter that have dark-brown (7.5YR 4/4) linings; very strongly acid; gradual, smooth boundary.

IIBx3—46 to 57 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) and dark-brown (7.5YR 4/4) mottles; weak, coarse, subangular blocky structure; very firm and brittle; thin, patchy, dark-brown (7.5YR 4/4) coatings on faces of some peds; common fine voids less than 1 millimeter in diameter that have dark-brown (7.5YR 4/4) linings; common sandstone fragments; very strongly acid; gradual, smooth boundary.

IIC—57 to 68 inches, yellowish-brown (10YR 5/4) loam; weak, thick, platy structure (inherent rock structure); many sandstone fragments; very strongly acid; gradual, smooth boundary.

R—68 to 72 inches, brown (7.5YR 5/4) and yellowish-brown (10YR 5/4), partly weathered fine-grained sandstone and siltstone; very strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 40 to 80 inches. Depth to the fragipan ranges from 24 to 36 inches.

In the Ap horizon color ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). In uncultivated areas a thin A1 horizon of very dark gray (10YR 3/1) to grayish-brown (10YR 5/2) silt loam is present. A thin A2 horizon of grayish-brown (10YR 4/2) or brown (10YR 5/3) silt loam is present in places. A B1 horizon is not present in places. The B2t horizon ranges from dark brown (7.5YR 4/4) to yellowish brown (10YR 5/6), and is heavy silt loam or light silty clay loam. The Bx horizon ranges from brown (10YR 4/3) to strong brown (7.5YR 5/6), and is silt loam, heavy silt loam, loam, or light clay loam. The C horizon has few to many sandstone or shale fragments in places and ranges from loam to silt loam that commonly has more than 15 to 20 percent sand.

Zanesville soils have similar drainage characteristics and are adjacent to Gilpin soils. They have positions on the landscape similar in shape to those of Rarden soils. Zanesville soils have a fragipan that Gilpin soils do not have and they are deeper over bedrock. They have a fragipan that Rarden soils do not have, are deeper over bedrock, and they have less clay in the subsoil and underlying material than Rarden soils.

**Zanesville silt loam, 2 to 6 percent slopes, eroded** (ZaB2).—This soil is on uplands, on broad convex ridges (fig. 19), on hillsides, on side slopes along natural draws, and on narrow long ridgetops. It has the profile described as representative of the series.

Included with this soil in mapping, on some of the broad ridgetops, are areas of moderately well drained soils that have gray mottling in the upper part of the subsoil. Included are a few small severely eroded areas, some of which are shown on the map by a severely eroded symbol. Also included are a few small slightly eroded areas.

Runoff is medium on this soil. The very slowly permeable fragipan, moderate available water capacity, runoff, and hazard of further erosion are limitations to use and management. If erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, and small grains are the major crops. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa and other deep-rooted crops. In years when rainfall is less than normal or is poorly distributed, crops are subject to some drought damage. This soil is also suited to grasses and legumes for forage and to trees. Capability unit IIe–7; woodland group 3d9.

**Zanesville silt loam, 6 to 12 percent slopes, eroded** (ZaC2).—This soil is on uplands, on ridgetops, hillsides, and side slopes along natural draws. It has a profile similar to that described as representative of the series, but bedrock is at a shallower depth. Areas range from 5 to more than 40 acres in size.

*Figure 19.*—**Area of Zanesville silt loam, 2 to 6 percent slopes, eroded.**

Included with this soil in mapping are a few small severely eroded areas, some of which are shown on the map by a severely eroded symbol. Also included are small seepy spots, and slightly eroded areas.

Runoff is medium on this soil. The very slow permeability of the fragipan, moderate available water capacity, runoff, and hazard of further erosion are limitations to use and management. If erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, small grains, and grasses and legumes for forage are the major crops. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa and other deep-rooted crops. In years when rainfall is less than normal or is poorly distributed, crops are subject to some drought damage. This soil is also suited to pasture, fruit crops, and trees. Capability unit IIIe–7; woodland group 3d9.

**Zanesville silt loam, 6 to 12 percent slopes, severely eroded** (ZaC3).—This soil is on uplands, on hillsides and side slopes along natural draws. Areas range from 5 to more than 30 acres in size. The slopes range from less than 100 to more than 300 feet in length. This soil has a profile similar to that described as representative of the series, but erosion has removed most of the surface layer and in places part of the subsoil. The plow layer is mainly strong brown. It is not as friable and is more difficult to prepare into a good seedbed than less eroded areas. Near the toe of some slopes is an accumulation of soil material that eroded from upper parts of the slopes. In places the fragipan is exposed on the surface. In places are a few gullies that have bedrock exposed in some of them. In some places are small seepy areas.

Included with this soil in mapping are a few areas of strongly sloping soils. Also included are a few places where the soils have a thin layer of till above the bedrock.

Runoff is rapid on this soil. The very slowly permeable fragipan, moderate available water capacity, runoff, and hazard of further erosion are limitations to use and management. This soil is suited to most crops commonly grown in the county, but it has limited suitability for row crops. Because the fragipan restricts the downward penetration of roots, this soil is not well suited to alfalfa or other deep-rooted crops. In years when rainfall is less than normal or is poorly distributed, crops are subject to some drought damage. This soil is also suited to pasture grasses and to trees. Some areas that are no longer used for crops and pasture are being reforested naturally (fig. 20). Capability unit IVe–7; woodland group 3d9.

*Figure 20.*—**Zanesville silt loam, 6 to 12 percent slopes, severely eroded, supporting sassafras, sumac, and young yellow-poplar.**

### Zipp Series

The Zipp series consists of deep, very poorly drained, nearly level soils on terraces. These soils formed in fine-textured lacustrine deposits. The native vegetation was water-tolerant hardwood trees, sedges, and grasses.

In a representative profile the surface layer is dark-gray silty clay loam about 6 inches thick. The subsoil is mottled, dark-gray and gray, very firm silty clay about 33 inches thick. The underlying material, to a depth of about 60 inches, is mottled, gray stratified silty clay and clay.

Zipp soils are moderate in content of organic matter. Available water capacity is high and permeability is very slow. Runoff is very slow or ponded. Depth to the seasonal high water table is 0 to 1 foot.

Representative profile of Zipp silty clay loam in a cultivated field 50 feet west and 936 feet north of the southeast corner of NW¼ sec. 5, T. 7 N., R. 6 E.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silty clay loam; cloddy, firm; neutral; abrupt, smooth boundary.

B21g—6 to 15 inches, dark-gray (N 4/0) silty clay; few, medium, olive-brown (2.5Y 4/4) mottles; moderate, fine and medium, angular and subangular blocky structure; very firm; very dark gray (N 3/0) coatings on faces of some peds; neutral; clear, smooth boundary.

B22g—15 to 31 inches, gray (10YR 5/1) silty clay; common, medium, distinct, olive (5Y 5/3) and olive-brown (2.5Y 4/4) mottles; weak, medium, prismatic structure that parts to moderate, medium, angular blocky; very firm; dark-gray (N 4/0) coatings on some vertical faces of peds; neutral; clear, smooth boundary.

B3g—31 to 39 inches, gray (5Y 5/1) silty clay; common, medium, distinct, olive-brown (2.5Y 4/4) and olive-gray (5Y 5/2) mottles; weak, medium, subangular blocky structure; very firm; neutral; clear, smooth boundary.

Cg—39 to 60 inches, gray (5Y 5/1) stratified silty clay and clay; common, medium, distinct, olive (5Y 5/4) mottles; massive; very firm; moderately alkaline (calcareous).

The solum ranges from 36 to 48 inches in thickness. In the Ap horizon color is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1). The B horizon ranges from dark gray (2.5Y 4/1) to gray (10YR 6/1). The upper part of the B horizon ranges from heavy silty clay loam to clay and the lower part is silty clay or clay. A B3 horizon is not present in places. The C horizon is clay or silty clay.

Zipp soils are adjacent to the somewhat poorly drained McGary soils and have a fine-textured subsoil similar to that of Saranac soils. They have a darker colored surface layer and contain fewer bright mottles in the subsoil than McGary soils. Zipp soils have a lighter colored surface layer than Saranac soils.

**Zipp silty clay loam** (0 to 2 percent slopes) (Zp).—This soil is in depressions and low swales on terraces that overlie lacustrine material. Areas range from 5 to more than 80 acres in size. Included in mapping are small areas that have a dark-colored surface layer and a few small areas of Henshaw and McGary soils.

Wetness and the very slow permeability of the subsoil are the major limitations to use and management. If a suitable drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. In places adequate outlets for drainage systems are difficult to develop. Corn and soybeans are the major crops. If worked or pastured when wet, the surface layer of this soil becomes puddled and plows up cloddy, making a good seedbed difficult to prepare. In a few low-lying areas this soil is subject to occasional flooding. Because the clayey subsoil restricts the downward penetration of roots, this soil is not well suited to such deep-rooted crops as alfalfa. This soil is also suited to permanent pasture grasses and trees. Capability unit IIIw–2; woodland group 2w11.

## *Use and Management of the Soils*

This section gives information on the use and management of the soils in Bartholomew County for cultivated crops and pasture, engineering structures and practices, town and country planning, trees, wildlife, and recreation. A table for predicted yields for important crops is also given.

Specific management for individual soils is not suggested in this section. Detailed information on use and management can be provided by the local District Conservationist of the Soil Conservation Service or by the Bartholomew County Cooperative Extension Service.

### Use of Soils as Cropland

About 62 percent of the acreage in Bartholomew County is used for crops and pasture (*15*). Corn, soybeans, small grains, grain sorghum, grasses and legumes for forage are the main crops. A small acreage is in specialty crops.

Some of the major management concerns in this county are wetness, the hazard of water erosion, maintaining fertility and organic-matter content, and maintaining or improving tilth. Of the intensively cultivated acreage, about 40 percent is limited by wetness, 11 percent by droughtiness, and 22 percent by erosion. Only 27 percent of the acreage has few limitations for crops (*3*).

The major management practices are installing suitable tile drainage systems, grassing waterways, contour farming, diversion terracing, grade stabilizing, minimum tillage, use of crop residues, planting green-manure crops and winter cover crops. Most of these soils require applications of lime and fertilizer in amounts indicated by tests and field trials.

On the pages that follow, the system of capability grouping used by the Soil Conservation Service is discussed; the soils in each capability unit are described; and management suited to the soils in each unit is suggested. Predicted yields of the principal crops are given for all the soils in the county in table 2.

#### *Capability grouping*

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops (*14*). The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major

and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, subclass, and 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 not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

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

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

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

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–1 or IIIe–7. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Bartholomew County are described and suggestions for the use and management of the soils are given.

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

#### CAPABILITY UNIT I–1

This unit consists of deep, nearly level, well-drained soils of the Camden, Martinsville, and Ockley series. These soils are on uplands and terraces. They have a silt loam, loam, or sandy loam surface layer and a silty clay loam, sandy clay loam, clay loam, or gravelly clay loam subsoil.

The content of organic matter is moderate. Available water capacity is high, and permeability is moderate. The major management needs are maintenance and improvement of tilth and the content of organic matter.

These soils are suitable for most crops commonly grown in the county. Corn, soybeans, small grains, and alfalfa are the major crops. These soils are also suitable for pasture grasses, trees, and special crops. A wide variety of cropping systems, including continuous production of row crops, can be used.

Use of crop residue, minimum tillage, winter cover crops, and green-manure crops help to maintain a desirable content of organic matter and good tilth. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT I–2

This unit consists of deep, nearly level, well drained and moderately well drained soils of the Eel, Genesee, Haymond, Medway, Ross, Steff, and Wilbur series. These soils are on bottom lands. They have a silt loam, silty clay loam, or loam surface layer and loam, silt loam, silty clay loam, or clay loam underlying layer.

The content of organic matter is moderate to high. Available water capacity is high, and permeability is moderate. The major hazard is flooding on this soil

and the major limitation is maintaining tilth. Stream scouring is the only erosion hazard.

These soils are suited to most crops commonly grown in the county. Corn, soybeans, grain sorghum, and grasses and legumes for forage are the main crops. Row crops generally are grown year after year. Fall-seeded small grain is subject to severe damage during periods of prolonged flooding.

Use of crop residue and cover crops help to maintain a favorable content of organic matter and help to protect the soil during winter. In places a close-growing grass such as tall fescue is needed in overflow channels and bare streambanks that are subject to scouring. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IIe–1

This unit consists of deep, gently sloping, well drained and moderately well drained soils of the Celina, Martinsville, Miami, Russell, and Xenia series. These soils have a loam or silt loam surface layer and a sandy clay loam, clay loam, or silty clay loam subsoil.

The content of organic matter is moderate. Available water capacity is high, and permeability is moderate or moderately slow. The major management needs are control of erosion and the maintenance and improvement of content of organic matter and tilth.

These soils are suited to most crops commonly grown in the county. Corn, soybeans, small grains, and alfalfa are the main crops. The soils are also suited to pasture grasses, to trees, and to special crops.

Use of crop residue, winter cover crops, minimum tillage, and grass-legume seedings help to control erosion and maintain good tilth. Grassed waterways, diversion terraces, and contour farming also help control soil losses. A wide variety of cropping systems are suitable for these soils. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IIe–7

This unit consists of deep, gently sloping, well drained and moderately well drained soils of the Cincinnati, Otwell, Rossmoyne, and Zanesville series. These soils have a silt loam surface layer and a silt loam or silty clay loam subsoil that has a very slowly permeable fragipan.

The content of organic matter is low. Available water capacity is moderate, and permeability is very slow. The major management needs are control of erosion and runoff, and maintenance and improvement of content of organic matter and tilth. The very slowly permeable fragipan restricts the downward movement of water and growth of roots.

These soils are suited to most crops commonly grown in the county. Corn, soybeans, small grain, and grasses and legumes for forage are the main crops. Because the fragipan restricts root growth and water penetration, alfalfa and other deep-rooted crops are not well suited to these soils. In years when rainfall is less than normal or poorly distributed, crops are subject to damage from drought. Early spring wetness caused by perching of water above the fragipan often delays farming operations in spring.

Use of minimum tillage, crop residue, and green-manure crops help to maintain or improve content of organic matter and tilth. These practices, along with terracing, contouring and grassed waterways help to control runoff and erosion. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IIe–9

This unit consists of moderately deep, gently sloping, well-drained soils of the Fox and Nineveh series. These soils are on terraces. They have a loam surface layer and a gravelly clay loam subsoil.

Content of organic matter on the Fox soils is moderate and on the Nineveh soils it is high. Available water capacity and permeability are moderate. In years when rainfall is below average or poorly distributed, crops are subject to drought damage. The major management needs are control of erosion and the maintenance of organic-matter content.

These soils are suited to most crops commonly grown in the county. Corn, grain sorghum, wheat, and alfalfa are the main crops. Grain sorghum is often substituted for corn in a cropping system as it is more drought tolerant. Such fall-seeded crops as wheat, that need moisture early in the season but that need little moisture during summer, are suited to these soils. These soils are suited to permanent pasture but midsummer pasture can be damaged by drought.

Use of crop residue, winter cover crops, and minimum tillage help to control erosion and maintain organic-matter content. Several combinations of cropping systems are suited to these soils. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IIe–11

Princeton fine sandy loam, 2 to 6 percent slopes, is the only soil in this unit. It is a deep, well-drained, gently sloping soil on uplands. This soil has a fine sandy loam surface layer and a sandy clay loam subsoil.

The content of organic matter is moderate. Available water capacity is moderate to high, and permeability is moderate. The major management needs are maintenance of organic-matter content and fertility and control of erosion. During years when rainfall is below average or poorly distributed, crops are subject to drought damage.

This soil is suitable for most crops commonly grown in the county. Corn, soybeans, small grains, grasses and legumes for forage are the main crops. Alfalfa, orchard trees, and special crops, such as melons, are also well suited to this soil.

Use of minimum tillage, crop residue, and green-manure crops help to improve and maintain a favorable content of organic matter and soil tilth. Use of contour farming, terracing, and grassed waterways help to control erosion. Crops grown on this soil respond well to applications of fertilizer.

CAPABILITY UNIT IIe–12

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

The content of organic matter is moderate. Available water capacity is high, and permeability is slow.

If an adequate drainage system is established and maintained, these soils are suited to most crops commonly grown in the county. Corn, soybeans, wheat, and legume-grass hay are the main crops. The soils are also suited to permanent pasture.

Use of crop residue, winter cover crops, green-manure crops, and minimum tillage help to control erosion and maintain organic-matter content and tilth. In places where runoff water accumulates, grassed waterways are needed to help control erosion. Many combinations of cropping systems are suited to these soils. Crops grown on these soils respond well to applications of fertilizer.

CAPABILITY UNIT IIw–1

This unit consists of deep, poorly drained and very poorly drained, nearly level soils of the Brookston, Rensselaer, and Westland series. These soils are on terraces and uplands. They have a surface layer of loam, clay loam, or silty clay loam and a subsoil of silt loam, clay loam, silty clay loam, or gravelly clay loam.

The content of organic matter is high. Available water capacity is high, and permeability is slow. During wet seasons, the water table is at or near the surface. The surface layer becomes hard and cloddy if these soils are worked or pastured while wet. The main limitations to use and management are wetness and puddling of the surface layer. Major management needs are the maintenance of tilth and organic-matter content.

If a suitable drainage system is established and maintained, these soils are suited to most crops commonly grown in the county. In places diversion terraces and grassed waterways are needed to intercept and carry off water from adjoining higher areas. Corn and soybeans are the main crops. The soil is also suited to permanent pasture grasses.

Use of green-manure crops, winter cover crops, and crop residue help to maintain organic-matter content. These practices along with minimum tillage help to improve tilth. Refraining from working or grazing these soils when wet helps to reduce soil puddling. These soils are suited to many combinations of cropping systems, including continuous row crops. Crops grown on these soils respond well to applications of fertilizer.

CAPABILITY UNIT IIw–2

This unit consists of deep, nearly level, somewhat poorly drained soils of the Ayrshire, Crosby, Fincastle, Henshaw, Sleeth, and Whitaker series. These soils are on terraces and uplands. They have a surface layer of loam, fine sandy loam, or silt loam and a subsoil of sandy clay loam, clay loam, or silty clay loam.

The content of organic matter is low or medium. Available water capacity is high. Permeability on Ayrshire, Sleeth, and Whitaker soils is moderate, moderately slow on Henshaw soil, and slow on Crosby and Fincastle soils. Wetness is the major limitation to use. Major management needs are improvement and maintenance of content of organic matter and tilth.

If an adequate drainage system is established and maintained, these soils are suited to most crops commonly grown in the county. Corn, soybeans, wheat, and legume-grass hay are the major crops. These soils are suited to many different combinations of cropping systems, including continuous row cropping.

Use of crop residue, winter cover crops, minimum tillage, and green-manure crops help to improve content of organic matter and tilth. Crops grown on these soils respond well to applications of fertilizer.

CAPABILITY UNIT IIw–3

This unit consists of deep, nearly level and gently sloping soils of the Avonburg, Bartle, and Dubois series. These soils are on uplands and terraces. They have a silt loam surface layer and a silt loam or silty clay loam subsoil that has a fragipan.

The content of organic matter is low. Available water capacity is moderate, and permeability is very slow. The fragipan in the subsoil restricts root penetration and downward movement of water and air. Wetness is the major limitation to use. Major management needs are improvement and maintenance of content of organic matter and tilth.

If a suitable drainage system is established and maintained, these soils are suited to most crops commonly grown in the county. These soils are not well suited to alfalfa, a deep-rooted crop, nor tolerant of wetness, because of a fragipan that restricts penetration of roots. The soils are suited to many combinations of cropping systems, including intensive cropping of corn and soybeans. The soils are also suited to pasture grasses.

Use of crop residue, minimum tillage, and green-manure crops help to improve content of organic matter and tilth. Crops grown on these soils respond well to applications of fertilizer.

CAPABILITY UNIT IIw–7

This unit consists of deep, nearly level, somewhat poorly drained soils of the Shoals, Stendal, and Wakeland series. These soils are on bottom lands. They have a surface layer of silt loam and underlying layers of silt loam or loam.

The content of organic matter is low on Stendal soil and moderate on Shoals and Wakeland soils. Available water capacity is high, and permeability is moderate. Flooding is the major hazard and wetness is the major limitation to use and management of this soil. The major management needs are maintaining and improving the content of organic matter and tilth.

If an adequate drainage system is installed and maintained, these soils are suited to most crops commonly grown in the county. The soils are suited to many combinations of cropping systems, including continuous row cropping. Corn and soybeans are the major crops. Such fall-seeded small grain as winter

wheat is subject to flood damage in winter and early in spring. These soils are also suited to permanent pasture grasses.

Use of crop residue, minimum tillage, and greenmanure crops help to improve content of organic matter and tilth. Diversion terraces are needed to protect some areas from runoff from adjacent uplands. In places a close-growing grass such as tall fescue is needed in overflow channels and on bare stream banks that are subject to scouring. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IIs–1

This unit consists of moderately deep, nearly level, well-drained soils of the Fox and Nineveh series. These soils are on terraces. They have a surface layer of loam or gravelly loam and subsoil that is clay loam and gravelly clay loam. They overlie loose gravel and sand at a depth of 24 to 40 inches.

The content of organic matter on Fox soils is moderate and high on Nineveh soils. Available water capacity is moderate, and permeability is moderate. The main limitation to use is droughtiness. In years when rainfall is below normal or poorly distributed, crops are subject to damage from drought. The major management needs are the improvement and maintenance of the content of organic matter and tilth.

These soils are suited to most crops commonly grown in the county. Corn, grain, sorghum, wheat, and alfalfa are the main crops. Because it can withstand more droughty conditions, grain sorghum is often substituted for corn in the cropping system. These soils are suited to permanent pasture grasses but midsummer pasture can be damaged by drought. These soils are well suited to irrigation.

Use of crop residue, winter cover crops, and minimum tillage help to maintain and improve content of organic matter and tilth. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IIs–4

Milton silt loam, 0 to 2 percent slopes, is the only soil in this unit. It is a moderately deep, nearly level, and well-drained soil on uplands and terraces. This soil has a silt loam surface layer, a clay loam subsoil, and overlies limestone bedrock at a depth of 20 to 40 inches.

The content of organic matter is moderate. Available water capacity is low to moderate, and permeability is moderately slow. The main limitations to use are droughtiness and depth over bedrock. The major management needs are the improvement and maintenance of content of organic matter and tilth.

This soil is suited to most crops commonly grown in the county. Corn, grain sorghum, wheat, and hay are the main crops. Because it can withstand more droughty conditions, grain sorghum is often substituted for corn in a cropping system. Such fall-seeded crops as wheat, that need moisture early in the season but have low moisture requirements during the summer, are suited to this soil. This soil is suited to permanent pasture grasses but midsummer pasture can be damaged by drought.

Use of crop residue, cover crops, and minimum tillage help to maintain and improve content of organic matter and tilth. Crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIs–7

This unit consists of moderately deep and deep, nearly level, well-drained soils of the Burnside, Landes, and Stonelick series. These soils are on bottom lands. The Burnside soils have a loam surface layer and flaggy loam underlying layers. The Landes soils have a gravelly sandy loam surface layer and sandy loam or gravelly loam underlying layers. The Stonelick soils have a sandy loam surface layer that overlies sandy loam alluvium.

The content of organic matter on Burnside and Stonelick soils is moderate and on Landes soils it is high. Available water capacity of all the soils in this unit is low to moderate. Permeability of the Burnside soils is moderate and of Landes and Stonelick soils it is moderately rapid. The major hazard is flooding and the main limitation is droughtiness. Major management needs are maintenance and improvement of content of organic matter and tilth. Some areas of Landes soils are 5 to 10 feet higher than adjoining soils on the bottom lands, thus are flooded less frequently and for a shorter duration. The Burnside soils generally are flooded for only a short duration. Flooding generally occurs in winter or early in spring.

These soils are suited to most crops commonly grown in the county. Corn, grain sorghum, soybeans, and hay are the main crops. Because it can withstand more droughty conditions, grain sorghum is often substituted for corn in a cropping system. This soil is also suited to pasture grasses, and some of the narrow bottoms are mainly used for pasture or hay.

Use of crop residue, winter cover crops, and minimum tillage help to maintain and improve content of organic matter and tilth. These soils are well suited to irrigation. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIe–1

This unit consists of deep, moderately sloping, eroded and gently sloping, severely eroded, well-drained soils of the Hickory and Miami series. These soils are on uplands. They have a surface layer of silt loam or clay loam and a subsoil of clay loam.

The content of organic matter is low or moderate. Available water capacity is high, and permeability is moderate or moderately slow. The major hazards are runoff and further erosion. The major management needs are maintenance and improvement of content of organic matter and tilth. If pastured or worked when wet, the severely eroded soils in this unit are subject to becoming cloddy and puddled.

These soils are suited to most crops commonly grown in the county. Corn, soybeans, wheat, and hay are the main crops. The soils are also suited to pasture grasses. Several combinations of cropping systems that help to control erosion and runoff are suited to these soils.

Use of crop residue, minimum tillage, and winter

cover crops help to control runoff and erosion. Green-manure crops help to maintain and increase the content of organic matter and improve tilth. Such practices as contouring and terracing help to control erosion and runoff. Grassed waterways help to control erosion where runoff water accumulates. Crops grown on these soils respond well to applications of fertilizer.

CAPABILITY UNIT IIIe–7

This unit consists of deep, moderately sloping, well-drained soils of the Cincinnati, Otwell, and Zanesville series. These soils are on uplands and terraces. They have a silt loam surface layer and a silt loam or silty clay loam subsoil that has a fragipan.

The content of organic matter is low. Available water capacity is moderate, and permeability is very slow. The major hazards are runoff and erosion. The major limitation to use of these soils is the very slowly permeable fragipan that restricts the downward movement of water and roots. The major management needs are maintenance and improvement of content of organic matter and tilth.

If adequate erosion-control practices are established and maintained, these soils are suitable for most crops commonly grown in the county. Corn, soybeans, wheat, grasses, and legumes are the main crops (fig. 21).

Use of crop residue, minimum tillage, and winter cover crops help to control runoff and erosion. Contour farming and terraces help to control erosion and runoff. Grassed waterways help to control erosion where runoff water concentrates. Several combinations of cropping systems that help to control erosion and runoff are suited to these soils. Green-manure crops help to maintain the content of organic matter and improve soil tilth. Crops grown on these soils respond well to applications of fertilizer.

CAPABILITY UNIT IIIe–8

Milton silt loam, 2 to 6 percent slopes, eroded, is the only soil in this unit. It is a moderately deep, gently sloping, well-drained soil on uplands and terraces. This soil has a silt loam surface layer and a clay loam subsoil. Limestone bedrock is at a depth of 20 to 40 inches.

The content of organic matter is moderate. Available water capacity is low to moderate, and permeability is moderately slow. The major hazards are runoff and erosion. The major limitation to use is the moderate available water capacity. Major management needs

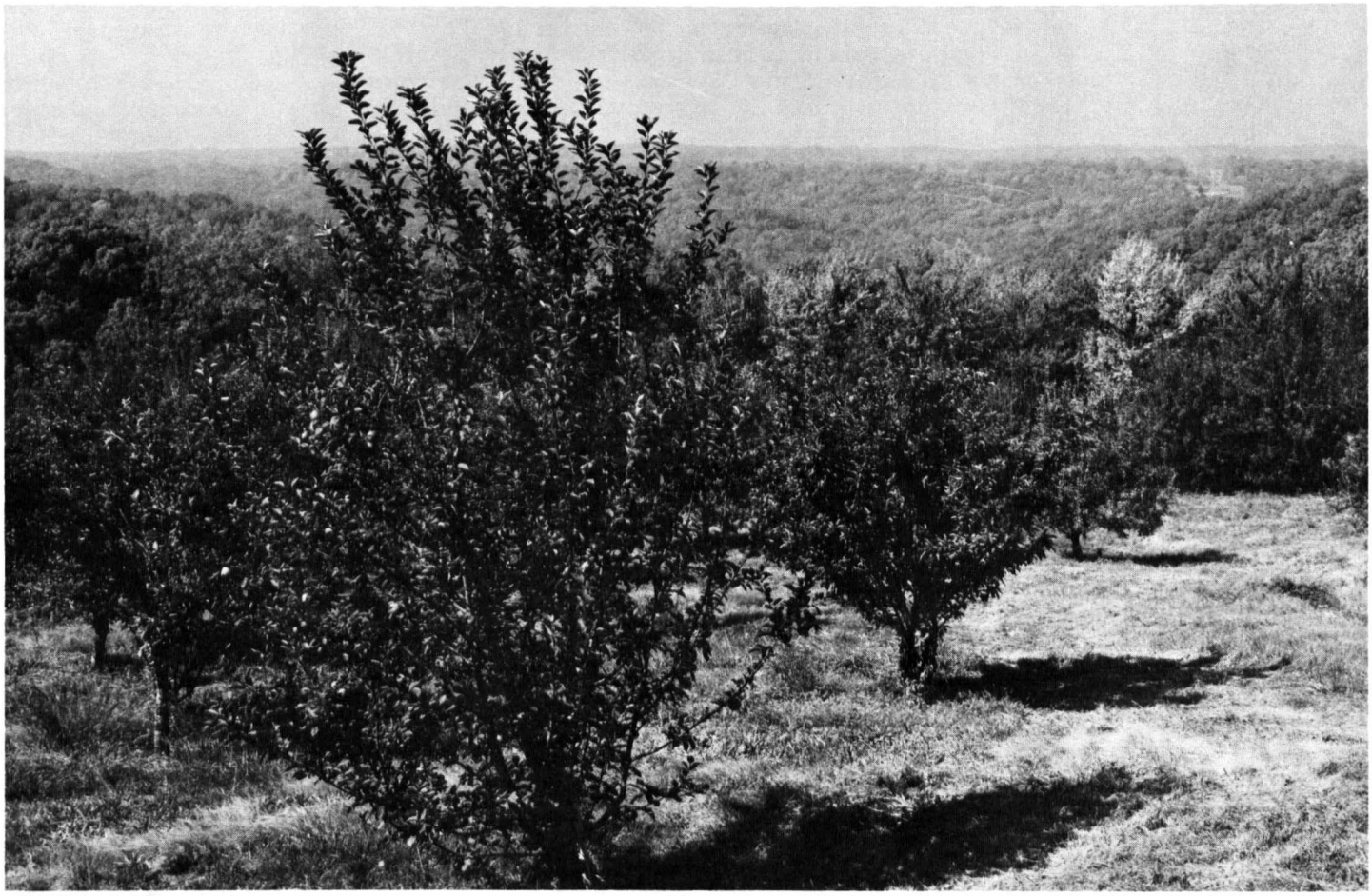

*Figure 21.*—**Apple orchard on Zanesville silt loam, 6 to 12 percent slopes, eroded. Berks and Weikert soils are the steep areas in the background.**

are improvement of content of organic matter and tilth.

If adequate erosion-control practices are established and maintained, this soil is suited to most crops commonly grown in the county. Corn, grain sorghum, wheat, and hay are the main crops. Such fall-seeded crops as wheat, that need moisture early in the season but have low moisture requirements during the summer, are suited to this soil. This soil is suited to permanent pasture grasses but midsummer pasture can be damaged by drought.

Use of crop residue, minimum tillage, and winter cover crops help to control runoff and erosion. Such practices as contouring and terracing help to control erosion and runoff. Grassed waterways help to control erosion where runoff water accumulates. Several combinations of cropping systems that help to control erosion and runoff are suited to this soil. Green-manure crops help to maintain the content of organic matter and improve tilth. Crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIe–12

Bloomfield loamy fine sand, 6 to 12 percent slopes, is the only soil in this unit. It is a deep, well-drained soil on uplands. This soil has a loamy fine sand surface layer and a subsoil of sand and sandy loam.

The content of organic matter is moderate. Available water capacity is low to moderate, and permeability is moderately rapid. The major hazards are erosion and soil blowing. The major limitation to use is droughtiness. A management need is improvement and maintenance of the content of organic matter.

Although this soil is used for most crops commonly grown in the county, moisture limitations make this soil better suited to crops that mature early in the season or have low moisture requirements. Because it can withstand more droughty conditions, grain sorghum is often substituted for corn in a cropping system. Such fall-seeded crops as wheat, that need moisture early in the season but have low moisture requirements during the summer, are suited to this soil. This soil is suited to permanent pasture grasses but midsummer pasture can be damaged by drought. The soil is suited to such specialty crops as melons.

Use of crop residue, minimum tillage, and green-manure crops help to control erosion, prevent soil blowing, and maintain and improve content of organic matter. If moisture is adequate, crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIe–13

Princeton fine sandy loam, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is a deep, well-drained soil on uplands. This soil has a fine sandy loam surface layer and a sandy clay loam subsoil.

The content of organic matter is moderate. Available water capacity is moderate to high, and permeability is moderate. The major hazards are runoff and erosion. The main limitation to use is droughtiness. A major management need is maintenance and improvement of content of organic matter.

This soil is suited to most crops commonly grown in the county. Corn, grain sorghum, wheat, and hay are the main crops. This soil is also suited to pasture grasses and such special crops as melons. Because it can withstand more droughty conditions, grain sorghum is often substituted for corn in a cropping system. Such fall-seeded crops as wheat that need moisture early in the season, but have low moisture requirements during the summer, are suited to this soil.

Use of crop residue, minimum tillage, and winter cover crops help to control runoff and erosion. Green-manure crops help to maintain the content of organic matter and improve tilth. Such practices as contouring and terracing help to control erosion and runoff. Grassed waterways help to control erosion where runoff water accumulates. Several combinations of conservation cropping systems that help to control erosion and runoff are suited to this soil. Crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIw–2

Zipp silty clay loam is the only soil in this unit. It is a deep, very poorly drained, and nearly level soil on terraces. This soil has a silty clay loam surface layer and a silty clay subsoil.

The content of organic matter is moderate. Available water capacity is high, and permeability is very slow. The major limitations to use of this soil are wetness and very slow permeability in the subsoil. The major management needs are maintenance and improvement of content of organic matter and tilth. If worked or pastured when wet, these soils become puddled and plow up cloddy, and good seedbeds are difficult to prepare.

If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Because of excessive wetness, this soil is not well suited to small grain and alfalfa.

Use of crop residue, minimum tillage, and green-manure crops help to improve the content of organic matter and tilth. Crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIw–6

McGary silt loam is the only soil in this unit. It is a deep, somewhat poorly drained, nearly level soil on terraces. This soil has a silt loam surface layer and a silty clay subsoil.

The content of organic matter is low. Available water capacity is moderate, and permeability is very slow. The major limitations to use and management of this soil are wetness and the very slow permeability of the subsoil. The major management needs are drainage and improvement and maintenance of content of organic matter and tilth.

If an adequate drainage system is established and maintained, this soil is suitable for most crops commonly grown in the county. It is not well suited to alfalfa, a deep-rooted crop not tolerant of wetness, because of a subsoil that restricts penetration of roots. Corn, soybeans, wheat, and hay are the major crops. This soil is also suited to pasture grasses.

Minimum tillage, use of crop residue, and growing green-manure crops help to improve and maintain content of organic matter and tilth. Crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIw–9

This unit consists of deep, nearly level, very poorly drained Saranac silt loam, overwash, and Saranac silty clay loam. These soils are on bottom lands. They have a silt loam or silty clay loam surface layer and a silty clay or clay subsoil.

The content of organic matter is high. Available water capacity is high, and permeability is moderately slow. The major hazard is flooding and the major limitation to use is wetness. The major management needs are maintenance and improvement of organic matter content and tilth.

If an adequate drainage system is established and maintained, these soils are suited to most crops commonly grown in the county. Corn, soybeans, wheat, hay, and pasture grasses are the main crops. In areas that are not protected from flooding, fall-seeded small grain is subject to flood damage.

Use of crop residue, minimum tillage, and green-manure crops help to improve and maintain content of organic matter and tilth. Crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIw–10

Bonnie silt loam is the only soil in this unit. It is a deep, poorly drained, and nearly level soil on bottom lands. It has a silt loam surface layer that is underlain by silt loam alluvium.

The content of organic matter is low. Available water capacity is high, and permeability is slow. The major hazard is flooding and the major limitation to use is wetness. The major management needs are maintenance and improvement of content of organic matter and tilth.

If an adequate drainage system is established and maintained, this soil is suited to most crops commonly grown in the county. Corn, soybeans, hay, and pasture grasses are the main crops. Because of excessive wetness and the hazard of flood damage, fall-seeded small grain and alfalfa are not well suited to this soil.

Use of crop residue, minimum tillage, and green-manure crops help to improve and maintain content of organic matter and tilth. Crops grown on this soil respond well to applications of fertilizer.

#### CAPABILITY UNIT IIIw–12

This unit consists of deep, poorly drained, nearly level soils of the Clermont and Peoga series. The Clermont soil is on uplands and the Peoga soil is on terraces. These soils have a silt loam surface layer and a silt loam or silty clay loam subsoil that has a brittle layer.

The content of organic matter is low. Available water capacity is high, and permeability is very slow. Wetness and the very slow permeability of the subsoil are major limitations to use. Major management needs are maintenance and improvement of content of organic matter and tilth.

If an adequate drainage system is established and maintained, these soils are suited to most crops commonly grown in the county. Corn, soybeans, hay, and pasture grasses are the main crops. Because of excess wetness and because the subsoil restricts root penetration, wheat and alfalfa are not well suited to these soils.

Use of crop residue, minimum tillage, and green-manure crops help to maintain and improve content of organic matter and tilth. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IVe–1

This unit consists of deep, well-drained, moderately sloping severely eroded, and strongly sloping eroded soils of the Hickory and Miami series. These soils are on uplands. The surface layer of the severely eroded soils is clay loam and silty clay loam. The surface layer of the eroded soils is silt loam. All of these soils have a clay loam subsoil.

The Hickory soils and severely eroded Miami soil are low in content of organic matter. The eroded Miami soil is moderate in content of organic matter. Available water capacity is high, and permeability is moderate. Runoff and erosion are major hazards. Major management needs are maintenance and improvement of content of organic matter and tilth. If worked or pastured when wet, the severely eroded soils become puddled and plow up cloddy, and good seedbeds are difficult to prepare.

A cropping system that includes small grain, grass-legume hay, and pasture crops and a limited frequency of row crops helps to control runoff and erosion.

Use of crop residue, minimum tillage, and green-manure crops help to maintain and improve content of organic matter and tilth. Use of these practices along with such other practices as contouring and grassed waterways helps to control runoff and erosion.

#### CAPABILITY UNIT IVe–7

This unit consists of deep, well-drained, moderately sloping severely eroded, and strongly sloping eroded soils of the Cincinnati, Otwell, and Zanesville series. These soils are on uplands and terraces. They have a silt loam surface layer and a silt loam and silty clay loam subsoil that has a fragipan.

The content of organic matter is low. Available water capacity is moderate, and permeability is very slow. The major hazards are runoff and erosion. The major limitation to use is the fragipan that causes the moderate available water capacity. Major management needs are maintenance and improvement of content of organic matter and tilth.

A cropping system that includes small grain, grass-legume hay, and pasture crops and a limited frequency of row crops helps to control runoff and erosion. Because the fragipan restricts the downward penetration of roots, alfalfa is not well suited to these soils.

Use of crop residue, minimum tillage, and green-manure crops help to maintain and improve content of organic matter and tilth. Use of these practices along with such other practices as contouring and grassed waterways helps to control runoff and erosion. Crops

grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IVe–8

This unit consists of moderately deep, well-drained, moderately sloping eroded soils of the Milton and Rarden series. These soils are on terraces and uplands. They have a silt loam surface layer. The Milton soil has a clay loam subsoil and the Rarden soil has a silty clay subsoil. They are underlain by bedrock at a depth of 20 to 40 inches.

The content of organic matter is low or moderate. Available water capacity is low or moderate. Permeability is moderately slow on Milton soils and slow on Rarden soils. The major hazards are runoff and erosion. The major limitations to use are the low to moderate available water capacity and the depth over bedrock. Major management needs are maintenance and improvement of content of organic matter and tilth.

A cropping system that includes small grain, grass-legume hay, and pasture crops and a limited frequency of row crops, helps to control runoff and erosion. Because the subsoil and underlying bedrock restrict the downward penetration of the roots, alfalfa is not well suited to Rarden soils.

Use of crop residue, minimum tillage, and green-manure crops help to maintain and improve content of organic matter and tilth. These practices along with such practices as contouring and grassed waterways help to control runoff and erosion. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT IVe–9

Fox complex, 6 to 12 percent slopes, severely eroded, is the only soil in this unit. It is a moderately deep, well-drained, moderately sloping and severely eroded soil on terraces. This soil has a clay loam surface layer and a clay loam subsoil overlying loose gravel and sand.

The content of organic matter is low. Available water capacity is low to moderate, and permeability is moderate. The major hazards are runoff and erosion. The major limitation to use is the low to moderate available water capacity. The major management needs are maintenance and improvement of content of organic matter and tilth. If worked or pastured when wet, the plow layer becomes hard and cloddy.

This soil is suited to cropping systems that include small grain, grass-legume hay, and pasture crops and a limited frequency of row crops.

Use of crop residue, minimum tillage, and green-manure crops help to maintain and improve content of organic matter and tilth. These practices along with such practices as contouring and grassed waterways help to control runoff and erosion. Crops grown on these soils respond well to applications of fertilizer.

#### CAPABILITY UNIT VIe–1

This unit consists of deep and moderately deep, well-drained, strongly sloping and moderately steep, eroded and severely eroded soils of the Cincinnati, Gilpin, Hickory, Miami, and Rarden series. These soils are on uplands. The severely eroded soils have a silt loam, silty clay loam, or clay loam surface layer. The eroded soils have a silt loam surface layer. All of these soils have a silty clay loam, clay loam, or silty clay subsoil. On the Rarden and Gilpin soils bedrock is at a depth of 20 to 40 inches.

The content of organic matter is moderate to low. Available water capacity is moderate to high, and permeability is moderate to very slow. The major hazards are runoff and erosion. The major limitation to use is the moderate available water capacity on some of these soils. The Cincinnati soil has a fragipan. The Gilpin and Rarden soils overlie shale or sandstone bedrock that restricts the downward penetration of roots and also limits the available water capacity.

These soils are suited to hay or pasture crops. Some areas, where the soils have steep slopes or are severely eroded, are better suited to permanent pasture. These soils are also suited to trees and to open-land wildlife habitat.

Permanent grasses and legumes can be maintained by controlled grazing and by timely and adequate applications of lime and fertilizer. Renovating permanent pastures on the contour helps to control erosion during the renovation period. Establishing and maintaining grassed waterways also help to control erosion and runoff.

#### CAPABILITY UNIT VIIe–1

This unit consists of deep and moderately deep, moderately steep and steep, well-drained, slightly eroded to severely eroded soils of the Gilpin, Hennepin, Hickory, and Rarden series, and Gullied land. These soils are on uplands. The severely eroded soils have a silty clay loam or silt loam surface layer and the slightly eroded soils have a loam or silt loam surface layer. The subsoil of these soils is silty clay loam, clay loam, loam, or silty clay.

The content of organic matter is low on these soils but on Hennepin soil it is moderate. Available water capacity is low to moderate, but on Hickory soil it is high. Permeability is moderate. The characteristics of Gullied land are variable. The major hazards are runoff and erosion. The major limitation to use is droughtiness on soils that have low to moderate available water capacity.

These soils are not suited to cultivation, but they are suited to selected hardwood and evergreen trees or permanent-pasture grasses. Well-established native grasses grow well enough to provide limited grazing.

Maintenance of a permanent cover of trees or grass helps to control runoff and erosion. Areas suited to grazing should not be overgrazed.

#### CAPABILITY UNIT VIIe–2

This unit consists of shallow and moderately deep, moderately steep to very steep, well-drained soils of the Berks, Weikert, Corydon, and Rockcastle soils. These soils are on uplands. Berks and Weikert soils have a surface layer of silt loam, or channery and shaly silt loam. Corydon soils have a stony silt loam surface layer, and Rockcastle soils have a silty clay loam surface layer.

The content of organic matter is low, but on Cory-

don soils it is high. Available water capacity is moderate, low, or very low. Permeability is slow to moderately rapid. The major hazards are very rapid runoff and erosion. The major limitations are the limited available water capacity and depth to bedrock.

These soils are not suited to cultivated crops. They are suited to selected hardwood and evergreen trees. Trees help to control runoff and erosion. These soils have limited use as pasture.

CAPABILITY UNIT VIIs–1

Rodman gravelly loam, 25 to 45 percent slopes, is the only soil in this unit. It is shallow over loose sandy gravel, steep to very steep, and excessively drained. This soil is on terrace breaks. The surface layer and subsoil are gravelly loam. Loose gravel and sand are at a depth of less than 15 inches.

The content of organic matter is moderate. Available water capacity is very low, and permeability is very rapid. Runoff and erosion are the major hazards. The major limitations to use are the limited available water capacity and shallowness over loose gravel and sand.

This soil is suited to woodland, wildlife habitat, recreation, and limited grazing. It is suited to early pasture but has limited use as summer pasture. A permanent plant cover is needed to control erosion.

CAPABILITY UNIT VIIIs–1

This unit consists of Riverwash. It is mostly sand and gravel on islands, sandbars, and natural levees along the Driftwood River, Flatrock River, and East Fork of the White River.

Riverwash supports a limited amount of vegetation. It is not suited to production of high-quality hardwoods; however, such low-quality trees as willow and osageorange grow in places. This mapping unit is better suited to wildlife habitat than to most other uses.

### *Predicted yields*

Table 2 shows for each soil the average yields per acre of the principal crops for improved high level of management.

The predicted yields given in table 2 can be expected if the following high-level management practices are used.

1. Using a cropping system that maintains tilth and content of organic matter.
2. Controlling erosion to the maximum extent feasible, so that soil quality is maintained or improved rather than reduced.
3. Maintaining a high level of fertility by means of frequent soil tests and using fertilizer in accordance with recommendations of the State Agricultural Experiment Station.
4. Liming the soils in accordance with the results of soil tests.
5. Using crop residue to the fullest extent practicable to protect and improve the soil.
6. Following minimum tillage practices where needed.
7. Using only the crop varieties that are best adapted to the climate and the soil.
8. Controlling weeds carefully by tillage and by spraying.
9. Draining wet areas so that wetness does not restrict yields of adapted crops.

The yields shown in table 2 are estimated averages for a period of 5 to 10 years. They are based on farm records, on interviews with farmers and members of the staff of the Purdue Agricultural Experiment Station, and on direct observations by soil scientists and soil conservationists. Considered in making the estimates were the prevailing climate, the characteristics of the soils, and the influence of a high level of management on the soils.

These yield figures are not intended to apply directly to specific tracts of land for any particular year, because the soils vary somewhat from place to place, management practices differ from farm to farm, and weather conditions vary from year to year. Nevertheless, these estimates are as accurate a guide as can be obtained without detailed and lengthy investigation. They are useful in showing the relative productivity of soils under a high level of management.

## Use of Soils as Woodland [2]

Hardwood forest originally covered most of Bartholomew County. In 1969 about 20,413 acres was woodland (*15*). Much of the present forest cover is on steep to very steep slopes in upland trees. Many small tracts are on nearly level, poorly drained and very poorly drained soils.

The soils vary widely in their suitability for trees. Productivity is affected by such things as available water capacity, depth of the root zone, thickness of the surface layer, texture, consistence, aeration, natural fertility, and depth to the water table.

Upland oaks, tulip-poplar, pin oak, and sweetgum are the principal woodland crops in Bartholomew County.

Upland oaks are dominant on the well-drained sites. The Cincinnati soils, for example, are well suited to upland oaks and associated species. White oak, red oak, black oak, chinquapin oak, hickory, white ash, sugar maple, and tulip-poplar are the dominant species.

Tulip-poplar generally grows on the lower parts of steep slopes, on cool aspects (north and northeast slopes), and in coves. The Princeton soils, for example, are well suited to tulip-poplar and associated species. Associated species include white ash, red oak, basswood, white oak, hickory, beech, black walnut, and sugar maple. Tulip-poplar is the species to be preferred for planting.

Pin oak grows on poorly drained soils on uplands, terraces, and bottom lands. The Clermont soils, for example, are well suited to pin oak and associated species. Associated species include soft maple, sweetgum, swamp white oak, elm, and ash.

[2] By JOHN O. HOLWAGER, woodland conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average yields per acre of specified crops*

[Dashes indicate the soil is not suitable for growing the crop specified]

| Soil | Corn | Wheat | Soybeans | Legume-grass hay | Pasture |
|---|---|---|---|---|---|
| | *Bu* | *Bu* | *Bu* | *Tons* | [1] *AUM* |
| Avonburg silt loam, 0 to 2 percent slopes | 110 | 50 | 38 | 3.6 | 7.2 |
| Avonburg silt loam, 2 to 4 percent slopes, eroded | 100 | 45 | 35 | 3.3 | 6.6 |
| Ayrshire fine sandy loam | 110 | 50 | 38 | 3.6 | 7.2 |
| Bartle silt loam | 110 | 50 | 38 | 3.6 | 7.2 |
| Berks and Weikert soils, 25 to 50 percent slopes | | | | | |
| Bloomfield loamy fine sand, 6 to 12 percent slopes | 60 | 27 | 21 | 2.0 | 4.0 |
| Bonnie silt loam | 130 | 52 | 46 | 4.3 | 8.6 |
| Brookston silty clay loam | 145 | 65 | 51 | 4.8 | 9.6 |
| Burnside loam | 65 | 30 | 30 | 3.5 | 7.0 |
| Camden silt loam, 0 to 2 percent slopes | 125 | 50 | 44 | 4.1 | 8.2 |
| Celina silt loam, 2 to 6 percent slopes, eroded | 90 | 40 | 32 | 3.0 | 6.0 |
| Cincinnati silt loam, 2 to 6 percent slopes, eroded | 95 | 43 | 33 | 3.1 | 6.2 |
| Cincinnati silt loam, 6 to 12 percent slopes, eroded | 85 | 38 | 30 | 2.8 | 5.6 |
| Cincinnati silt loam, 6 to 12 percent slopes, severely eroded | 75 | 34 | 26 | 2.5 | 5.0 |
| Cincinnati silt loam, 12 to 18 percent slopes, eroded | 70 | 32 | 24 | 2.3 | 4.6 |
| Cincinnati silt loam, 12 to 18 percent slopes, severely eroded | | | | 2.0 | 4.0 |
| Clermont silt loam | 125 | 56 | 44 | 4.1 | 8.2 |
| Corydon stony silt loam, 25 to 40 percent slopes | | | | | |
| Crosby silt loam, 0 to 2 percent slopes | 105 | 47 | 37 | 3.4 | 6.8 |
| Crosby silt loam, 2 to 4 percent slopes, eroded | 100 | 45 | 35 | 3.3 | 6.6 |
| Dubois silt loam | 110 | 50 | 38 | 3.6 | 7.2 |
| Eel silt loam | 120 | 48 | 42 | 4.0 | 8.0 |
| Fincastle silt loam, 0 to 2 percent slopes | 130 | 52 | 46 | 4.3 | 8.6 |
| Fincastle silt loam, 2 to 4 percent slopes, eroded | 125 | 50 | 44 | 4.1 | 8.2 |
| Fox loam, 0 to 2 percent slopes | 90 | 45 | 32 | 3.0 | 6.0 |
| Fox loam, 2 to 6 percent slopes, eroded | 85 | 42 | 30 | 7.8 | 5.6 |
| Fox complex, 6 to 12 percent slopes, severely eroded | 70 | 35 | 24 | 2.3 | 4.6 |
| Genesee loam | 120 | 48 | 42 | 4.0 | 8.0 |
| Gilpin silt loam, 12 to 18 percent slopes, eroded | | 25 | | 1.6 | 3.2 |
| Gilpin silt loam, 12 to 18 percent slopes, severely eroded | | 22 | | 1.5 | 3.0 |
| Gilpin silt loam, 18 to 25 percent slopes | | | | 1.3 | 2.6 |
| Gullied land | | | | | |
| Haymond silt loam | 125 | 50 | 44 | 4.1 | 8.2 |
| Hennepin loam, 18 to 40 percent slopes | | | | 2.0 | 4.0 |
| Henshaw silt loam | 135 | 54 | 47 | 4.4 | 8.8 |
| Hickory silt loam, 6 to 12 percent slopes, eroded | 80 | 35 | 25 | 3.0 | 6.0 |
| Hickory silt loam, 12 to 18 percent slopes, eroded | 85 | 38 | 30 | 2.8 | 5.6 |
| Hickory silt loam, 18 to 25 percent slopes, eroded | | 29 | | 2.1 | 4.2 |
| Hickory silt loam, 25 to 50 percent slopes | | | | 1.6 | 3.2 |
| Hickory silty clay loam, 6 to 12 percent slopes, severely eroded | 70 | 30 | 20 | 3.0 | 6.0 |
| Hickory silty clay loam, 12 to 18 percent slopes, severely eroded | | | | 2.5 | 5.0 |
| Landes gravelly sandy loam, gravelly substratum | 100 | 45 | 35 | 3.3 | 6.6 |
| Martinsville sandy loam, 0 to 2 percent slopes | 115 | 46 | 40 | 3.8 | 7.6 |
| Martinsville loam, 0 to 2 percent slopes | 120 | 48 | 42 | 4.0 | 8.0 |
| Martinsville loam, 2 to 6 percent slopes, eroded | 115 | 46 | 40 | 3.8 | 7.6 |
| McGary silt loam | 100 | 45 | 35 | 3.3 | 6.6 |
| Medway silty clay loam | 130 | 52 | 46 | 4.3 | 8.6 |
| Miami silt loam, 2 to 6 percent slopes, eroded | 105 | 47 | 37 | 3.4 | 6.8 |
| Miami silt loam, 6 to 12 percent slopes, eroded | 95 | 43 | 33 | 3.1 | 6.2 |
| Miami silt loam, 12 to 18 percent slopes, eroded | 80 | 36 | 28 | 2.6 | 5.2 |
| Miami clay loam, 2 to 6 percent slopes, severely eroded | 100 | 45 | 35 | 3.3 | 6.6 |
| Miami clay loam, 6 to 12 percent slopes, severely eroded | 90 | 40 | 32 | 3.0 | 6.0 |
| Miami clay loam, 12 to 18 percent slopes, severely eroded | | | | 2.5 | 5.0 |
| Milton silt loam, 0 to 2 percent slopes | 75 | 38 | 26 | 2.5 | 5.0 |
| Milton silt loam, 2 to 6 percent slopes, eroded | 70 | 35 | 24 | 2.3 | 4.6 |
| Milton silt loam, 6 ot 12 percent slopes, eroded | | 25 | | 1.6 | 3.2 |
| Nineveh loam, 0 to 2 percent slopes | 100 | 45 | 35 | 3.3 | 6.6 |
| Nineveh loam, 2 to 6 percent slopes, eroded | 95 | 43 | 33 | 3.1 | 6.2 |
| Nineveh gravelly loam, 0 to 2 percent slopes | 95 | 43 | 33 | 3.1 | 6.2 |
| Ockley loam, 0 to 2 percent slopes | 110 | 44 | 38 | 3.6 | 7.2 |
| Otwell silt loam, 2 to 6 percent slopes, eroded | 95 | 43 | 33 | 3.1 | 6.2 |
| Otwell silt loam, 6 to 12 percent slopes, eroded | 85 | 38 | 30 | 2.8 | 5.6 |
| Otwell silt loam, 6 to 12 percent slopes, severely eroded | 75 | 34 | 26 | 2.5 | 5.0 |
| Otwell silt loam, 12 to 18 percent slopes, eroded | 70 | 32 | 24 | 2.3 | 4.6 |
| Peoga silt loam | 125 | 50 | 44 | 4.1 | 8.2 |
| Princeton fine sandy loam, 2 to 6 percent slopes | 100 | 45 | 35 | 3.3 | 6.6 |
| Princeton fine sandy loam, 6 to 12 percent slopes, eroded | 85 | 38 | 30 | 2.8 | 5.6 |
| Rarden silt loam, 6 to 12 percent slopes, eroded | 50 | 25 | 18 | 1.6 | 3.2 |
| Rarden silt loam, 12 to 18 percent slopes, eroded | | | | 1.2 | 2.4 |
| Rarden silty clay loam, 12 to 18 percent slopes, severely eroded | | | | 0.8 | 1.6 |
| Rensselaer loam | 150 | 60 | 53 | 5.0 | 10.6 |

TABLE 2.—*Predicted average yields per acre of specified crops*—Continued

| Soil | Corn | Wheat | Soybeans | Legume-grass hay | Pasture |
|---|---|---|---|---|---|
| | *Bu* | *Bu* | *Bu* | *Tons* | *AUM* |
| Rensselaer clay loam | 150 | 60 | 53 | 5.0 | 10.0 |
| Riverwash | | | | 0.5 | 1.0 |
| Rockcastle silty clay loam, 18 to 35 percent slopes | | | | 0.1 | 0.2 |
| Rodman gravelly loam, 25 to 45 percent slopes | 135 | 54 | 47 | 4.4 | 8.8 |
| Ross silt loam | 135 | 54 | 47 | 4.4 | 8.8 |
| Ross silty clay loam | 95 | 43 | 33 | 3.1 | 6.2 |
| Rossmoyne silt loam, 2 to 6 percent slopes, eroded | 115 | 46 | 40 | 3.8 | 7.6 |
| Russell silt loam, 2 to 6 percent slopes, eroded | 125 | 50 | 44 | 4.1 | 8.2 |
| Saranac silt loam, overwash | 125 | 50 | 44 | 4.1 | 8.2 |
| Saranac silty clay loam | 130 | 52 | 46 | 4.3 | 8.6 |
| Shoals silt loam | 120 | 48 | 42 | 4.0 | 8.0 |
| Sleeth loam | 120 | 48 | 42 | 4.0 | 8.0 |
| Steff silt loam | 130 | 52 | 46 | 4.3 | 8.6 |
| Stendal silt loam | 100 | 45 | 35 | 3.3 | 6.6 |
| Stonelick sandy loam | 135 | 54 | 47 | 4.4 | 8.8 |
| Wakeland silt loam | 140 | 56 | 49 | 4.6 | 9.2 |
| Westland clay loam | 140 | 56 | 49 | 4.6 | 9.2 |
| Whitaker loam | 125 | 50 | 44 | 4.1 | 8.2 |
| Wilbur silt loam | 115 | 46 | 40 | 3.8 | 7.6 |
| Xenia silt loam, 2 to 6 percent slopes, eroded | 85 | 38 | 30 | 2.8 | 5.6 |
| Zanesville silt loam, 2 to 6 percent slopes, eroded | 75 | 34 | 26 | 2.5 | 5.0 |
| Zanesville silt loam, 6 to 12 percent slopes, eroded | 65 | 29 | 23 | 2.1 | 4.2 |
| Zanesville silt loam, 6 to 12 percent slopes, severely eroded | 110 | 50 | 38 | 3.6 | 7.2 |
| Zipp silty clay loam | | | | | |

[1] Animal-unit-months per acre. The number of months one animal unit (1 cow, 1 horse, 5 sheep, or 5 goats) can be grazed per acre during the grazing season without damage to the pasture.

Sweetgum is a major forest type on poorly drained upland and terrace soils and on poorly drained and somewhat poorly drained bottom land soils. The Stendal soils, for example, are well suited to sweetgum and associated species. Associated species include soft maple, red river birch, hickory, ash, and sycamore. Sweetgum is a minor component of several timber types.

### *Woodland groups*

The soils of Bartholomew County have been placed in woodland suitability groups to assist owners and managers in planning for the use of the soils for woodland crops. Each group is made up of soils that are suited to the same kinds of trees, that need approximately the same kind of management for similar vegetation, and that have about the same potential productivity.

Each woodland group is identified by a three-part symbol, such as 1o1, 3w5, and 5d22. The first part of the symbol is always a number. It indicates the potential productivity of the soils in the group: 1 indicates it is very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on field determinations of the average site index. Site index is the height, in feet, that the dominant trees of a given species, on a specified kind of soil, reach in a natural, unmanaged stand in a stated number of years. The site index of merchantable hardwoods and softwoods in this county is the height reached in 50 years.

In table 3, the site-index values for upland oak were compiled from USDA Technical Bulletin 560 (*7*); for pin oak and sweet gum, from the Forestry Handbook (*9*); and for tulip-poplar, from unpublished Forest Service data assembled in 1957.

Site indexes can be converted to growth and yield data by following the methods shown in USDA Technical Bulletin 560 (*7*), as adapted by Case, Gingrich, and Lloyd in 1962; or by following the methods in Agricultural Handbook 181 (*5*), as adapted by Case in 1962.

The second part of the symbol identifying a woodland group is a lowercase letter. This letter indicates an important soil property that imposes a slight to severe hazard or limitation in managing the soils of the group for woodland crops. A letter *c* indicates that the main limitation is the kind or amount of clay in the upper part of the soils in the group; *f*, that the soils contain large amounts of coarse fragments; *o*, that the soils have a few limitations that restrict their use for trees; *r*, that the main limitation is steep slopes; *s*, that the soils are sandy and dry, have little or no difference in texture between the surface layer and subsoil, have low available water capacity, and have a low supply of plant nutrients; and *w*, that water in or on the soil, either seasonally or year round, is the chief limitation.

The third part of the symbol is an identification number. Identification numbers are generally assigned locally but are part of a statewide system. Not all the units of the system are represented in Bartholomew County; therefore, the numbers in this survey are not consecutive.

In table 3, each woodland group is rated according to the capabilities, limitations, and hazards of the soils for woodland use. The hazards or limitations that affect management of soils for woodland are windthrow

hazard, erosion hazard, equipment limitations and seedling mortality. Ratings applied to these hazards and limitations in table 3 are slight, moderate, and severe. These hazards and limitations are explained in the following paragraphs. The Guide to Mapping Units, at the back of this survey, shows the woodland group in which each soil has been placed.

*Seedling mortality* refers to the expected loss of natural or planted seedlings attributable to the characteristics of the soils, the hazard of erosion, and the direction of the slope. The rating is *slight* if natural regeneration generally is adequate for restocking. The rating is *moderate* if natural regeneration cannot always be relied upon for adequate and immediate restocking. It is *severe* if considerable replanting, special preparation of the seedbed, and use of superior planting techniques are required to assure satisfactory stands.

The *erosion hazard* refers to the risk of erosion when the soils are managed for production of woodland. The hazard is *slight* if problems of erosion control are unimportant. It is *moderate* if some attention must be given to prevention of unnecessary soil erosion. It is *severe* if intensive erosion-control measures are needed to insure establishment of a satisfactory stand.

*Windthrow hazard* measures the effect of the soils on root development and the ability of the soils to hold trees firmly. The rating is *slight* if there is no special problem and individual trees can be expected to remain standing if released on all sides; *moderate* if development of roots is adequate for stability except during periods of excessive soil wetness or high wind; and *severe* if development of roots is not adequate for stability and individual trees can be expected to blow over if released on all sides.

*Equipment limitation* is rated on the basis of soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting the trees. The limitation is *slight* if there is no restriction on the kind of equipment used or on the time of year it can be used; *moderate* if there is a seasonal restriction of less than 3 months or if there is a moderate restriction caused by slope, wetness, stoniness, or other physical characteristics; and *severe* if there is a seasonal restriction of more than 3 months when equipment cannot be used or if there are other severe restrictions caused by steep slopes, wetness, stoniness, or numerous gullies.

The trees listed as most *desirable species in natural stands* are those that have the most rapid growth rate combined with the highest value and marketability.

*Suitable species for planting* are listed in order of priority of preference. This is not a complete list of suitable trees.

## Wildlife

In table 4 the soils of Bartholomew County are evaluated according to their relative suitability for wildlife habitat. The evaluations or ratings are predictions of the behavior of each soil for wildlife habitat.

The interpretive information can prove helpful to those responsible for making decisions for management of wildlife habitat. The table gives ratings for the following wildlife habitat elements: 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, and ponds. A rating of *good* means wildlife habitat generally is easily created, improved, or maintained. Few or no soil limitations affect management. A rating of *fair* means wildlife habitat generally can be created, improved, or maintained, but moderate soil limitations affect management. A rating of *poor* means wildlife habitat generally can be created, improved, or maintained, but soil limitations are severe. A rating of *very poor* means that it is very questionable that habitat can be created, improved, or maintained; impractical under prevailing conditions.

Soil characteristics that were evaluated to rate the soils are: depth to bedrock, erosion, flooding or ponding, permeability, stoniness, slope, texture, reaction, wetness, depth to seasonal high water table, and available water capacity. The rating of soils for producing wildlife habitat provides an aid in the selection of sites for habitat management, indications of management intensity needed to produce satisfactory results, and a means of grouping known soil conditions for broad-scale wildlife land-use planning, for wildlife land acquisition, and development. These ratings are an aid in showing landowners, in conjunction with soil maps of their property, places where management practices to attract desired wildlife are best applied and helps them in their selection of practices. These ratings can also be useful in showing why the landowner's desire to attract a particular species of wildlife is not feasible.

In evaluating the soils for wildlife elements, no consideration was given to the size and shape of soil areas, nor to the pattern they form with other soils in the landscape. These factors must be considered when an evaluation is made of an area consisting of two or more soils. The ability of wildlife to move from place to place also is disregarded. This is because the wildlife species is not directly rated, while habitat suitability is. Rating criteria are applicable only to wildlife habitat. Ratings used in this section should not be applied to agriculture, woodland, or other soil uses.

In table 4 the column heading *Grain and seed crops* refers to domestic grains or seed crops producing annual herbaceous plants, planted to produce wildlife foods. Examples of these crops include corn, sorghum, wheat, oat, soybean, millet, sunflower, and buckwheat.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes that are established by planting and furnish wildlife cover and food. Examples of these crops include fescue, brome, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, sericea lespedeza, and crown vetch.

*Wild herbaceous upland plants* are native or introduced perennial grasses and weeds that provide food and cover principally to upland forms of wildlife, and are mainly established through natural processes. Examples of these plants include bluestem, wild rye, ragweed, lespedeza, goldenrod, and foxtail.

TABLE 3.—*Suitability of*

[Dashed lines indicate that the species is not numerous enough on the soils of the

| Woodland group | Site index [1] | | | | Seedling mortality |
|---|---|---|---|---|---|
| | Upland oaks | Tulip-poplar | Pin oak | Sweetgum | |
| Group 1o1: Soils deep and moderately deep over sand and gravel, well drained and moderately well drained, and nearly level to strongly sloping. Moderate or high available water capacity, except for the Fox soils, which have low or moderate available water capacity. | 85–95 | 95–105 | ---------- | 70–80 | Slight to moderate |
| Group 1r2: Soils except the Nineveh are deep. Nineveh is moderately deep over sand and gravel. All soils of the group are well drained, nearly level to very steep, and moderate or high in available water capacity. | 85–95 | 95–105 | ---------- | ---------- | Slight to moderate |
| Group 4r3: Gullied land, consisting of gullies 2 to 10 feet deep between narrow ridges 3 to 50 feet wide. | ---------- | ---------- | ---------- | ---------- | Moderate to severe |
| Group 3w5: Deep, somewhat poorly drained, nearly level and gently sloping soils that have moderate to high available water capacity. | 80–90 | 90–100 | 85–100 | 75–85 | Slight |
| Group 3d7: Shallow, well-drained, moderately steep to very steep soils that have low to very low available water capacity. | 65–75 | 80–90 | ---------- | ---------- | Severe |
| Group 1o8: Soils except Burnside are deep. Burnside is moderately deep. All soils are well drained or moderately well drained, nearly level, and subject to flooding. Stonelick has moderate available water capacity and Burnside low to moderate. All other soils have high available water capacity. | ---------- | 95–105 | ---------- | 95–105 | Slight |
| Group 3d9: Deep, well drained and moderately well drained, gently sloping to strongly sloping soils with fragipans, and that have moderate available water capacity. | 70–85 | 90–100 | ---------- | 80–85 | Slight |
| Group 3o10: Moderately deep, well-drained, nearly level to moderately steep soils that have low to moderate available water capacity. | | | | | |
| North-facing slopes | 75–85 | 90–100 | ---------- | ---------- | Slight |
| South-facing slopes | 65–75 | ---------- | ---------- | ---------- | Slight to moderate |
| Group 2w11: Deep, poorly drained and very poorly drained, nearly level soils that have high available water capacity. | 95–105 | 90–105 | 85–105 | 85–95 | Moderate |
| Group 3r12: Shallow and moderately deep, well-drained, steep and very steep soils that have very low to moderate available water capacity. | | | | | |
| North-facing slopes | 80–90 | 80–90 | ---------- | ---------- | Slight |
| South-facing slopes | 70–80 | ---------- | ---------- | ---------- | Slight to moderate |
| Group 2w13: Deep, somewhat poorly drained, nearly level soils that have high available water capacity and that flood. | ---------- | ---------- | 90–105 | 85–95 | Slight |

See footnote at end of table.

*soils for woodland*

group to be a major crop or that measurement of existing trees is not feasible]

| Erosion hazard | Windthrow hazard | Equipment limitations | Desirable species in natural stands | Species suitable for planting |
|---|---|---|---|---|
| Slight to moderate | Slight | Slight to moderate | Tulip-poplar, white ash, red oak, black walnut, white oak. | White pine, shortleaf pine, black locust, red pine. |
| Slight to severe | Slight | Slight to moderate | Tulip-poplar, white ash, red oak, black walnut, white oak. | White pine, shortleaf pine, black locust, Virginia pine, red pine. |
| Severe | Slight | Severe | Few existing stands | Black locust, red pine, white pine, Virginia pine, shortleaf pine. |
| Slight | Moderate to severe | Moderate | Sweetgum, pin oak, soft maple, white ash, tulip-poplar, swamp white oak. | White pine, sweetgum, soft maple, sycamore. |
| Moderate | Moderate | Severe | Red oak, white oak, chinquapin oak, black walnut, tulip-poplar, white ash. | White pine, red pine. |
| Slight | Slight | Slight | Cottonwood, sycamore, tulip-poplar, black walnut, white ash, southern red oak. | White pine, cottonwood, black locust, sycamore, black walnut. |
| Slight to moderate | Moderate | Slight | White oak, white ash, tulip-poplar, black oak. | White pine, red pine, shortleaf pine, Virginia pine. |
| Moderate | Slight to moderate | Moderate | Tulip-poplar, white oak, red oak, white ash. | Shortleaf pine, Virginia pine, white pine. |
| Moderate | Slight to moderate | Slight to moderate | White oak, black oak, tulip-poplar, white ash. | Red pine, shortleaf pine, Virginia pine. |
| Slight | Moderate to severe | Severe | Sweetgum, pin oak, soft maple, bur oak, white ash, tulip-poplar, swamp white oak. | Planting very rarely needed. |
| Moderate | Slight to moderate | Severe | White oak, black oak, red oak, tulip-poplar, white ash. | White pine, red pine, shortleaf pine. |
| Moderate | Slight to moderate | Severe | White oak, red oak, white ash. | Shortleaf pine, Virginia pine, loblolly pine. |
| Slight | Moderate | Moderate | Sweetgum, pin oak, soft maple, white ash, green ash. | Cottonwood, sycamore, sweetgum. |

TABLE 3.—*Suitability of*

| Woodland group | Site index [1] | | | | Seedling mortality |
|---|---|---|---|---|---|
| | Upland oaks | Tulip-poplar | Pin oak | Sweet-gum | |
| Group 2s15: Deep, well-drained, moderately sloping soil that has low to moderate available water capacity. | 80–85 | 75–85 | ---------- | ---------- | Slight to moderate |
| Group 4r16: Riverwash, consisting of sand and gravel mixed with silty material on small islands, gravel and sand bars, and natural levees along rivers. | ---------- | ---------- | ---------- | ---------- | Slight |
| Group 4f19: Very shallow over sand and gravel, excessively drained, steep to very steep soil that has very low available water capacity. | 60–70 | ---------- | ---------- | ---------- | Slight to moderate |
| Group 5d22: Moderately deep, well-drained, moderately sloping to steep soils that have low to moderate available water capacity. | 45–55 | ---------- | ---------- | ---------- | Moderate to severe |
| Group 5d23: Soils except Landes are deep, well-drained, nearly level soils that have high available water capacity. Landes is moderately deep over sand and gravel and has low to moderate available water capacity. | ---------- | ---------- | ---------- | ---------- | ---------- |

[1] The height of the dominant trees in a stand at the age of 50.

*Hardwood woody plants* are deciduous trees, shrubs, and woody vines that produce fruits, nuts, buds, twigs, or foliage used extensively as food by wildlife; and which commonly are established through natural processes but also may be planted. Examples are oak, beech, cherry, hawthorn, dogwood, maple, birch, poplar, blueberry, greenbrier, rose, and viburnum.

*Coniferous woody plants* are cone-bearing trees and shrubs, mainly of importance to wildlife as cover, but which also may furnish food in the form of browse, seeds, or fruitlike cones; and which commonly are established through natural processes but also may be planted. Examples of these plants are pine, spruce, white cedar, hemlock, balsam fir, redcedar, juniper, and yew.

*Wetland food and cover plants* are annual and perennial wild herbaceous plants on moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover extensively used by wetland forms of wildlife. Examples of these plants are smartweed, wild millet, bulrush, sedge, reed, cattail, and pondweed.

*Shallow water developments* include impoundments or excavation of areas of control of water generally not exceeding 5 feet in depth. Examples of shallow water developments are low dikes and levees, shallow dugouts, level ditches, devices for water-level control, or marshy streams and channels.

*Ponds* are dugout water areas or combinations of dugout and low dikes (dammed areas) that have water of suitable quality, of suitable depth, and are of sufficient supply for the production of fish or wildlife. An example is a pond at least $\frac{1}{10}$ acre in surface area that has an average depth of 6 feet over at least one-fourth of the area; and having a dependably high water table or other sources of unpolluted ground water of low acidity. Runoff from watershed areas was not considered.

Tables 4 also rates the soils according to their suitability as habitat for three kinds of wildlife in the county: open-land, woodland, and wetland.

*Open-land wildlife* are birds and mammals that normally frequent cropland, pasture, meadow, lawns, and areas covered by grasses, herbs, and shrubby growth. Examples are quail, pheasant, rabbit, and red fox.

*Woodland wildlife* are birds and mammals that normally frequent wooded areas of hardwood trees and shrubs, coniferous trees and shrubs, or a mixture of such plants. Examples are ruffed grouse, woodcock, gray and fox squirrel, gray fox, deer, and wild turkey.

*Wetland wildlife* are birds and mammals that normally frequent such wet areas as ponds, streams, ditches, marsh and swamps. Examples are duck, geese, rail, mink, muskrat, and beaver.

## Use of Soils for Recreation

"Outdoor recreational activity, already a major part of American life, will triple by the year 2000. Outdoor recreation should be an integral element in local land use planning" (4).

The location of Bartholomew County in relationship to centers of population, and the landscape and resources of the county make it possible to develop income-producing recreation enterprises. The most likely enterprises are hunting areas, shooting preserves, improved picnic areas, camping areas, golf courses, fishing waters, and water sports. Many recreation facilities have been established and are in use today.

Potential watershed development in upland areas of-

*soils for woodland*—Continued

| Erosion hazard | Windthrow hazard | Equipment limitations | Desirable species in natural stands | Species suitable for planting |
|---|---|---|---|---|
| Moderate | Slight | Slight to moderate | Black oak, tulip-poplar, red oak, white oak, black walnut. | White pine, shortleaf pine, Virginia pine. |
| Slight to moderate | Slight | Severe | Cottonwood, sycamore, soft maple, green ash. | Virginia pine, shortleaf pine, white pine. |
| Moderate to severe | Moderate | Moderate or severe | Chinquapin oak, red oak, basswood, white ash. | Black locust, white pine, jack pine. |
| Moderate | Moderate to severe | Moderate to severe | Chestnut oak, white oak, Virginia pine. | White pine, shortleaf pine, black locust. |
| | | | | White pine, red pine, Norway spruce, arborvitae. |

fers potential for multi-purpose impoundments of different-sized bodies of water. Some well-drained soils on uplands are well suited to picnic grounds, intensive play areas, and tent and camp trailer sites.

In table 5 the soils in Bartholomew County are rated according to their limitations for developing six kinds of recreation facilities as follows:

*Cottages and service buildings.*—These ratings apply to seasonal or year-round cottages, washrooms and bathrooms, picnic shelters, and service buildings. Factors considered are wetness and flood hazard, slope, rockiness and stoniness, and depth to hard bedrock. Additional considerations are suitability for septic tank filter fields, shrink-swell and frost potential, hillside slippage, presence of loose sand, and bearing capacity. Suitability of the soil for supporting vegetation and whether basements and underground utilities are planned should be considered in the final evaluation.

*Tent and camp trailer sites.*—These are areas suitable for tent and camp trailer sites and the accompanying activities of outdoor living. These sites are used frequently during the camping season. These areas require little site preparation. They should be suitable for unsurfaced parking for car and camp trailers and for heavy foot traffic by humans, horses, and vehicular traffic. Factors considered are wetness and flooding hazard, permeability, slope, surface soil texture, coarse fragments and stoniness or rockiness. Suitability of the soil for supporting vegetation should be considered in the final evaluation.

*Picnic areas, parks, and extensive play areas.*—These are areas suitable for heavy foot traffic and are used by people for the consumption of food in a natural outdoor environment. Ratings are based on wetness and flooding hazard, slope, surface soil texture, and stoniness and rockiness. Ratings do not include such features as presence of trees or ponds, which may affect the desirability of a site. Suitability of a soil for supporting vegetation should be considered in the final evaluation.

*Playgrounds, athletic fields, and intensive play areas.*—These areas are developed for playgrounds and such organized games as baseball, football, tennis, and badminton. These areas are subject to heavy foot traffic and generally require a level surface, good drainage, and a soil texture and consistence that gives a firm surface. Ratings are based on wetness and flooding hazard, slope, surface soil texture, stoniness and rockiness, and permeability. It is assumed that good plant cover can be established and maintained on areas where needed.

*Bridle paths, nature and hiking trails.*—This soil rating applies to areas that are to be used for trails, cross-country hiking, bridle paths, and other intensive uses which allow for the movement of people. It is assumed that these areas are to be used as they occur in nature and that little soil will be moved in providing this recreational use. The most desirable soils from a physical standpoint for bridle paths, nature and hiking trails have good foot and hoof trafficability. They are well drained, loamy in texture, and have nearly level to sloping surfaces. They have good stability, are not subject to erosion or cutting out, and are free of coarse fragments and stones or rock outcrops. Consideration should be given to placement of paths and trails on sloping relief on the contour to help control erosion. Variability in slope gradient on paths and

TABLE 4.—*Suitability of soils for elements*

| Soil series and map symbols | Elements of wildlife habitat | | | |
|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous upland plants | Hardwood plants |
| Avonburg: | | | | |
| AvA | Fair | Fair | Good | Good |
| AvB2 | Fair | Fair | Good | Good |
| Ayrshire: Ay | Fair | Fair | Good | Good |
| Bartle: Ba | Fair | Fair | Good | Good |
| Berks: BeF | Very poor | Poor | Good | Good |
| For Weikert part of BeF see Weikert series. | | | | |
| Bloomfield: BmC | Fair | Fair | Good | Good |
| Bonnie: Bo | Poor | Fair | Fair | Good |
| Brookston: Br | Very poor | Poor | Poor | Good |
| Burnside: Bu | Fair | Good | Good | Good |
| Camden: Ca | Good | Good | Good | Good |
| Celina: CeB2 | Good | Good | Good | Good |
| Cincinnati: | | | | |
| CnB2 | Good | Good | Good | Good |
| CnC2, CnC3 | Fair | Good | Good | Good |
| CnD2, CnD3 | Poor | Fair | Good | Good |
| Clermont: Cr | Poor | Fair | Fair | Good |
| Corydon: CyF | Very poor | Poor | Good | Good |
| Crosby: | | | | |
| CzA | Fair | Fair | Good | Good |
| CzB2 | Fair | Fair | Good | Good |
| Dubois: Du | Fair | Fair | Good | Good |
| Eel: Ee | Fair | Good | Good | Good |
| Fincastle: | | | | |
| FcA | Fair | Fair | Good | Good |
| FcB2 | Fair | Fair | Good | Good |
| Fox: | | | | |
| FoA | Fair | Good | Good | Good |
| FoB2 | Fair | Good | Good | Good |
| FxC3 | Fair | Good | Good | Good |
| Genesee: Ge | Fair | Good | Good | Good |
| Gilpin: | | | | |
| GpD2, GpD3 | Poor | Fair | Good | Good |
| GpE | Very poor | Fair | Good | Good |
| Gullied land: Gu. | | | | |
| Too variable to rate. | | | | |
| Haymond: Ha | Fair | Good | Good | Good |
| Hennepin: HeF | Very poor | Fair | Good | Good |
| Henshaw: Hh | Fair | Fair | Good | Good |
| Hickory: | | | | |
| HkC2, HoC3 | Fair | Good | Good | Good |
| HkD2, HoD3 | Poor | Fair | Good | Good |
| HkE2, HkF | Very poor | Fair | Good | Good |
| Landes: La | Fair | Fair | Fair | Good |
| Martinsville: MaA, MbA, MbB2 | Good | Good | Good | Good |
| McGary: Mc | Fair | Fair | Good | Good |
| Medway: Md | Fair | Good | Good | Good |
| Miami: | | | | |
| MmB2 | Good | Good | Good | Good |
| MmC2 | Fair | Good | Good | Good |
| MoB3, MoC3 | Fair | Fair | Fair | Good |
| MmD2, MoD3 | Poor | Fair | Good | Good |
| Milton: MtA, MtB2, MtC2 | Fair | Good | Good | Good |
| Nineveh: NgA, NgB2, NnA | Fair | Good | Good | Good |
| Ockley: OcA | Good | Good | Good | Good |
| Otwell: | | | | |
| OtB2 | Good | Good | Good | Good |
| OtC2, OtC3 | Fair | Good | Good | Good |
| OtD2 | Poor | Fair | Good | Good |
| Peoga: Pe | Poor | Fair | Fair | Good |
| Princeton: | | | | |
| PrB | Good | Good | Good | Good |
| PrC2 | Fair | Good | Good | Good |
| Rarden: | | | | |
| RaC2 | Fair | Good | Good | Good |
| RaD2, ReD3 | Poor | Fair | Good | Good |
| Rensselaer: Rf, Rg | Very poor | Poor | Poor | Good |
| Riverwash: Rh. | | | | |
| Too variable to rate. | | | | |

*of wildlife habitat and kinds of wildlife*

| Elements of wildlife habitat—Continued | | | | Kinds of wildlife | | |
|---|---|---|---|---|---|---|
| Coniferous plants | Wetland food and cover plants | Shallow water developments | Ponds | Open-land wildlife | Woodland wildlife | Wetland wildlife |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Poor | Poor | Poor | Good | Fair | Poor. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Fair | Very poor | Very poor | Very poor | Poor | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Fair | Fair | Fair | Very poor | Fair | Good | Fair. |
| Good | Good | Good | Good | Poor | Good | Good. |
| Poor | Poor | Poor | Poor | Good | Good | Poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Fair | Good | Good | Good | Fair | Good | Good. |
| Fair | Very poor | Very poor | Very poor | Poor | Good | Very poor. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Poor | Poor | Poor | Good | Fair | Poor. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Very poor | Poor | Poor | Good | Good | Very poor. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Poor | Poor | Poor | Good | Fair | Poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Poor | Poor | Poor | Good | Good | Poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Fair | Good | Good | Good | Fair | Good | Good. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Good | Good | Good | Good | Poor | Good | Good. |

TABLE 4.—*Suitability of soils for elements*

| Soil series and map symbols | Elements of wildlife habitat | | | |
|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous upland plants | Hardwood plants |
| Rockcastle: RkF | Very poor | Very poor | Poor | Poor |
| Rodman: RnF | Very poor | Very poor | Poor | Poor |
| Ross: Ro, Rp | Fair | Good | Good | Good |
| Rossmoyne: RsB2 | Good | Good | Good | Good |
| Russell: RuB2 | Good | Good | Good | Good |
| Saranac: Sa, Sc | Very poor | Poor | Poor | Good |
| Shoals: Sh | Fair | Fair | Good | Good |
| Sleeth: Sm | Fair | Fair | Good | Good |
| Steff: St | Fair | Fair | Good | Good |
| Stendal: Sx | Poor | Fair | Fair | Good |
| Stonelick: Sz | Poor | Fair | Fair | Good |
| Wakeland: Wa | Fair | Fair | Good | Good |
| Weikert: BeF | Very poor | Very poor | Poor | Poor |
| For Berks portion of BeF, refer to Berks series. | | | | |
| Westland: Wc | Very poor | Poor | Poor | Good |
| Whitaker: Wh | Fair | Fair | Good | Good |
| Wilbur: Wu | Fair | Good | Good | Good |
| Xenia: XeB2 | Good | Good | Good | Good |
| Zanesville: | | | | |
| ZaB2 | Good | Good | Good | Good |
| ZaC2, ZaC3 | Fair | Good | Good | Good |
| Zipp: Zp | Very poor | Poor | Poor | Good |

trails may serve to enhance interest but slopes should not exceed 12 percent for prolonged distances.

*Golf course fairways.*—In evaluating soils for use as golf courses, consideration was given only to those features of the soil that influence their use for fairways. Greens, traps, hazards, and trees are manmade, generally from disturbed, transported soil material. For best use, fairways should be well drained and firm, be free of flooding during use periods, have good trafficability, contain a minimum of coarse fragments or stones, and have gently undulating slopes. They should be capable of supporting a good turf and be well suited to many kinds of trees and shrubs. Loamy soils are best, but coarser textured soils serve equally well if irrigated. Poorly drained mineral soils have severe limitations to use but they can be used for pond sites to provide esthetic value or for storing water for turf maintenance. Sandy soils likewise may be designed for hazards or used as a source of sand for greens.

The ratings used in table 5 are slight, moderate, and severe. For a rating other than slight, the degree of limitations of the soil for developing a specific recreation facility is also given. A rating of *slight* means the facility is easily created, improved, or maintained. Limitations that affect design and management are few. A *moderate* limitation means that the facility generally can be created, improved, or maintained; but there are moderate soil limitations that affect design and management. A rating of *severe* means that the practicability of establishing the facility is questionable. Extreme measures are needed to overcome the limitations and usage is generally unsound or not practical.

## Engineering Uses of the Soils [3]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternative routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.

[3] HAROLD W. BELCHER, JR., area engineer, Soil Conservation Service, assisted in preparing this section.

*of wildlife habitat and kinds of wildlife*—Continued

| Elements of wildlife habitat—Continued | | | | Kinds of wildlife | | |
|---|---|---|---|---|---|---|
| Coniferous plants | Wetland food and cover plants | Shallow water developments | Ponds | Open-land wildlife | Woodland wildlife | Wetland wildlife |
| Good | Very poor | Very poor | Very poor | Very poor | Poor | Very poor. |
| Good | Very poor | Very poor | Very poor | Very poor | Poor | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Good | Fair | Fair | Very poor | Poor | Good | Poor. |
| Poor | Fair | Fair | Poor | Good | Fair | Fair. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Poor | Fair | Fair | Good | Fair | Poor. |
| Poor | Fair | Fair | Very poor | Fair | Fair | Fair. |
| Poor | Very poor | Very poor | Very poor | Fair | Fair | Very poor. |
| Poor | Fair | Fair | Poor | Good | Fair | Fair. |
| Good | Very poor | Very poor | Very poor | Very poor | Poor | Very poor. |
| Good | Good | Good | Good | Poor | Good | Good. |
| Poor | Fair | Fair | Fair | Good | Fair | Fair. |
| Poor | Poor | Poor | Poor | Good | Good | Poor. |
| Poor | Very poor | Very poor | Poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Poor | Very poor | Very poor | Very poor | Good | Good | Very poor. |
| Good | Good | Good | Good | Poor | Good | Good. |

6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 6, 7, and 8, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 6 and 7, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many of these terms commonly used in soil science.

### *Engineering soil classification systems*

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*16*) used by the SCS engineers, Department of Defense, and others, and the AASHO (*1*) system adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group-index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 8; the estimated classification, without group index numbers, is given in table 6 for all soils mapped in the survey area.

TABLE 5.—*Degree and kinds of*

| Soil series and map symbols | Cottages and service buildings | Campsites for tents and trailers | Picnic areas, parks, and extensive play areas |
|---|---|---|---|
| Avonburg: AvA, AvB2 | Moderate: seasonal high water table. | Severe: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained. |
| Ayrshire: Ay | Moderate: seasonal high water table. | Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. |
| Bartle: Ba | Moderate: seasonal high water table. | Severe: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained. |
| Berks: BeF<br>For Weikert part of BeF, see Weikert series. | Severe: steep slopes | Severe: steep slope | Severe: steep slope |
| Bloomfield: BmC | Moderate: moderate slope | Moderate: sandy material subject to blowing; impaired trafficability; droughty. | Moderate: sandy material subject to blowing; impaired trafficability; droughty. |
| Bonnie: Bo | Severe: subject to flooding; poorly drained. | Severe: poorly drained; subject to flooding. | Severe: poorly drained; subject to flooding. |
| Brookston: Br | Severe: very poorly drained; subject to ponding. | Severe: very poorly drained; subject to ponding. | Severe: very poorly drained; subject to ponding. |
| Burnside: Bu | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Camden: Ca | Slight | Slight | Slight |
| Celina: CeB2 | Slight | Slight | Slight |
| Cincinnati: | | | |
| CnB2 | Slight | Moderate: very slow permeability. | Slight |
| CnC2 | Moderate: moderate slope | Moderate: moderate slope; very slow permeability. | Moderate: moderate slope |
| CnC3 | Moderate: moderate slope | Moderate: moderate slope; very slow permeability. | Moderate: moderate slope |
| CnD2, CnD3 | Severe: strong slope | Severe: strong slope | Severe: strong slope |
| Clermont: Cr | Severe: poorly drained; seasonal high water table. | Severe: poorly drained; very slowly permeable fragipan. | Severe: poorly drained; seasonal high water table. |
| Corydon: CyF | Severe: steep slope | Severe: steep slope | Severe: steep slope |
| Crosby: CzA, CzB2 | Moderate: seasonal high water table. | Moderate: somewhat poorly drained; slow permeability. | Moderate: somewhat poorly drained. |
| Dubois: Du | Moderate: seasonal high water table. | Severe: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained. |
| Eel: Ee | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Fincastle: | | | |
| FcA | Moderate: seasonal high water table. | Moderate: somewhat poorly drained; slow permeability. | Moderate: somewhat poorly drained. |
| FcB2 | Moderate: seasonal high water table. | Moderate: somewhat poorly drained; slow permeability. | Moderate: somewhat poorly drained. |
| Fox: | | | |
| FoA | Slight | Slight | Slight |
| FoB2 | Slight | Slight | Slight |
| FxC3 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |

*limitations for recreational uses*

| Playgrounds, athletic fields, and intensive play areas | Paths and trails | Golf fairways |
|---|---|---|
| Severe: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Moderate: somewhat poorly drained | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: steep slope | Severe: steep slope | Severe: steep slope. |
| Severe: moderately sloping | Moderate: sandy material, subject to blowing; impaired trafficability. | Moderate: sandy material, subject to blowing; droughty. |
| Severe: poorly drained; subject to flooding | Severe: poorly drained; subject to flooding | Severe: poorly drained; subject to flooding. |
| Severe: very poorly drained; subject to ponding. | Severe: very poorly drained; subject to ponding. | Severe: very poorly drained; subject to ponding. |
| Severe: subject to flooding [1] | Severe: subject to flooding [1] | Severe: subject to flooding.[1] |
| Slight | Slight | Slight. |
| Moderate: gentle slope; moderately slow permeability. | Slight | Slight. |
| Moderate: gentle slope; very slow permeability. | Slight | Slight. |
| Severe: moderate slope | Slight | Moderate: moderate slope. |
| Severe: moderate slope | Slight | Severe: severely eroded. |
| Severe: strong slope | Moderate: strong slope | Severe: strong slope. |
| Severe: poorly drained; seasonal high water table; very slow permeability. | Severe: poorly drained; seasonal high water table. | Severe: poorly drained; seasonal high water table. |
| Severe: steep slope | Severe: steep slope; bedrock exposed on surfaces in places. | Severe: steep slope. |
| Moderate: somewhat poorly drained; slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Moderate: subject to flooding.[1] |
| Moderate: somewhat poorly drained; slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Moderate: somewhat poorly drained; slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Slight | Slight | Slight. |
| Moderate: gentle slope | Slight | Slight. |
| Severe: moderate slope | Slight | Severe: severely eroded. |

TABLE 5.—*Degree and kinds of*

| Soil series and map symbols | Cottages and service buildings | Campsites for tents and trailers | Picnic areas, parks, and extensive play areas |
|---|---|---|---|
| Genesee: Ge | Severe: subject to flooding | Severe: subject to flooding | Moderate: subject to flooding |
| Gilpin: GpD2, GpD3 | Severe: strong slope | Severe: strong slope | Severe: strong slope |
| GpE | Severe: moderately steep slope | Severe: moderately steep slope | Severe: moderately steep slope |
| Gullied land: Gu | Too variable to rate. | | |
| Haymond: Ha | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Hennepin: HeF | Severe: steep slope | Severe: steep slope | Severe: steep slope |
| Henshaw: Hh | Moderate: seasonal high water table. | Moderate: somewhat poorly drained; moderately slow permeability. | Moderate: somewhat poorly drained. |
| Hickory: HkC2 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |
| HkD2 | Severe: strong slope | Severe: strong slope | Severe: strong slope |
| HkE2 | Severe: moderately steep slope | Severe: moderately steep slope | Severe: moderately steep slope |
| HkF | Severe: steep slope | Severe: steep slope | Severe: steep slope |
| HoC3 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |
| HoD3 | Severe: strong slope | Severe: strong slope | Severe: strong slope |
| Landes: La | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Martinsville: MaA, MbA | Slight | Slight | Slight |
| MbB2 | Slight | Slight | Slight |
| McGary: Mc | Moderate: seasonal high water table. | Moderate: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained. |
| Medway: Md | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Miami: MmB2, MoB3 | Slight | Slight | Slight |
| MmC2 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |
| MoC3 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |
| MmD2, MoD3 | Severe: strong slope | Severe: strong slope | Severe: strong slope |
| Milton: MtA | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. | Slight |
| MtB2 | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. | Slight |
| MtC2 | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. | Slight |
| Nineveh: NgA, NnA | Slight | Slight | Slight |
| NgB2 | Slight | Slight | Slight |
| Ockley: OcA | Slight | Slight | Slight |
| Otwell: OtB2 | Slight | Slight | Slight |
| OtC2 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |

*limitations for recreational uses*—Continued

| Playgrounds, athletic fields, and intensive play areas | Paths and trails | Golf fairways |
|---|---|---|
| Severe: subject to flooding | Moderate: subject to flooding | Moderate: subject to flooding. |
| Severe: strong slope | Moderate: strong slope | Severe: strong slope. |
| Severe: moderately steep slope | Severe: moderately steep slope | Severe: moderately steep slope. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Moderate: subject to flooding.[1] |
| Severe: steep slope | Severe: steep slope | Severe: steep slope. |
| Moderate: somewhat poor drained; moderately slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: moderate slope | Slight | Moderate: moderate slope. |
| Severe: strong slope | Moderate: strong slope | Severe: strong slope. |
| Severe: moderately steep slope | Severe: moderately steep slope | Severe: moderately steep slope. |
| Severe: steep slope | Severe: steep slope | Severe: steep slope. |
| Severe: moderate slope | Slight | Severe: severely eroded. |
| Severe: strong slope | Moderate: strong slope | Severe: strong slope. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Moderate: subject to flooding.[1] |
| Slight | Slight | Slight. |
| Moderate: gentle slope | Slight | Slight. |
| Moderate: somewhat poorly drained; very slow permeability. | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Moderate: subject to flooding.[1] |
| Moderate: gentle slope | Slight | Slight. |
| Severe: moderate slope | Slight | Moderate: moderate slope. |
| Severe: moderate slope | Slight | Severe: severely eroded. |
| Severe: strong slope | Moderate: strong slope | Severe: strong slope. |
| Slight | Slight | Slight to moderate. |
| Moderate: gentle slope | Slight | Slight to moderate. |
| Severe: moderate slope | Slight | Slight to moderate. |
| Slight | Slight | Slight. |
| Moderate: gentle slope | Slight | Slight. |
| Slight | Slight | Slight. |
| Moderate: gentle slope | Slight | Slight. |
| Severe: moderate slope | Moderate: moderate slope | Moderate: moderate slope. |

TABLE 5.—*Degree and kind of*

| Soil series and map symbols | Cottages and service buildings | Campsites for tents and trailers | Picnic areas, parks, and extensive play areas |
|---|---|---|---|
| OtC3 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |
| OtD2 | Severe: strong slope | Severe: strong slope | Severe: strong slope |
| Peoga: Pe | Severe: poorly drained; seasonal high water table. | Severe: poorly drained; very slow permeability. | Severe: poorly drained; seasonal high water table. |
| Princeton: | | | |
| PrB | Slight | Slight | Slight |
| PrC2 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |
| Rarden: | | | |
| RaC2 | Moderate: moderate slope | Moderate: moderate slope | Moderate: moderate slope |
| RaD2, ReD3 | Severe: strong slope | Severe: strong slope | Severe: strong slope |
| Ransselaer: Rf, Rg | Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. |
| Riverwash: Rh Too variable to rate. | | | |
| Rockcastle: RkF | Severe: steep slope | Severe: steep slope | Severe: steep slope |
| Rodman: RnF | Severe: steep slope | Severe: steep slope | Severe: steep slope |
| Ross: Ro, Rp | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Rossmoyne: RsB2 | Slight | Moderate: very slow permeability. | Slight |
| Russell: RuB2 | Slight | Slight | Slight |
| Saranac: Sa, Sc | Severe: subject to flooding; very poorly drained; seasonal high water table. | Severe: very poorly drained; seasonal high water table; subject to flooding. | Severe: very poorly drained; seasonal high water table; subject to flooding. |
| Shoals: Sh | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Sleeth: Sm | Moderate: seasonal high water table. | Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. |
| Steff: St | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Stendal: Sx | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Stonelick: Sz | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Wakeland: Wa | Severe: subject to flooding | Severe: subject to flooding [1] | Moderate: subject to flooding [1] |
| Weikert: BeF For Berks part of BeF, see Berks series. | Severe: steep slope | Severe: steep slope | Severe: steep slope |
| Westland: Wc | Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. |
| Whitaker: Wh | Moderate: seasonal high water table. | Moderate: somewhat poorly drained. | Moderate: somewhat poorly drained. |
| Wilbur: Wu | Severe: subject to flooding | Severe: subject to flooding [1] | Severe: subject to flooding [1] |
| Xenia: XeB2 | Slight | Slight | Slight |
| Zanesville: ZaB2 | Slight | Severe: very slow permeability; soft when wet; slow to dry after rains. | Slight |

*limitations for recreational uses*—Continued

| Playgrounds, athletic fields, and intensive play areas | Paths and trails | Golf fairways |
|---|---|---|
| Severe: moderate slope | Moderate: moderate slope | Severe: severely eroded. |
| Severe: strong slope | Moderate: strong slope | Severe: strong slope. |
| Severe: poorly drained; seasonal high water table. | Severe: poorly drained; seasonal high water table. | Severe: poorly drained; seasonal high water table. |
| Moderate: gentle slope | Slight | Slight. |
| Severe: moderate slope | Slight | Moderate: moderate slope. |
| Severe: moderate slope | Slight | Moderate: moderate slope. |
| Severe: strong slope | Moderate: strong slope | Severe: strong slope. |
| Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. |
| Severe: steep slope | Severe: steep slope | Severe: steep slope. |
| Severe: steep slope | Severe: steep slope | Severe: steep slope. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Moderate: subject to flooding.[1] |
| Moderate: gentle slope; very slow permeability. | Slight | Slight. |
| Moderate: gentle slope | Slight | Slight. |
| Severe: very poorly drained; seasonal high water table; subject to flooding. | Severe: very poorly drained; seasonal high water table; subject to flooding. | Severe: very poorly drained; seasonal high water table; subject to flooding. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Severe: subject to flooding.[1] |
| Moderate: somewhat poorly drained | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Moderate: subject to flooding.[1] |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Severe: subject to flooding.[1] |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Severe: subject to flooding.[1] |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Severe: subject to flooding.[1] |
| Severe: steep slope | Severe: steep rocky slope | Severe: steep slope. |
| Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; seasonal high water table; subject to ponding. |
| Moderate: somewhat poorly drained | Moderate: somewhat poorly drained | Moderate: somewhat poorly drained. |
| Severe: subject to flooding [1] | Moderate: subject to flooding [1] | Moderate: subject to flooding.[1] |
| Moderate: gentle slope | Slight | Slight. |
| Severe: very slow permeability; soft when wet; slow to dry after rains. | Slight | Slight. |

TABLE 5.—*Degree and kind of*

| Soil series and map symbols | Cottages and service buildings | Campsites for tents and trailers | Picnic areas, parks, and extensive play areas |
|---|---|---|---|
| ZaC2 | Moderate: moderate slope | Severe: very slow permeability; soft when wet; slow to dry after rains. | Moderate: moderate slope |
| ZaC3 | Moderate: moderate slope | Severe: very slow permeability; soft when wet; slow to dry after rains. | Moderate: moderate slope |
| Zipp: Zp | Severe: very poorly drained; seasonal high water table; subject to ponding. | Severe: very poorly drained; subject to ponding; very slow permeability. | Severe: very poorly drained; subject to ponding. |

[1] Areas with less frequency of flooding will not have as severe limitations. Onsite investigations needed to determine frequency of flooding.

***Soil properties significant to engineering***

Several estimated soil properties significant in engineering are given in table 6. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6.

Depth to bedrock is distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to the plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 6, but in table 8 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

***Engineering interpretations of soils***

The estimated interpretations in table 7 are based on the engineering properties of soils shown in table 6, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Bartholomew County. In table 7, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil suitability is rated by the terms *good, fair,* and *poor.* Following are explanations of some of the terms in table 7.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or response of plants when

*limitations for recreational uses*—Continued

| Playgrounds, athletic fields, and intensive play areas | Paths and trails | Golf fairways |
|---|---|---|
| Severe: very slow permeability; soft when wet; slow to dry after rains. | Moderate: moderate slope | Moderate: moderate slope. |
| Severe: very slow permeability; soft when wet; slow to dry after rains. | Moderate: moderate slope | Severe: severely eroded. |
| Severe: very poorly drained; subject to ponding or flooding; very slow permeability. | Severe: seasonal high water table; very poorly drained; subject to ponding. | Severe: seasonal high water table; very poorly drained; subject to ponding. |

fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and (2) the relative ease of excavating the material at borrow areas.

Highways, as rated in table 7, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material (fig. 22, p. 132).

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; and availability of outlets for drainage.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Grassed waterways are natural or constructed waterways, typically broad and shallow, that are covered by grass for protection against erosion. They are used to conduct water away from cultivated areas.

### *Soil test data*

Table 8 contains engineering test data for some of the major soil series in Bartholomew County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction (or moisture-density) data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 6.

## Town and Country Planning

Residential, commercial, industrial, and institutional developments are increasing in Bartholomew County

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such
referring to other series that appear in the first column of this table.

| Soil series and map symbols | Depth to— | | Depth from surface | USDA texture | Classification | |
|---|---|---|---|---|---|---|
| | Seasonal high water table | Bedrock | | | Unified | AASHO |
| | *Feet* | *Feet* | *Inches* | | | |
| Avonburg: AvA, AvB2 | 1–3 | >15 | 0–18 | Silt loam | ML or CL–ML | A–4 |
| | | | 18–27 | Light silty clay loam | ML | A–4 |
| | | | 27–63 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 63–75 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 75–120 | Clay loam | CL | A–6 |
| | | | 120–130 | Loam | CL | A–6 |
| Ayrshire: Ay | 1–3 | >15 | 0–14 | Fine sandy loam | SM or ML | A–4 |
| | | | 14–22 | Loam | ML or CL | A–4 |
| | | | 22–45 | Sandy clay loam | SC or CL | A–6 or A–4 |
| | | | 45–57 | Heavy sandy loam | SM | A–2 or A–4 |
| | | | 57–86 | Stratified sand | SP–SM or SM | A–2 |
| Bartle: Ba | 1–3 | >15 | 0–14 | Silt loam | ML or CL | A–4 |
| | | | 14–32 | Silt loam | ML or CL | A–4 |
| | | | 32–65 | Silt loam and silty clay loam. | ML or CL | A–6 or A–4 |
| | | | 65–96 | Stratified silty clay loam and silt loam. | ML or CL | A–6 or A–4 |
| Berks: BeF | >6 | 2–3½ | 0–8 | Silt loam | ML or CL | A–4 |
| For Weikert part of BeF, see Weikert series. | | | 8–28 | Shaly silt loam | SM | A–1, A–2, or A–4 |
| | | | 28 | Interbedded sandstone and shale. | | |
| Bloomfield: BmC | >6 | >15 | 0–14 | Loamy fine sand | SM | A–2 |
| | | | 14–33 | Fine sand | SP–SM or SM | A–2 or A–3 |
| | | | 33–72 | Fine sand to sandy loam | SP or SM | A–2 |
| | | | 72–86 | Fine sand | SP–SM or SM | A–2 or A–3 |
| Bonnie: Bo | 0–1 | >15 | 0–14 | Silt loam | ML or CL | A–4 |
| | | | 14–40 | Silt loam to heavy silt loam. | ML or CL | A–4 |
| | | | 40–60 | Silt loam | ML or CL | A–4 |
| Brookston: Br | 0–1 | >15 | 0–7 | Light silty clay loam | CL or ML | A–6 or A–7 |
| | | | 7–45 | Silty clay loam to clay loam. | CL, CH, or MH | A–7 |
| | | | 45–60 | Heavy loam | CL | A–4 or A–6 |
| Burnside: Bu | >6 | 3½–7 | 0–12 | Loam | ML or CL | A–4 or A–6 |
| | | | 12–42 | Flaggy loam | GM or SM | A–1 |
| | | | 42–60 | Clay shale | | |
| Camden: Ca | >6 | >15 | 0–16 | Silt loam to heavy silt loam. | ML or CL | A–4 or A–5 |
| | | | 16–69 | Silty clay loam to clay loam. | ML or CL | A–6 or A–7 |
| | | | 69–96 | Sand | SM | A–2 |
| Celina: CeB2 | 3–6 | >15 | 0–11 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 11–34 | Silty clay loam and clay loam. | CL or ML | A–6 or A–7 |
| | | | 34–60 | Loam | CL or CL–ML or ML | A–4 or A–6 |
| Cincinnati: CnB2, CnC2, CnC3, CnD2, CnD3. | >6 | >15 | 0–10 | Silt loam | ML or CL–ML | A–4 |
| | | | 10–27 | Light silty clay loam and heavy silt loam. | ML or CL or CL–ML | A–4 or A–6 |
| | | | 27–62 | Loam to heavy loam | CL or ML | A–6 |
| | | | 62–140 | Light clay loam to loam | ML or CL | A–4 or A–6 |

See footnotes at end of table.

*significant to engineering*

kinds of mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for The symbol > means more than; and the symbol < means less than.]

| Percentage passing sieve— | | | Liquid limit | Plastic index | Permeability | Available water capacity | Reaction | Frost potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|---|
| No. 10 | No. 40 | No. 200 | | | | | | | |
| | | | *Percent* | | *Inches per hour* | *Inches per inch of soil* | *pH* | | |
| 95–100 | 90–100 | 85–95 | 25–32 | 0–5 | 0.6–2.00 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 95–100 | 90–100 | 85–95 | 28–35 | 6–10 | 0.06–0.20 | 0.18–0.20 | 4.5–5.0 | High | Low. |
| 95–100 | 90–100 | 70–90 | 28–35 | 10–15 | <0.06 | [1] 0.06–0.08 | 4.5–5.5 | High | Low. |
| 95–100 | 90–100 | 75–95 | 28–35 | 10–15 | 0.06–0.20 | 0.06–0.08 | 6.1–6.5 | High | Low. |
| 95–100 | 85–100 | 75–90 | 25–37 | 14–18 | 0.06–0.20 | [1] 0.06–0.08 | 6.6–7.3 | Moderate | Moderate. |
| 95–100 | 85–100 | 65–85 | 25–32 | 14–18 | 0.06–0.20 | [1] 0.06–0.08 | 7.9–8.4 | High | Moderate. |
| 100 | 80–90 | 40–55 | <6 | [2] NP | 2.0–6.30 | 0.16–0.18 | 6.6–7.3 | High | Low. |
| 95–100 | 75–90 | 50–75 | 20–30 | 0–10 | 0.6–2.00 | 0.17–0.19 | 5.6–6.0 | High | Low. |
| 100 | 80–90 | 40–55 | 23–31 | 0–11 | 0.6–2.00 | 0.16–0.18 | 5.6–7.3 | Moderate to high | Low to moderate. |
| 100 | 65–85 | 25–50 | <6 | [2] NP | 0.6–2.00 | 0.11–0.13 | 7.9–8.4 | High | Low. |
| 100 | 70–85 | 10–30 | [2] NP | [2] NP | 0.6–2.00 | 0.14–0.16 | 7.9–8.4 | High | Low. |
| 95–100 | 90–100 | 85–95 | 20–30 | 5–10 | 0.6–2.0 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 95–100 | 90–100 | 85–95 | 28–35 | 5–10 | 0.6–2.0 | 0.20–0.22 | 4.5–5.0 | High | Low. |
| 95–100 | 90–100 | 80–95 | 30–35 | 9–15 | <0.06 | [1] 0.06–0.08 | 5.1–6.5 | High | Low to moderate. |
| 95–100 | 90–100 | 85–95 | 35–40 | 9–20 | 0.20–0.6 | [1] 0.06–0.08 | 6.6–7.3 | High | Moderate. |
| 80–100 | 75–95 | 70–90 | 20–30 | 2–10 | 0.6–2.0 | 0.17–0.20 | 5.1–5.5 | High | Low. |
| 45–70 | 30–65 | 20–50 | [2] NP–6 | [2] NP | 0.6–2.0 | 0.10–0.14 | 4.5–5.0 | Low | Low. |
| 100 | 75–90 | 20–30 | [2] NP | [2] NP | 6.0–20.0 | 0.10–0.12 | 5.6–7.3 | Low | Low. |
| 100 | 65–90 | 5–30 | <6 | [2] NP | 6.0–20.0 | 0.06–0.08 | 5.6–6.0 | Low | Low. |
| 100 | 65–80 | 5–30 | 15–18 | [2] NP | 2.0–6.0 | 0.08–0.10 | 5.6–6.0 | Low | Low. |
| 100 | 65–80 | 5–20 | <6 | [2] NP | 6.0–20.0 | 0.05–0.07 | 6.1–6.5 | Low | Low. |
| 95–100 | 90–100 | 90–100 | 25–30 | 6–11 | 0.6–2.0 | 0.22–0.24 | 5.6–7.3 | High | Low. |
| 95–100 | 90–100 | 90–100 | 26–30 | 4–10 | 0.06–0.2 | 0.20–0.22 | 5.1–5.5 | High | Low. |
| 95–100 | 90–100 | 90–100 | 26–30 | 4–10 | 0.06–0.2 | 0.20–0.22 | 5.1–6.5 | High | Low. |
| 95–100 | 90–100 | 70–95 | 37–50 | 17–23 | 0.20–0.6 | 0.21–0.23 | 6.6–7.3 | High | Moderate. |
| 95–100 | 90–100 | 80–90 | 40–58 | 20–35 | 0.06–0.2 | 0.18–0.20 | 6.6–7.3 | Moderate to high | Moderate to high. |
| 85–100 | 80–95 | 55–70 | 22–32 | 7–13 | 0.06–0.2 | 0.05–0.19 | 7.9–8.4 | High | Low to moderate. |
| 85–95 | 80–90 | 70–75 | 20–30 | 2–10 | 0.6–2.0 | 0.18–0.21 | 4.5–7.3 | Moderate | Moderate. |
| 35–50 | 25–40 | 15–25 | [3] | [2] NP | 2.0–6.0 | 0.08–0.11 | 4.5–5.0 | Low | Low. |
| | | | | | | | 4.5–5.0 | | |
| 95–100 | 90–100 | 85–95 | 29–43 | 5–10 | 0.6–2.0 | 0.22–0.24 | 6.6–7.3 | High | Low. |
| 95–100 | 90–100 | 60–85 | 35–45 | 10–20 | 0.6–2.0 | 0.18–0.20 | 6.6–7.3 | Moderate | Moderate. |
| 95–100 | 65–90 | 15–25 | [3] | [2] NP | 2.0–6.0 | 0.05–0.07 | 7.9–8.4 | Low | Low. |
| 95–100 | 85–95 | 70–90 | 28–32 | 8–12 | 0.6–2.0 | 0.22–0.24 | 5.7–7.3 | High | Low. |
| 85–95 | 80–95 | 70–90 | 36–45 | 16–21 | 0.2–0.6 | 0.15–0.19 | 5.1–7.3 | Moderate | Moderate. |
| 85–95 | 65–90 | 60–75 | 25–30 | 5–20 | 0.2–0.6 | 0.05–0.19 | 7.9–8.4 | Moderate | Moderate. |
| 95–100 | 85–100 | 60–95 | 20–30 | 2–6 | 0.6–2.0 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 90–100 | 85–100 | 70–95 | 28–35 | 5–12 | 0.6–2.0 | 0.20–0.22 | 4.5–5.5 | Moderate to high | Moderate. |
| 90–100 | 85–100 | 58–95 | 28–35 | 14–22 | <0.06 | [1] 0.06–0.08 | <4.5–5.5 | Moderate | Moderate. |
| 90–100 | 80–95 | 55–80 | 24–41 | 8–23 | 0.2–0.6 | [1] 0.06–0.08 | 5.1–8.4 | Moderate | Low to moderate. |

TABLE 6.—*Estimated soil properties*

| Soil series and map symbols | Depth to— | | Depth from surface | USDA texture | Classification | |
|---|---|---|---|---|---|---|
| | Seasonal high water table | Bedrock | | | Unified | AASHO |
| | *Feet* | *Feet* | *Inches* | | | |
| Clermont: Cr | 0–1 | >15 | 0–24 | Silt loam | ML or CL or CL–ML | A–4 |
| | | | 24–70 | Light silty clay loam | CL | A–6 |
| | | | 70–143 | Light clay loam to clay loam to loam. | CL | A–6 |
| Corydon: CyF | >6 | 1–11½ | 0–7 | Silt loam and loam | CL | A–4 or A–6 |
| | | | 7–18 | Silty clay | CL or CH | A–7 |
| | | | 18 | Limestone. | | |
| Crosby: CzA, CzB2 | 1–3 | >15 | 0–14 | Silt loam | ML or CL or CL–ML | A–4 or A–6 |
| | | | 14–30 | Clay loam | CL or CH or MH | A–7 |
| | | | 30–60 | Loam | CL or ML or CL–ML | A–4 or A–6 |
| Dubois: Du | 1–3 | >15 | 0–16 | Silt loam | ML or CL | A–4 |
| | | | 16–27 | Silt loam and silty clay loam. | ML or CL | A–6 or A–7 |
| | | | 27–66 | Silty clay loam | MH | A–7 |
| | | | 66–150 | Stratified silty clay loam | CL or ML | A–4 or A–6 |
| Eel: Ee | 3–6 | >15 | 0–19 | Silt loam | ML or CL or CL–ML | A–4 or A–6 |
| | | | 19–34 | Loam | CL or CL–ML | A–4 |
| | | | 34–60 | Loam | CL or CL–ML, SM | A–4 |
| Fincastle: FcA, FcB2 | 1–3 | >15 | 0–13 | Silt loam | CL or ML | A–4 or A–6 |
| | | | 13–24 | Silty clay loam | CL | A–6 or A–7 |
| | | | 24–48 | Clay loam | CL or CH | A–7 |
| | | | 48–60 | Loam | CL or CL–ML | A–4 or A–6 |
| Fox: FoA, FoB2, FxC3 | >6 | >15 | 0–12 | Loam | CL or SC | A–4 or A–6 |
| | | | 12–33 | Clay loam, gravelly clay loam. | ML or SM or CL or SC | A–2, A–4, or A–6 |
| | | | 33–60 | Gravel and sand | SP–SM or GP–GM | A–1 |
| Genesee: Ge | >6 | >15 | 0–8 | Loam | ML or CL or CL–ML | A–4 |
| | | | 8–40 | Loam | ML or CL | A–6 or A–4 |
| | | | 40–60 | Stratified silt loam, loam, and fine sands. | SM, ML, CL | A–4 or A–6 |
| Gilpin: GpD2, GpD3, GpE | >6 | 2–3½ | 0–12 | Silt loam to heavy silty loam. | ML or CL or CL–ML | A–4 |
| | | | 12–40 | Light silty clay loam | CL | A–6 |
| | | | 40 | Sandstone and shale bedrock. | | |
| Gullied land: Gu. Properties too variable for reliable estimates. | | | | | | |
| Haymond: Ha | >6 | >15 | 0–30 | Silt loam | ML or CL or ML–CL | A–4 |
| | | | 30–60 | Silt loam | ML or CL or ML–CL | A–4 or A–6 |
| Hennepin: HeF | >6 | >15 | 0–12 | Loam | ML or CL or ML–CL | A–4 |
| | | | 12–60 | Loam | ML or CL–ML or CL | A–4 |

See footnotes at end of table.

*significant to engineering*—Continued

| Percentage passing sieve— | | | Liquid limit | Plastic index | Permeability | Available water capacity | Reaction | Frost potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|---|
| No. 10 | No. 40 | No. 200 | | | | | | | |
| | | | *Percent* | | *Inches per hour* | *Inches per inch of soil* | *pH* | | |
| 95–100 | 90–100 | 75–95 | 20–30 | 3–10 | 0.6–2.0 | 0.22–0.24 | 4.5–7.3 | High | Low. |
| 95–100 | 90–100 | 80–95 | 26–36 | 12–20 | <0.06 | [4] 0.08–0.12 | 4.5–5.0 | High | Moderate. |
| 95–100 | 90–100 | 70–90 | 25–33 | 10–18 | 0.2–0.6 | [3] 0.08–0.12 | 5.6–8.4 | High | Moderate. |
| 80–100 | 80–100 | 80–100 | 30–40 | 12–25 | 0.6–2.0 | 0.15–0.18 | 6.6–7.3 | Moderate | Moderate to high. |
| 80–100 | 80–100 | 80–100 | 50–70 | 25–45 | 0.2–0.6 | 0.11–0.13 | 6.6–7.3 | Moderate | Moderate to high. |
| 95–100 | 90–100 | 70–90 | 23–35 | 6–16 | 0.6–2.0 | 0.22–0.24 | 6.6–7.3 | High | Low. |
| 90–100 | 85–95 | 60–95 | 44–71 | 27–48 | 0.06–0.2 | 0.15–0.19 | 5.6–6.5 | Moderate to high | Moderate to high. |
| 75–100 | 65–95 | 50–75 | 18–30 | 5–15 | 0.2–0.6 | 0.05–0.19 | 7.9–8.4 | High | Moderate. |
| 95–100 | 90–100 | 75–90 | 26–31 | 0–9 | 0.06–2.0 | 0.22–0.24 | 6.6–7.3 | High | Low. |
| 95–100 | 90–100 | 75–90 | 30–44 | 12–25 | 0.2–0.06 | 0.18–0.21 | 4.5–5.0 | High | Moderate. |
| 95–100 | 90–100 | 75–90 | 50–55 | 19–25 | <0.06 | [1] 0.06–0.08 | 4.5–5.0 | Moderate to high | Moderate to high. |
| 95–100 | 90–100 | 75–100 | 30–35 | 12–15 | 0.06–0.2 | [1] 0.06–0.08 | 5.6–7.3 | High | Moderate. |
| 100 | 95–100 | 70–95 | 26–36 | 6–12 | 0.6–2.0 | 0.18–0.22 | 6.6–7.3 | High | Low. |
| 100 | 85–100 | 65–95 | 21–31 | 4–10 | 0.6–2.0 | 0.14–0.18 | 6.6–7.3 | Moderate | Low to moderate. |
| 95–100 | 80–100 | 40–80 | 21–30 | 4–10 | 0.6–2.0 | 0.14–0.16 | 7.9–8.4 | Moderate | Low. |
| 95–100 | 90–100 | 70–90 | 27–31 | 7–12 | 0.6–2.0 | 0.22–0.24 | 6.6–7.3 | High | Low. |
| 95–100 | 90–100 | 70–100 | 35–45 | 23–30 | 0.06–0.2 | 0.18–0.20 | 5.6–6.0 | High | Moderate. |
| 95–100 | 75–95 | 50–85 | 40–55 | 34–40 | 0.06–0.2 | 0.15–0.19 | 5.6–6.0 | Moderate to high | Moderate to high. |
| 80–95 | 70–85 | 50–70 | 16–26 | 5–14 | 0.20–0.6 | 0.05–0.19 | 7.9–8.4 | High | Moderate. |
| 90–100 | 75–95 | 45–85 | 25–30 | 6–15 | 0.6–2.0 | 0.20–0.22 | 6.6–7.3 | Low to moderate | Low. |
| 50–85 | 35–65 | 26–60 | 34–50 | 5–22 | 0.6–2.0 | 0.19–0.21 | 5.6–7.3 | Moderate | Moderate. |
| 35–65 | 5–35 | 5–10 | ([3]) | [2] NP | >20.0 | 0.02–0.04 | 7.9–8.4 | Low | Low. |
| 95–100 | 85–100 | 55–75 | 25–30 | 5–9 | 0.6–2.0 | 0.20–0.22 | 6.6–7.3 | High | Low. |
| 95–100 | 75–90 | 50–75 | 27–33 | 8–13 | 0.6–2.0 | 0.17–0.19 | 6.6–8.4 | Moderate | Low. |
| 95–100 | 65–95 | 40–80 | 28–32 | 7–11 | 0.6–2.0 | 0.17–0.19 | 7.9–8.4 | Moderate | Low. |
| 95–100 | 90–100 | 70–90 | 25–33 | 5–10 | 0.6–2.0 | 0.22–0.24 | <4.5–5.0 | High | Low. |
| 95–100 | 90–100 | 65–85 | 30–38 | 15–18 | 0.6–2.0 | 0.18–0.20 | <4.5–5.0 | Moderate | Moderate. |
| 100 | 95–100 | 85–95 | 20–30 | 4–10 | 0.6–2.0 | 0.22–0.24 | 6.1–7.3 | High | Low. |
| 95–100 | 95–100 | 85–95 | 18–26 | 7–14 | 0.6–2.0 | 0.20–0.22 | 6.1–6.5 | High | Low. |
| 95–100 | 70–95 | 60–75 | 20–30 | 4–10 | 0.6–2.0 | 0.20–0.22 | 7.4–7.8 | Moderate | Low to moderate. |
| 95–100 | 70–95 | 50–75 | 16–28 | 0–15 | 0.2–0.6 | 0.05–0.19 | 7.9–8.4 | Moderate | Low to moderate. |

TABLE 6.—*Estimated soil properties*

| Soil series and map symbols | Depth to— | | Depth from surface | USDA texture | Classification | |
|---|---|---|---|---|---|---|
| | Seasonal high water table | Bedrock | | | Unified | AASHO |
| | *Feet* | *Feet* | *Inches* | | | |
| Henshaw: Hh | 1–3 | >10 | 0–13 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 13–52 | Silty clay loam | CL | A–6 or A–7 |
| | | | 52–60 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 60–96 | Silty clay loam, silt loam, and clay. | ML or CL | A–6 or A–7 |
| Hickory: HkC2, HkD2, HkE2, HkF, HoC3, HoD3. | >6 | >15 | 0–12 | Silt loam | CL or ML or CL–ML | A–4 |
| | | | 12–43 | Clay loam | CL or SC | A–6 |
| | | | 43–60 | Loam | CL or CL–ML or SC | A–4 |
| Landes: La | >6 | >15 | 0–7 | Gravelly sandy loam | SC | A–2 or A–4 |
| | | | 7–28 | Sandy loam to gravelly loam. | SC | A–2 or A–4 |
| | | | 28–60 | Gravel and sand | SP–SM | A–1 |
| Martinsville: MaA, MbA, MbB2 | >6 | >15 | 0–14 | Loam | ML or CL or CL–ML | A–4 |
| | | | 14–39 | Clay loam | CL or ML | A–4 or A–6 |
| | | | 39–55 | Heavy sandy loam | SM or SC | A–2 or A–4 |
| | | | 55–72 | Stratified sand, fine sand, and silt. | SM | A–2 or A–4 |
| McGary: Mc | 1–3 | >15 | 0–11 | Heavy silt loam to silty clay loam. | ML or CL | A–4 or A–6 |
| | | | 11–38 | Silty clay | CH | A–7 |
| | | | 38–60 | Stratified silty clay and clay. | CL or CH or MH | A–7 |
| Medway: Md | 3–6 | >15 | 0–23 | Silty clay loam | CL | A–6 or A–7 |
| | | | 23–60 | Clay loam | CL or ML | A–6 or A–7 |
| Miami: MmB2, MmC2, MmD2, MoB3, MoC3, MoD3. | >6 | >15 | 0–10 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 10–18 | Silty clay loam | ML or CL | A–6 |
| | | | 18–39 | Clay loam | CL | A–6 or A–7 |
| | | | 39–60 | Heavy loam | ML or CL or CL–ML | A–4 |
| Milton: MtA, MtB2, MtC2 | >6 | 2–3½ | 0–13 | Silt loam to heavy silt loam. | ML or CL | A–4 |
| | | | 13–39 | Clay loam to heavy clay loam. | CL or CH or MH | A–7 |
| | | | 29–31 | Silty clay | CH or MH | A–7 |
| | | | >31 | Limestone bedrock. | | |
| Nineveh: NgA, NgB2, NnA | >6 | >15 | 0–14 | Loam | CL or ML | A–4 or A–6 |
| | | | 14–38 | Gravelly clay loam and sandy clay loam. | CL or SC | A–2 or A–4 |
| | | | 38–60 | Loose stratified gravel and sand. | SW–SM | A–1 |
| Ockley: OcA | >6 | >15 | 0–16 | Loam | CL | A–4 |
| | | | 16–45 | Clay loam, gravelly clay loam. | CL or SC or ML or SM | A–7 or A–2 |
| | | | 45–60 | Stratified gravel and sand. | SW–SM | A–1 |
| Otwell: OtB2, OtC2, OtC3, OtD2. | >6 | >15 | 0–11 | Silt loam to heavy silt loam. | ML or CL or CL–ML | A–4 or A–6 |
| | | | 11–27 | Silty clay loam | CL | A–7 |
| | | | 27–48 | Heavy loam | CL | A–6 |
| | | | 48–100 | Stratified silt loam and silty clay loam. | ML or CL | A–6 or A–7 |

See footnotes at end of table.

*significant to engineering*—Continued

| Percentage passing sieve— | | | Liquid limit | Plastic index | Permeability | Available water capacity | Reaction | Frost potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|---|
| No. 10 | No. 40 | No. 200 | | | | | | | |
| | | | *Percent* | | *Inches per hour* | *Inches per inch of soil* | *pH* | | |
| 100 | 90–100 | 70–90 | 28–34 | 7–14 | 0.6–2.0 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 100 | 95–100 | 85–95 | 35–49 | 20–30 | 0.2–0.6 | 0.18–0.20 | 5.6–6.0 | High | Moderate. |
| 100 | 90–100 | 70–100 | 30–38 | 5–12 | 0.2–0.6 | 0.20–0.22 | 6.6–7.3 | High | Low. |
| 100 | 90–100 | 70–100 | 35–50 | 14–25 | 0.2–0.6 | 0.08–0.10 | 7.9–8.4 | Moderate to high | Moderate. |
| 95–100 | 90–100 | 70–90 | 19–28 | 0–10 | 0.6–2.0 | 0.22–0.24 | 5.6–7.3 | High | Low. |
| 90–100 | 85–100 | 45–85 | 28–37 | 10–14 | 0.6–2.0 | 0.15–0.19 | 5.1–7.3 | Moderate | Moderate. |
| 90–100 | 85–95 | 45–75 | 17–26 | 4–10 | 0.6–2.0 | 0.05–0.19 | 7.9–8.4 | Moderate | Moderate to low. |
| 70–80 | 55–80 | 30–50 | 15–22 | 6–10 | 2.0–6.0 | 0.10–0.14 | 6.6–7.3 | Moderate | Low. |
| 80–95 | 60–80 | 30–50 | 15–22 | 6–10 | 2.0–6.0 | 0.12–0.14 | 6.6–7.3 | Moderate | Low. |
| 40–60 | 15–30 | 5–12 | (3) | [2] NP | >20.0 | 0.02–0.04 | 7.9–8.4 | Low | Low. |
| 100 | 85–100 | 60–75 | 20–30 | 0–8 | 0.6–2.0 | 0.20–0.22 | 6.6–7.3 | Moderate | Low to moderate. |
| 95–100 | 85–100 | 70–86 | 20–35 | 9–20 | 0.6–2.0 | 0.15–0.19 | 5.6–6.5 | Moderate | Moderate. |
| 95–100 | 85–95 | 30–50 | 15–28 | 4–12 | 0.6–2.0 | 0.11–0.13 | 6.6–7.3 | Moderate | Low. |
| 90–100 | 65–95 | 20–50 | (3) | [2] NP | 2.0–6.0 | 0.02–0.04 | 7.9–8.4 | Moderate | Low. |
| 100 | 95–100 | 90–100 | 35–40 | 10–15 | 0.6–2.0 | 0.21–0.24 | 5.1–7.3 | High | Low. |
| 100 | 95–100 | 90–100 | 50–65 | 30–40 | <0.06 | 0.11–0.13 | 5.1–8.4 | Moderate | High. |
| 100 | 90–100 | 90–100 | 45–55 | 20–38 | 0.06–0.20 | 0.08–0.10 | 7.9–8.4 | Moderate | High. |
| 95–100 | 95–100 | 85–95 | 35–45 | 18–22 | 0.6–2.0 | 0.21–0.23 | 6.6–7.3 | Moderate | Moderate. |
| 100 | 85–95 | 70–80 | 35–45 | 18–24 | 0.20–0.6 | 0.14–0.16 | 6.6–7.3 | Moderate | Moderate. |
| 95–100 | 85–100 | 65–90 | 30–35 | 4–12 | 0.6–2.0 | 0.22–0.24 | 6.6–7.3 | High | Low. |
| 85–100 | 80–100 | 65–90 | 30–40 | 12–17 | 0.6–2.0 | 0.18–0.20 | 5.6–6.0 | Moderate | Moderate. |
| 85–100 | 75–90 | 60–80 | 39–47 | 18–30 | 0.6–2.0 | 0.15–0.19 | 5.1–6.5 | Moderate | Moderate. |
| 80–100 | 75–95 | 50–75 | 14–24 | 0–10 | 0.6–2.0 | 0.05–0.19 | 7.9–8.4 | Moderate | Low to moderate. |
| 95–100 | 90–100 | 80–90 | 30–35 | 7–12 | 0.6–2.0 | 0.22–0.24 | 6.6–7.3 | High | Low. |
| 95–100 | 90–100 | 80–90 | 44–55 | 21–30 | 0.20–0.6 | 0.15–0.19 | 6.1–7.3 | Moderate | Moderate to high. |
| 90–100 | 80–100 | 75–95 | 50–75 | 25–35 | 0.20–0.6 | 0.09–0.11 | 6.6–7.3 | Moderate | High. |
| 85–100 | 70–90 | 50–75 | 25–35 | 8–17 | 0.6–2.0 | 0.20–0.22 | 6.1–7.3 | Moderate | Low to moderate. |
| 70–95 | 45–75 | 30–60 | 35–47 | 27–35 | 0.6–2.0 | 0.19–0.21 | 6.1–7.3 | Moderate | Moderate. |
| 45–70 | 10–30 | 5–15 | (3) | [2] NP | >20.0 | 0.02–0.04 | 7.9–8.4 | Low | Low. |
| 95–100 | 85–95 | 60–85 | 24–32 | 7–12 | 0.6–2.0 | 0.20–0.22 | 5.1–7.3 | Moderate | Low to moderate. |
| 70–95 | 40–75 | 28–60 | 40–55 | 10–42 | 0.6–2.0 | 0.19–0.21 | 5.1–7.3 | Moderate | Moderate. |
| 40–70 | 15–45 | 5–15 | (3) | [2] NP | >20.0 | 0.02–0.04 | 7.9–8.4 | Low | Low. |
| 95–100 | 90–100 | 85–95 | 22–32 | 7–15 | 0.6–2.0 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 95–100 | 95–100 | 85–95 | 40–50 | 20–30 | 0.6–2.0 | 0.18–0.20 | 4.5–5.0 | Moderate | Moderate. |
| 95–100 | 90–100 | 70–90 | 30–40 | 16–23 | <0.06 | [1] 0.06–0.08 | 4.5–5.0 | Moderate | Moderate. |
| 95–100 | 90–100 | 65–80 | 36–50 | 14–26 | 0.2–0.6 | [1] 0.06–0.08 | 5.1–8.4 | Moderate | Moderate. |

TABLE 6.—*Estimated soil properties*

| Soil series and map symbols | Depth to— | | Depth from surface | USDA texture | Classification | |
|---|---|---|---|---|---|---|
| | Seasonal high water table | Bedrock | | | Unified | AASHO |
| | *Feet* | *Feet* | *Inches* | | | |
| Peoga: Pe | 0–1 | >15 | 0–24 | Silt loam | ML | A–4 or A–6 |
| | | | 24–48 | Silty clay loam | CL | A–7 |
| | | | 48–85 | Stratified silt loam, silty clay loam, and silty clay. | CL | A–6 or A–4 |
| Princeton: PrB, PrC2 | >6 | >15 | 0–14 | Fine sandy loam | SM or ML | A–4 |
| | | | 14–47 | Heavy sandy loam and sandy clay loam. | SC or CL or SM | A–6 or A–4 or A–2 |
| | | | 47–74 | Sandy loam and fine sand | SM | A–4 or A–2 |
| | | | 74–96 | Fine sand | SM or SP–SM | A–2 or A–3 |
| Rarden: RaC2, RaD2, ReD3 | >6 | 1¾–3½ | 0–8 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 8–26 | Silty clay | CL or CH | A–7 |
| | | | 26–38 | Partly weathered shale. | | |
| | | | 38–44 | Clay shale. | | |
| Rensselaer: Rf, Rg | 0–1 | >15 | 0–15 | Clay loam | ML or CL | A–6 or A–7 |
| | | | 15–47 | Clay loam | ML or CL | A–4, A–6 or A–7 |
| | | | 47–72 | Sand, sandy loam, fine sand and silt. | ML or SM | A–2 or A–4 |
| Riverwash: Rh. Properties too variable for reliable estimates. | | | | | | |
| Rockcastle: RkF | >6 | 1¾–2½ | 0–11 | Silty clay loam | CL | A–6 |
| | | | 11–22 | Silty clay | CL | A–7 |
| | | | 22–36 | Decomposing shale. | | |
| | | | 36–60 | Clay shale. | | |
| Rodman: RnF | >6 | >15 | 0–12 | Gravelly loam | ML or SM | A–4 |
| | | | 12–60 | Sand and gravel | SP–SM or SM | A–1 |
| Ross: Ro, Rp | >6 | >15 | 0–30 | Silty clay loam | CL | A–6 or A–7 |
| | | | 30–45 | Loam | CL | A–6 |
| | | | 45–72 | Stratified sand and sandy loam. | SC or SM | A–4 or A–2 |
| Rossmoyne: RsB2 | 3–6 | >15 | 0–12 | Silt loam | ML or CL or CL–ML | A–4 or A–6 |
| | | | 12–25 | Silt loam | ML or CL–ML | A–4 |
| | | | 25–35 | Silty clay loam | ML or CL | A–6 |
| | | | 35–120 | Silt loam to clay loam | ML or CL | A–6 |
| | | | 120–130 | Light clay loam | CL or CL–ML | A–6 or A–4 |
| Russell: RuB2 | >6 | >15 | 0–15 | Silt loam | ML or CL or CL–ML | A–4 |
| | | | 15–26 | Silty clay loam | CL or ML | A–6 or A–7 |
| | | | 26–48 | Clay loam | CL | A–6 or A–7 |
| | | | 48–72 | Loam | CL or CL–ML | A–4 or A–6 |
| Saranac: Sa, Sc | 0–1 | >15 | 0–15 | Silty clay loam | CL | A–6 or A–7 |
| | | | 15–39 | Light silty clay to silty clay. | CL or CH or MH | A–7 |
| | | | 39–61 | Stratified silt loam, clay loam, and sandy loam. | ML or CL | A–6 |
| Shoals: Sh | 1–3 | >15 | 0–8 | Silt loam | ML or CL or CL–ML | A–4 or A–6 |
| | | | 8–43 | Silt loam and loam | ML or CL or CL–ML | A–4 or A–6 |
| | | | 43–60 | Stratified loam, silt loam, and sandy loam. | ML or CL or CL–ML | A–4 or A–6 |

See footnotes at end of table.

*significant to engineering*—Continued

| Percentage passing sieve— | | | Liquid limit | Plastic index | Permeability | Available water capacity | Reaction | Frost potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|---|
| No. 10 | No. 40 | No. 200 | | | | | | | |
| | | | *Percent* | | *Inches per hour* | *Inches per inch of soil* | *pH* | | |
| 100 | 90–100 | 70–95 | 24–30 | 8–14 | 0.6–2.0 | 0.22–0.24 | 4.5–7.3 | High | Low. |
| 100 | 95–100 | 85–95 | 35–45 | 23–27 | <0.06 | [4] 0.08–0.12 | 4.5–5.0 | High | Moderate. |
| 100 | 90–100 | 65–95 | 30–36 | 12–20 | 0.06–0.2 | [3] 0.08–0.12 | 4.5–5.5 | High | Moderate. |
| 100 | 90–100 | 40–60 | <6 | [2] NP | 2.0–6.0 | 0.16–0.18 | 6.6–7.3 | Moderate | Low. |
| 100 | 80–100 | 25–55 | 18–32 | 0–14 | 0.6–2.0 | 0.16–0.18 | 5.6–6.5 | Moderate | Low to moderate. |
| 100 | 70–90 | 30–50 | 15–20 | [2] NP | 0.6–2.0 | 0.11–0.13 | 6.6–7.8 | Moderate | Low. |
| 100 | 70–80 | 5–25 | 15–20 | [2] NP | 6.0–20.0 | 0.05–0.07 | 7.9–8.4 | Low | Low. |
| 95–100 | 90–100 | 85–95 | 22–32 | 7–15 | 0.6–2.0 | 0.22–0.24 | 5.1–6.0 | High | Low. |
| 90–100 | 85–100 | 80–95 | 46–55 | 20–35 | 0.06–0.2 | 0.11–0.13 | <4.5 | Moderate | Moderate to high. |
| 95–100 | 85–100 | 55–80 | 30–45 | 10–30 | 0.6–2.0 | 0.17–0.19 | 6.6–7.3 | High | Moderate. |
| 95–100 | 80–100 | 50–80 | 30–45 | 9–30 | 0.06–0.2 | 0.15–0.19 | 6.6–7.3 | High | Moderate. |
| 95–100 | 60–100 | 12–60 | 0–21 | [2] NP | 0.6–2.0 | 0.05–0.07 | 7.9–8.4 | Moderate to high | Low. |
| 95–100 | 90–100 | 85–95 | 30–37 | 15–30 | 0.6–2.0 | 0.21–0.23 | <4.5–5.5 | Moderate | Moderate. |
| 95–100 | 90–100 | 75–85 | 46–55 | 20–30 | 0.06–0.2 | 0.11–0.13 | 4.5–5.0 | Moderate | Moderate. |
| 70–80 | 50–75 | 40–60 | 10–12 | [2] NP | >20.0 | 0.17–0.20 | 7.9–8.4 | Low | Low. |
| 50–70 | 15–30 | 5–15 | ([3]) | [2] NP | >20.0 | 0.02–0.05 | 7.9–8.4 | Low | Low. |
| 95–100 | 90–100 | 70–90 | 35–50 | 18–23 | 0.6–2.0 | 0.21–0.23 | 6.6–7.3 | Moderate | Moderate. |
| 95–100 | 85–95 | 60–75 | 30–40 | 16–24 | 0.6–2.0 | 0.17–0.19 | 6.6–7.3 | Moderate | Moderate. |
| 90–100 | 70–80 | 35–50 | 20–35 | 5–15 | 0.6–2.0 | 0.19–0.21 | 7.9–8.4 | Moderate | Low. |
| 95–100 | 90–100 | 85–95 | 15–26 | 2–12 | 0.6–2.0 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 95–100 | 90–100 | 60–95 | 20–28 | 2–14 | 0.6–2.0 | 0.20–0.22 | 4.5–5.0 | High | Low. |
| 95–100 | 90–100 | 65–90 | 34–42 | 14–20 | <0.06 | [1] 0.06–0.08 | 4.5–5.0 | Moderate | Moderate. |
| 95–100 | 90–100 | 75–90 | 34–42 | 14–20 | 0.2–0.6 | [1] 0.06–0.08 | 4.5–5.5 | Moderate | Moderate. |
| 90–100 | 80–95 | 50–80 | 20–35 | 5–12 | 0.2–0.6 | [1] 0.06–0.08 | 7.9–8.4 | Moderate | Moderate. |
| 100 | 90–100 | 85–95 | 25–31 | 2–8 | 0.6–2.0 | 0.22–0.24 | 5.6–7.3 | High | Low. |
| 95–100 | 90–100 | 85–95 | 33–45 | 16–25 | 0.6–2.0 | 0.18–0.20 | 5.1–5.5 | Moderate | Moderate. |
| 95–100 | 85–95 | 70–80 | 31–45 | 18–25 | 0.6–2.0 | 0.15–0.19 | 5.1–7.3 | Moderate | Modetate. |
| 90–100 | 85–95 | 60–75 | 16–26 | 4–16 | 0.6–2.0 | 0.05–0.19 | 7.9–8.4 | Moderate | Low to moderate. |
| 95–100 | 90–100 | 85–95 | 35–50 | 20–30 | 0.20–0.6 | 0.21–0.23 | 7.4–8.4 | High | Moderate. |
| 95–100 | 90–100 | 85–95 | 40–58 | 20–35 | 0.20–0.6 | 0.11–0.13 | 7.9–8.4 | Moderate to high | Moderate to high. |
| 95–100 | 70–90 | 60–80 | 30–40 | 10–24 | 0.20–0.6 | 0.19–0.21 | 7.9–8.4 | High | Moderate. |
| 95–100 | 90–100 | 80–90 | 26–36 | 6–12 | 0.6–2.0 | 0.22–0.24 | 5.6–7.3 | High | Low. |
| 95–100 | 90–100 | 70–85 | 21–35 | 3–15 | 0.6–2.0 | 0.20–0.22 | 6.6–7.3 | High | Low to moderate. |
| 95–100 | 80–90 | 60–80 | 21–35 | 3–15 | 0.6–2.0 | 0.19–0.21 | 7.9–8.4 | High | Moderate. |

TABLE 6.—*Estimated soil properties*

| Soil series and map symbols | Depth to— | | Depth from surface | USDA texture | Classification | |
|---|---|---|---|---|---|---|
| | Seasonal high water table | Bedrock | | | Unified | AASHO |
| | *Feet* | *Feet* | *Inches* | | | |
| Sleeth: Sm | 1–3 | >15 | 0–14 | Loam | CL or ML or CL–ML | A–4 or A–6 |
| | | | 14–38 | Clay loam | CL | A–7 |
| | | | 38–50 | Gravelly clay loam | SC or CL | A–6 |
| | | | 50–60 | Gravel and sand | SP–SM or SM | A–1 or A–2 |
| Steff: St | 3–6 | 10 | 0–15 | Silt loam | ML or CL | A–7 |
| | | | 15–41 | Silt loam | ML or CL | A–4 |
| | | | 41–62 | Silt loam | ML or CL | A–4 |
| Stendal: Sx | 1–3 | >15 | 0–15 | Silt loam | ML or CL | A–4 |
| | | | 15–60 | Silt loam | ML or CL | A–4 or A–6 |
| Stonelick: Sz | >6 | >15 | 0–10 | Sandy loam | SM | A–2 or A–4 |
| | | | 10–34 | Sandy loam | SM | A–2 or A–4 |
| | | | 34–60 | Stratified sand | SP–SM or SM | A–1 or A–2 |
| Wakeland: Wa | 1–3 | >10 | 0–12 | Silt loam | ML or CL | A–4 |
| | | | 12–60 | Silt loam | ML or CL | A–4 |
| Weikert: BeF | >6 | 1–1½ | 0–6 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 6–19 | Channery silt loam | SM | A–4 or A–2 |
| For Berks part of BeF, see Berks series. | | | 19 | Shale and sandstone bedrock. | | |
| Westland: Wc | 0–1 | >15 | 0–12 | Clay loam | CL | A–7 |
| | | | 12–46 | Clay loam | CL | A–7 |
| | | | 46–50 | Gravelly clay loam | CL or SC | A–6 |
| | | | 50–65 | Stratified gravel and sand | SP–SM or SM | A–1 |
| Whitaker: Wh | 1–3 | >15 | 0–12 | Loam | CL | A–4 or A–6 |
| | | | 12–30 | Clay loam | CL | A–6 |
| | | | 30–43 | Sandy clay loam | SC or CL | A–2, A–4 or A–6 |
| | | | 43–60 | Stratified sandy loam and sandy clay loam. | SM | A–2 or A–4 |
| Wilbur: Wu | 3–6 | >15 | 0–17 | Silt loam | ML or CL | A–4 |
| | | | 17–43 | Silt loam | ML or CL | A–4 or A–6 |
| | | | 43–60 | Loam | ML or CL | A–4 or A–6 |
| Xenia: XeB2 | 3–6 | >15 | 0–11 | Silt loam | ML or CL or CL–ML | A–4 |
| | | | 11–29 | Silty clay loam | CL | A–6 or A–7 |
| | | | 29–61 | Clay loam | CL | A–6 or A–7 |
| | | | 61–86 | Heavy loam | CL or CL–ML | A–4 or A–6 |
| Zanesville: ZaB2, ZaC2, ZaC3 | >6 | 3½–6½ | 0–9 | Silt loam | ML | A–4 |
| | | | 9–26 | Heavy silt loam and light silty clay loam. | ML or CL | A–4, A–6 or A–7 |
| | | | 26–46 | Light silty clay loam, heavy silt loam. | ML or CL | A–4 or A–6 |
| | | | 46–68 | Silt loam and loam | CL | A–6 or A–4 |
| | | | 68–72 | Sandstone and siltstone | | |
| Zipp: Zp | 0–1 | >15 | 0–15 | Silty clay loam and silty clay. | CH or MH | A–7 |
| | | | 15–39 | Silty clay | CH or MH | A–7 |
| | | | 39–60 | Stratified silty clay and clay. | CL or CH or ML | A–6 or A–7 |

[1] Fragipan limits water available for plants by restricting water movement and root penetration.
[2] Nonplastic.

*significant to engineering*—Continued

| Percentage passing sieve— | | | Liquid limit | Plastic index | Permeability | Available water capacity | Reaction | Frost potential | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|---|
| No. 10 | No. 40 | No. 200 | | | | | | | |
| | | | *Percent* | | *Inches per hour* | *Inches per inch of soil* | *pH* | | |
| 90–100 | 85–95 | 60–90 | 25–32 | 6–10 | 0.6–2.0 | 0.20–0.22 | 6.6–7.3 | High | Low to moderate. |
| 95–100 | 90–100 | 70–95 | 30–50 | 20–35 | 0.6–2.0 | 0.15–0.19 | 5.6–7.3 | High | Moderate. |
| 70–90 | 30–70 | 45–60 | 35–40 | 15–19 | 0.6–2.0 | 0.12–0.15 | 6.6–7.3 | High | Moderate. |
| 60–90 | 25–70 | 5–20 | (3) | [2] NP | >20.0 | 0.02–0.04 | 7.9–8.4 | Low | Low. |
| 100 | 95–100 | 75–95 | 28–35 | 3–9 | 0.6–2.0 | 0.22–0.24 | 5.6–7.3 | High | Low. |
| 100 | 95–100 | 75–95 | 28–35 | 3–9 | 0.6–2.0 | 0.20–0.22 | 5.1–5.5 | High | Low. |
| 95–100 | 90–100 | 70–90 | 28–35 | 3–9 | 0.6–2.0 | 0.20–0.22 | 5.1–5.5 | High | Low. |
| 100 | 95–100 | 75–90 | 28–35 | 3–9 | 0.6–2.0 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 100 | 95–100 | 75–90 | 28–35 | 3–15 | 0.6–2.0 | 0.20–0.22 | 5.1–6.0 | High | Low. |
| 95–100 | 60–70 | 30–40 | 20–25 | 5–9 | 2.00–6.0 | 0.13–0.15 | 7.4–7.8 | Moderate | Low. |
| 95–100 | 60–70 | 30–40 | 20–25 | 5–9 | 2.00–6.0 | 0.13–0.15 | 7.9–8.4 | Moderate | Low. |
| 50–75 | 30–60 | 5–10 | (3) | [2] NP | >20.0 | 0.05–0.07 | 7.9–8.4 | Low | Low. |
| 100 | 95–100 | 75–95 | 28–35 | 3–9 | 0.6–2.0 | 0.22–0.24 | 5.6–7.3 | High | Low. |
| 100 | 95–100 | 75–95 | 28–35 | 3–9 | 0.6–2.0 | 0.20–0.22 | 5.6–6.0 | High | Low. |
| 90–100 | 75–90 | 70–85 | 20–30 | 2–10 | 2.00–6.0 | 0.22–0.24 | 5.1–5.5 | High | Low. |
| 70–90 | 60–90 | 30–50 | NP–6 | [2] NP | 2.00–6.0 | 0.11–0.15 | 4.5–5.0 | Low to moderate | Low. |
| 90–100 | 70–90 | 50–70 | 35–50 | 24–32 | 0.20–0.6 | 0.17–0.19 | 6.6–7.3 | High | Moderate. |
| 90–100 | 70–90 | 50–70 | 35–50 | 25–30 | 0.06–0.2 | 0.15–0.19 | 6.6–7.3 | High | Moderate. |
| 70–80 | 50–75 | 35–65 | 34–40 | 16–22 | 0.06–0.2 | 0.19–0.21 | 7.9–8.4 | Moderate to low | Moderate. |
| 40–60 | 25–50 | 5–20 | (3) | [2] NP | >20.0 | 0.02–0.04 | 7.9–8.4 | Low | Low. |
| 95–100 | 90–100 | 60–75 | 20–27 | 8–13 | 0.6–2.0 | 0.20–0.22 | 6.1–7.3 | High | Low to moderate. |
| 95–100 | 85–95 | 60–75 | 28–40 | 13–17 | 0.6–2.0 | 0.15–0.19 | 5.6–6.0 | High | Moderate. |
| 95–100 | 80–90 | 30–60 | 20–27 | 7–13 | 0.6–2.0 | 0.16–0.18 | 6.1–6.5 | High | Moderate. |
| 90–100 | 65–90 | 10–40 | (3) | [2] NP | 0.6–2.0 | 0.19–0.21 | 7.9–8.4 | Moderate to high | Low to moderate. |
| 100 | 90–100 | 85–95 | 28–35 | 3–9 | 0.6–2.0 | 0.22–0.24 | 6.6–7.3 | High | Low. |
| 100 | 90–100 | 85–95 | 28–35 | 3–15 | 0.6–2.0 | 0.20–0.22 | 6.6–7.3 | High | Low. |
| 95–100 | 85–95 | 70–80 | 28–35 | 3–15 | 0.6–2.0 | 0.17–0.19 | 5.6–6.0 | High | Low. |
| 100 | 90–100 | 85–95 | 25–31 | 2–8 | 0.6–2.0 | 0.22–0.24 | 5.6–7.3 | High | Low. |
| 95–100 | 90–100 | 85–95 | 33–45 | 16–25 | 0.20–0.6 | 0.18–0.20 | 5.1–5.5 | Moderate | Moderate. |
| 95–100 | 85–95 | 70–80 | 31–50 | 20–25 | 0.20–0.6 | 0.14–0.16 | 5.1–6.0 | Moderate | Moderate. |
| 90–100 | 85–95 | 60–75 | 20–32 | 4–16 | 0.20–2.0 | 0.05–0.19 | 7.9–8.4 | Moderate | Low to moderate. |
| 100 | 90–100 | 85–95 | 24–30 | 6–11 | 0.6–2.0 | 0.22–0.24 | 5.1–7.3 | High | Low. |
| 100 | 90–100 | 80–95 | 37–45 | 7–17 | 0.6–2.0 | 0.18–0.20 | 4.5–5.5 | High | Moderate. |
| 95–100 | 90–100 | 80–90 | 26–40 | 8–20 | <0.06 | [1] 0.06–0.08 | 4.5–5.0 | Moderate to high | Moderate. |
| 90–100 | 85–95 | 75–90 | 24–31 | 8–12 | 0.20–0.6 | [1] 0.06–0.08 | 4.5–5.0 | Moderate to high | Moderate. |
| 100 | 95–100 | 90–95 | 40–60 | 20–27 | 0.06–0.20 | 0.14–0.21 | 6.6–7.3 | High | Moderate to high. |
| 100 | 95–100 | 75–95 | 50–60 | 20–27 | <0.06 | 0.11–0.13 | 6.6–7.3 | Moderate to high | High. |
| 100 | 95–100 | 85–95 | 30–55 | 12–30 | <0.06 | 0.10–0.12 | 7.9–8.4 | Moderate to high | High. |

[3] Impractical to estimate.
[4] Brittle subsoil limits water available for plants by restricting water movemand and root penetration.

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Avonburg: AvA, AvB2 | Surface: fair; low in organic-matter content. | Not suitable | Subsoil and underlying material: fair to poor; medium to low shear strength; medium to high compressibility; fair stability; poor to fair compaction characteristics; low to moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; low to moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Ayrshire: Ay | Surface: fair to good; moderate organic-matter content.<br>Subsoil: fair to poor; somewhat clayey; seasonal high water table. | Not suitable | Subsoil and underlying material: fair to poor; medium to low shear strength; slight to medium compressibility; fair to poor stability; fair to good compaction characteristics; low to moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Slight to medium compressibility in the subsoil; low to moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Bartle: Ba | Surface: fair; low in organic-matter content.<br>Subsoil: poor; fragipan; seasonal high water table. | Not suitable | Subsoil and underlying material: fair to poor; medium to low shear strength; medium to high compressibility; fair stability; poor to fair compaction characteristics; low to moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; low to moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Berks: BeF | Surface: poor; low in organic-matter content; high in channery and shaly material. | Not suitable | Subsoil and underlying material: good; to fair shear strength; slight to medium compressibility; fair stability; fair to good compaction characteristics; low shrink-swell potential; moderate susceptibility to frost heave; rippable sandstone and shale bedrock at a depth of 20 to 40 inches. | Slight to medium compressibility in the subsoil; low shrink-swell potential; moderate susceptibility to frost heave; rippable sandstone and shale bedrock at a depth of 20 to 40 inches; steep topography; cuts and fills needed. |
| Bloomfield: BmC | Surface and subsoil: poor; sand; droughty; subject to soil blowing. | Not suitable | Subsoil and underlying material: good; fair to good shear strength; slight to very slight compressibility; fair to poor stability; fair to good compaction characteristics; low shrink-swell potential; low susceptibility to frost heave. | Slight to very slight compressibility in the subsoil; low shrink-swell potential; susceptibility to frost heave; cuts and fills needed; cuts difficult to vegetate because of sandy material. |

*engineering properties of soils*

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Subsoil and underlying material: medium to low shear strength; fair stability; poor to fair compaction characteristics; low to moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow seepage rate; seasonal high water table. | Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; very slow permeability in the fragipan. | Soil features favorable | Difficult to establish plant cover where fragipan is exposed. |
| Subsoil and underlying material: medium to low shear strength; fair to poor stability; fair to good compaction characteristics; low to moderate shrink-swell potential; low permeability when compacted; fair resistance to piping. Underlying material: moderate permeability when compacted; poor resistance to piping. | Moderate to rapid seepage rate in underlying material; seasonal high water table; nearly level. | Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil and underlying material: medium to low shear strength; fair stability; poor to fair compaction characteristics; low to moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow seepage rate; seasonal high water table; nearly level; suitable for pit ponds. | Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; very slow permeability in the fragipan. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil and underlying material: good to fair stability; fair to good compaction characteristics; low shrink-swell potential; moderate permeability when compacted; poor resistance to piping. | Slow to moderate seepage rate; bedrock at a depth of 20 to 40 inches. | Not needed; well drained. | Steep slopes | Steep slopes. |
| Subsoil and underlying material: fair to good shear strength; fair to poor stability; fair to good compaction characteristics; low shrink-swell potential; moderate to high permeability when compacted; fair to poor resistance to piping. | Rapid seepage rate; too coarse to hold water. | Not needed; well drained. | Not needed; porous sands; little runoff. | Not needed; porous sands; little runoff. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Bonnie: Bo | Fair in the upper foot; poor below; low in organic-matter content; seasonal high water table. | Not suitable | Underlying material; fair to poor; fair to poor shear strength; medium to high compressibility; poor to fair stability; poor to fair compaction characteristics; low shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility; low shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Brookston: Br | Surface: fair; somewhat clayey.<br>Subsoil: poor; clayey; high water table. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to poor compaction characteristics; moderate to high shrink-swell potential; moderate to high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; moderate to high shrink-swell potential; moderate to high susceptibility to frost heave; seasonal high water table. |
| Burnside: Bu | Surface and underlying material: poor; moderate in organic-matter content; high in channery and shaly material. | Not suitable | Underlying material: good; good to fair shear strength; slight compressibility; fair stability; fair to good compaction characteristics; low shrink-swell potential; low susceptibility to frost heave. | Slight compressibility in the subsoil; low shrink-swell potential; low susceptibility to frost heave; subject to flooding. |
| Camden: Ca | Surface: good.<br>Subsoil: fair; somewhat clayey. | Not suitable | Subsoil: fair shear strength; medium to high compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave.<br>Underlying material: good; fair shear strength; slight compressibility; fair stability; fair to good compaction characteristics; low shrink-swell potential and susceptibility to frost heave. | Medium to high compressibility, moderate shrink-swell potential, and susceptibility to frost heave in the subsoil; slight compressibility, low shrink-swell potential and susceptibility to frost heave in the underlying material. |
| Celina: CeB2 | Surface: good.<br>Subsoil: fair or poor; somewhat clayey. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; cuts and fills needed. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Underlying material: fair to poor shear strength; poor to fair stability; poor to fair compaction characteristics; low shrink-swell potential; moderate to low permeability when compacted; poor resistance to piping. | Slow to moderate seepage rate; seasonal high water table; subject to flooding; nearly level; suitable for pit ponds. | Poorly drained; seasonal high water table at a depth of 0 to 1 foot; slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil and underlying material: fair shear strength; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate; seasonal high water table; nearly level; suitable for pit ponds. | Very poorly drained; water table at a depth of 0 to 1 foot; slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Underlying material: good to fair shear strength; fair stability; fair to good compaction characteristics; low shrink-swell potential; moderate permeability when compacted; fair resistance to piping. | Rapid seepage rate; subject to flooding. | Not needed; well drained. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil: fair strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: fair shear strength; fair stability; fair to good compaction characteristics; low shrink-swell potential; moderate permeability when compacted; poor resistance to piping. | Rapid seepage rate in underlying material. | Not needed; well drained. | Not needed | Not needed. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate | Moderately well drained | Soil features favorable | Soil features favorable. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Cincinnati: CnB2, CnC2, CnC3, CnD2, CnD3. | Surface: fair; low in organic-matter content. Subsoil: poor; fragipan; low in organic-matter content. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; cuts and fills needed; difficult to establish vegetation on cuts where fragipan is exposed. |
| Clermont: Cr | Surface: fair; low in organic-matter content. Subsoil: poor; low in organic-matter content; seasonal high water table. | Not suitable | Subsoil and underlying material: poor to fair; fair shear strength; medium to high compressibility; fair stability; fair compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Corydon: CyF | Very poor; stone fragments throughout; shallow over bedrock. | Not suitable; possible source of limestone suitable for crushing. | Subsoil and underlying material: poor; steep slopes; bedrock at a depth of less than 20 inches. | Steep slopes; shallow over bedrock. |
| Crosby: CzA, CzB2 | Surface: good; moderate in organic-matter content. Subsoil: fair or poor; clayey; seasonal high water table. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate to high shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; moderate to high shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Dubois: Du | Surface: fair or poor; low in organic-matter content. Subsoil: poor; fragipan; somewhat clayey, seasonal high water table. | Not suitable | Subsoil and underlying material: fair to poor; fair to poor shear strength; medium to high compressibility; fair stability; poor to fair compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate | Not needed; well drained | Soil features favorable | May be difficult to vegetate where fragipan is exposed. |
| Subsoil and underlying material: fair shear strength; fair stability; fair compaction characteristics; moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow seepage rate; seasonal high water table; nearly level; suitable for pit ponds. | Poorly drained; water table at a depth of 0 to 1 foot; very slow permeability. | Not needed | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil and underlying material: steep slopes; bedrock at a depth of less than 20 inches. | Shallow over bedrock that has solution channels in places that allow seepage. | Not needed; well drained | Steep slopes | Steep slopes. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate; seasonal high water table. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; slow permeability. | Soil features favorable | Soil features favorable. |
| Subsoil and underlying material: fair to poor shear strength; fair stability; poor to fair compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate; seasonal high water table; nearly level; suitable for pit ponds. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; very slow permeability in the fragipan. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Eel: Ee | Surface and underlying material: good; subject to flooding. | Not suitable | Underlying material: fair to poor; fair to poor shear strength; medium to high compressibility; fair to good stability; fair to poor compaction characteristics; low to moderate shrink-swell potential; moderate susceptibility to frost heave; subject to flooding. | Medium to high compressibility in the underlying material; low to moderate shrink-swell potential; moderate susceptibility to frost heave; subject to flooding. |
| Fincastle: FcA, FcB2 | Surface: good; moderate in organic-matter content.<br>Subsoil: fair to poor; clayey; low in organic-matter content; seasonal high water table. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate to high shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; moderate to high shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Fox: FoA, FoB2, FxC3 | Surface: fair or good; contains a few ½- to 2-inch pebbles in places.<br>Subsoil: poor or fair; somewhat gravelly and clayey. | Good below a depth of 24 to 40 inches. | Subsoil: fair; fair shear strength; medium to high compressibility; fair to good compaction characteristics; moderate shrink-swell potential; susceptibility to frost heave.<br>Underlying material: very good; good to fair shear strength; very slight compressibility; fair to good stability; good compaction characteristics; low shrink-swell potential and susceptibility to frost heave. | Subsoil: medium to high compressibility; moderate shrink-swell potential; susceptibility to frost heave.<br>Underlying material: very slight compressibility; low shrink-swell potential and susceptibility to frost heave; cuts and fills needed in places; difficult to vegetate where loose gravel and sand are exposed. |
| Genesee: Ge | Surface and underlying material: good; subject to flooding. | Generally not suitable; sand and gravel in underlying material in places. | Underlying material: fair to poor; fair to poor shear strength; medium to high compressibility; fair to good stability; fair to poor compaction characteristics; low shrink-swell potential; moderate susceptibility to frost heave; subject to flooding. | Medium to high compressibility in the underlying material; low shrink-swell potential; moderate susceptibility to frost heave; subject to flooding. |
| Gilpin: GpD2, GpD3, GpE | Surface: fair; low in organic-matter content.<br>Subsoil: poor; somewhat clayey; contains channery and shaley material. | Not suitable | Subsoil: fair; fair shear strength; medium to high compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave; bedrock at a depth of 20 to 40 inches. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; rippable bedrock at a depth of 20 to 40 inches; steep topography; cuts and fills needed; side slopes difficult to vegetate. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Underlying material: fair to poor shear strength; fair to good stability; fair to poor compaction characteristics; low to moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Moderate to slow seepage rate; subject to flooding. | Moderately well drained | Not needed except to divert runoff from adjoining higher areas. | Not needed except where overflow water concentrates. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate to high shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate; seasonal high water table. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; slow permeability. | Soil features favorable | Soil features favorable. |
| Subsoil: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: good to fair shear strength; fair to good stability; good compaction characteristics; low shrink-swell potential; high permeability when compacted; fair to good resistance to piping. | Rapid seepage rate; too sandy and gravelly to hold water. | Not needed; well drained | Not needed | Depth to loose gravel and sand is 24 to 40 inches. |
| Underlying material: fair to poor shear strength; fair to good stability; fair to poor compaction characteristics; low shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow to rapid seepage rate; variable texture in the underlying material; subject to flooding. | Not needed; well drained | Not needed; well drained | Not needed except where overflow water concentrates. |
| Subsoil: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low to moderate permeability when compacted; fair to good resistance to piping; bedrock at a depth of 20 to 40 inches. | Moderate to slow seepage rate; bedrock at a depth of 20 to 40 inches. | Not needed; well drained | Depth to bedrock is 20 to 40 inches. | Depth to bedrock is 20 to 40 inches. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Gullied land: Gu. Properties too variable for reliable estimates. | | | | |
| Haymond: Ha | Surface and underlying material good; subject to flooding. | Not suitable | Underlying material: fair to poor; poor shear strength; medium compressibility; poor to fair stability; poor compaction characteristics; low shrink-swell potential; moderate to high susceptibility to frost heave; subject to flooding. | Medium compressibility in the subsoil; low shrink-swell potential; moderate to high susceptibility to frost heave; subject to flooding. |
| Hennepin: HeF | Surface: fair; thin; steep slopes. Subsoil: fair to poor; low in organic-matter content. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good compaction characteristics; low to moderate shrink-swell potential; moderate susceptibility to frost heave. | Medium to high compressibility; low to moderate shrink-swell potential; moderate susceptibility to frost heave; steep topography; deep cuts needed; difficult to vegetate lower part of side slopes. |
| Henshaw: Hh | Surface: good; moderate in organic-matter content. Subsoil: fair to poor; clayey; low in organic-matter content; seasonal high water table. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |
| Hickory: HkC2, HkD2, HkE2, HkF, HoC3, HoD3. | Surface: fair; low in organic-matter content. Subsoil: poor; somewhat clayey. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; moderate susceptibility to frost heave. | Moderate to high compressibility in the subsoil; moderate shrink-swell potential; moderate susceptibility to frost heave; cuts and fills needed; difficult to vegetate side slopes of deep cuts. |
| Landes: La | Surface: fair; contains gravel in places. Subsoil: poor; gravelly. | Good below a depth of 2 to 3 feet. | Subsoil and underlying material: good; fair to good shear strength; slight compressibility; fair to good stability; good compaction characteristics; low shrink-swell potential; moderate susceptibility to frost heave; subject to flooding. | Slight compressibility in the subsoil; low shrink-swell potential; moderate susceptibility to frost heave; subject to flooding. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Underlying material: poor shear strength; poor to fair stability; poor compaction characteristics; low shrink-swell potential; moderate permeability when compacted; poor resistance to piping. | Slow to rapid seepage rate; variable texture in underlying material; subject to flooding. | Not needed; well drained. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff comes from adjoining higher areas. |
| Subsoil and underlying material: fair shear strength; fair stability; fair to good compaction characteristics; low to moderate shrink-swell potential; low permeability when compacted; fair to good resistance to piping. | Moderate to slow seepage rate. | Not needed; well drained. | Steep slopes. | Steep slopes. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow seepage rate; seasonal high water table; nearly level; suitable for pit ponds. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; moderately slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil and underlying material: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate. | Not needed; well drained. | Soil features favorable. | Soil features favorable. |
| Subsoil and underlying material; fair to good shear strength; fair to good stability; good compaction characteristics; low shrink-swell potential; moderate to high permeability when compacted; fair resistance to piping. | Rapid seepage rate; too sandy and gravelly to hold water; subject to flooding. | Not needed; well drained. | Not needed. | Not needed. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Martinsville: MaA, MbA, MbB2. | Surface: good. Subsoil: fair; somewhat clayey. | Poor to fair; variation of textures in underlying materials. | Subsoil: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. Underlying material: good; fair to good shear strength; slight compressibility; fair to poor stability; fair to good compaction characteristics; low shrink-swell potential; moderate susceptibility to frost heave. | Subsoil: medium to high compressibility; moderate shrink-swell potential; susceptibility to frost heave. Underlying material: slight compressibility; low shrink-swell potential; moderate susceptibility to frost heave. |
| McGary: Mc | Surface: fair; low in organic-matter content. Subsoil: very poor; clayey and plastic; seasonal high water table. | Not suitable | Subsoil and underlying material: poor; poor shear strength; high compressibility; fair to poor stability; fair to poor compaction characteristics; high shrink-swell potential; moderate susceptibility to frost heave; seasonal high water table. | High compressibility in the subsoil; high shrink-swell potential; moderate susceptibility to frost heave; seasonal high water table. |
| Medway: Md | Surface and subsoil: fair; somewhat clayey. | Not suitable | Subsoil and underlying material: fair to poor; fair to poor shear strength; medium to high compressibility; fair stability; fair compaction characteristics; moderate shrink-swell potential; susceptibility to frost heave; subject to flooding. | Medium to high compressibility in the subsoil; moderate shrink-swell potential; susceptibility to frost heave; seasonal high water table; subject to flooding. |
| Miami: MmB2, MmC2, MmD2, MoB3, MoC3, MoD3. | Surface: fair or good; eroded areas somewhat clayey. Subsoil: fair or poor; clayey. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; cuts and fills needed. |
| Milton: MtA, MtB2, MtC2. | Surface: fair or good. Subsoil: poor or very poor; clayey; bedrock at a depth of 20 to 40 inches. | Not suitable: possible source of limestone suitable for crushing. | Subsoil: poor; fair to poor shear strength; medium to high compressibility; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; moderate susceptibility to frost heave; limestone bedrock at a depth of 20 to 40 inches. | Medium to high compressibility in the subsoil; moderate to high shrink-swell potential; moderate susceptibility to frost heave; limestone bedrock at a depth of 20 to 40 inches; cuts and fills needed in places. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Subsoil: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: fair to good shear strength; fair to poor stability; fair to good compaction characteristics; low shrink-swell potential; moderate to high permeability when compacted; fair resistance to piping. | Rapid seepage rate in underlying material; too sandy to hold water. | Not needed; well drained. | Not needed. | Soil features favorable. |
| Subsoil and underlying material: poor shear strength; fair to poor stability; fair to poor compaction characteristics; high shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate; seasonal high water table. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; very slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil and underlying material: fair to poor shear strength; fair stability; fair compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Moderate to slow seepage rate; subject to flooding. | Moderately well drained. | Not needed except to divert runoff from adjoining higher areas. | Not needed except where overflow water concentrates. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Moderate to slow seepage rate in underlying material. | Not needed; well drained. | Soil features favorable. | Soil features favorable. |
| Subsoil: fair to poor shear strength; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; low permeability when compacted; good resistance to piping; limestone bedrock at a depth of 20 to 40 inches. | Slow to rapid seepage rate; limestone bedrock at a depth of 20 to 40 inches; solution channels in places that allow seepage. | Not needed; well drained. | Depth to bedrock is 20 to 40 inches. | Depth to bedrock is 20 to 40 inches. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Nineveh: NgA, NgB2, NnA. | Surface: fair or good; contains a few ½- to 2-inch pebbles in places. Subsoil: poor or fair; somewhat gravelly and clayey. | Good below a depth of 24 to 40 inches. | Subsoil: fair; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. Underlying material: very good; good to fair shear strength; very slight compressibility; fair to good compaction characteristics; low shrink-swell potential and susceptibility to frost heave. | Subsoil: medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. Underlying material: very slight compressibility; low shrink-swell potential and susceptibility to frost heave. |
| Ockley: OcA | Surface: good. Subsoil: poor or fair; somewhat gravelly and clayey. | Good below a depth of 40 to 60 inches. | Subsoil: fair; fair shear strength; medium to high compressibility; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. Underlying material: very good; good to fair shear strength; very slight compressibility; fair to good stability; good compaction characteristics; low shrink-swell potential and susceptibility to frost heave. | Subsoil: medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. Underlying material: very slight compressibility; low shrink-swell potential and susceptibility to frost heave. |
| Otwell: OtB2, OtC2, OtC3, OtD2. | Surface: fair; low in organic-matter content. Subsoil: poor; fragipan; low in organic-matter content. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; moderate susceptibility to frost heave. | Medium to high compressibility in the subsoil; moderate shrink-swell potential; moderate susceptibility to frost heave; cuts and fills needed; difficult to establish vegetation on cuts where fragipan is exposed. |
| Peoga: Pe | Surface: fair; low in organic-matter content. Subsoil: poor; low in organic-matter content; seasonal high water table. | Not suitable | Subsoil and underlying material: poor to fair; fair shear strength; medium to high compressibility; fair stability; fair compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Subsoil: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: good to fair shear strength; fair to good stability; good compaction characteristics; low shrink-swell potential; high permeability when compacted; good resistance to piping. | Rapid seepage rate; too sandy and gravelly to hold water. | Not needed; well drained. | Not needed. | Soil features favorable. |
| Subsoil: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: good to fair shear strength; fair to good stability; good compaction characteristics; low shrink-swell potential; high permeability when compacted; good resistance to piping. | Rapid seepage rate; too sandy and gravelly to hold water. | Not needed; well drained. | Not needed. | Not needed. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate. | Not needed; well drained. | Soil features favorable. | Difficult to vegetate in places where fragipan is exposed. |
| Subsoil and underlying material: fair shear strength; fair stability; fair compaction characteristics; moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow seepage rate; seasonal high water table; nearly level; suitable for pit ponds. | Poorly drained; water table at a depth of 0 to 1 foot; very slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Princeton: PrB, PrC2 | Surface: good. Subsoil: fair; somewhat clayey. | Not suitable | Subsoil: fair to good; fair to good shear strength; medium compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; moderate susceptibility to frost heave. Underlying material: good; fair to good shear strength; slight compressibility; fair stability; fair to good compaction characteristics; low shrink-swell potential; low susceptibility to frost heave. | Subsoil: medium compressibility; moderate shrink-swell potential and susceptibility to frost heave. Underlying material: slight compressibility; low shrink-swell potential and susceptibility to frost heave; cuts and fills needed; difficult to vegetate where loose sand is exposed in the cuts. |
| Rarden: RaC2, RaD2, ReD3 | Surface: fair; low in organic-matter content. Subsoil: poor; clayey. | Not suitable | Subsoil: poor; fair to poor shear strength; high compressibility; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; moderate susceptibility to frost heave; clay shale bedrock at a depth of 20 to 40 inches. | High compressibility in the subsoil; moderate to high shrink-swell potential; moderate susceptibility to frost heave; clay shale bedrock below a depth of 20 to 40 inches; cuts and fills needed; cuts difficult to vegetate where shale is exposed. |
| Rensselaer: Rf, Rg | Surface: fair; somewhat clayey. Subsoil: fair or poor; somewhat clayey; seasonal high water table. | Generally not suitable; in places the underlying material contains sand pockets. | Subsoil and underlying material: poor to fair; fair shear strength; slight to medium compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Slight to medium compressibility; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table; subject to ponding. |
| Riverwash: Rh. Properties too variable for reliable estimates. | | | | |
| Rockcastle: RkF | Surface and subsoil: poor or very poor; clayey; shallow over shale bedrock. | Not suitable | Subsoil: poor; fair to poor shear strength; high compressibility; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; moderate susceptibility to frost heave; clay shale bedrock at a depth of 20 to 40 inches. | High compressibility in the subsoil: moderate to high shrink-swell potential; moderate susceptibility to frost heave; clay shale bedrock below a depth of 20 to 40 inches; cuts and fills needed; cuts difficult to vegetate where shale is exposed. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Subsoil: fair to good shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: fair to good shear strength; fair stability; fair to good compaction characteristics; low shrink-swell potential; moderate to high permeability when compacted; fair to poor resistance to piping. | Rapid seepage rate; too sandy to hold water. | Not needed; well drained. | No limitations if topography is favorable. | Erosion hazard during construction. |
| Subsoil: fair to poor shear strength; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; low permeability when compacted; good resistance to piping; clay shale bedrock at a depth of 20 to 40 inches. | Slow seepage rate; clay shale at a depth of 20 to 40 inches. | Not needed; well drained. | Clay shale bedrock at a depth of 20 to 40 inches. | Clay shale bedrock at a depth of 20 to 40 inches; difficult to vegetate. |
| Subsoil: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; moderate permeability when compacted; poor resistance to piping. | Moderate seepage rate in underlying material; high water table; nearly level. | Very poorly drained; water table at a depth of 0 to 1 foot; ponding of surface water; slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil: fair to poor shear strength; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; low permeability when compacted; good resistance to piping; clay shale bedrock at a depth of 20 to 40 inches. | Slow seepage rate; clay shale bedrock at a depth of 20 to 40 inches. | Not needed; well drained. | Steep slope | Steep slope. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Rodman: RnF | Surface and subsoil: poor or very poor; shallow over gravel. | Good | Subsoil and underlying material: very good; good to fair shear strength; very slight compressibility; fair to good stability; good compaction characteristics; low shrink-swell potential and susceptibility to frost heave. | Very slight compressibility in the subsoil; low shrink-swell potential and susceptibility to frost heave; cuts and fills needed; cuts are difficult to vegetate where loose gravel and sand are exposed. |
| Ross: Ro, Rp | Surface: fair or good; somewhat clayey in places.<br>Underlying material: fair or good; somewhat clayey in places; subject to flooding. | Generally not suitable; in places there is sand and gravel in the underlying material. | Underlying material: fair to poor; fair to poor shear strength; medium to high compressibility; fair stability; fair compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave; subject to flooding. | Medium to high compressibility in the underlying material; moderate shrink-swell potential and susceptibility to frost heave; subject to flooding. |
| Rossmoyne: RsB2 | Surface: fair; low in organic-matter content.<br>Subsoil: poor; fragipan; low in organic-matter content. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; cuts and fills needed; cuts difficult to vegetate where fragipan is exposed. |
| Russell: RuB2 | Surface: good.<br>Subsoil: fair or poor; somewhat clayey. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; cuts and fills needed. |
| Saranac: Sa, Sc | Surface: fair or poor; somewhat clayey.<br>Subsoil: poor; clayey; subject to flooding; seasonal high water table. | Generally not suitable; in places there is sand and gravel in the underlying material. | Subsoil: poor; poor shear strength; high compressibility; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; moderate to high susceptibility to frost heave.<br>Underlying material: fair to poor; fair shear strength; medium compressibility; fair stability; fair compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table; subject to flooding. | High compressibility; moderate to high shrink-swell potential; moderate to high susceptibility to frost heave in the subsoil; seasonal high water table; subject to flooding. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Subsoil and underlying material: good to fair shear strength; fair to good stability; good compaction characteristics; low shrink-swell potential; high permeability when compacted; good resistance to piping. | Rapid seepage rate; too sandy and gravelly to hold water. | Not needed | Steep slope | Steep slope. |
| Underlying material: fair to poor shear strength; fair stability; fair compaction characteristics; moderate shrink-swell potential; moderate to low permeability when compacted; fair to good resistance to piping. | Moderate to rapid seepage rate in the underlying material; subject to flooding. | Not needed; well drained | Not needed | Not needed except where overflow water concentrates. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Moderate to rapid seepage rate in the underlying material; subject to flooding. | Not needed | Not needed | Not needed except where overflow water concentrates. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Moderate to slow seepage rate. | Not needed; well drained | Soil features favorable | Soil features favorable. |
| Subsoil: poor shear strength; fair to poor stability; fair to poor compaction characteristics; moderate to high shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: fair shear strength; fair stability; fair compaction characteristics; moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow to moderate seepage rate; high water table; subject to flooding; suitable for pit ponds. | Very poorly drained; water table at a depth of 0 to 1 foot; ponding of surface water; moderately slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Not needed except where overflow water concentrates. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Shoals: Sh | Surface and underlying material: good; underlying layers variable in texture; subject to flooding; seasonal high water table. | Generally not suitable; in places there is sand and gravel in the underlying material. | Underlying material: fair to poor; fair to poor shear strength; medium to high compressibility; fair to good stability; fair to poor compaction characteristics; low to moderate shrink-swell potential; high susceptibility to frost heave; subject to flooding; seasonal high water table. | Medium to high compressibility: low to moderate shrink-swell potential; high susceptibility to frost heave; subject to flooding; seasonal high water table. |
| Sleeth: Sm | Surface: good.<br>Subsoil: fair or poor; somewhat clayey; gravelly in places; seasonal high water table. | Good below a depth of 40 to 60 inches. | Subsoil: fair to poor; fair shear strength; medium to high compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave.<br>Underlying material: very good; good to fair shear strength; very slight compressibility; fair to good stability; good compaction characteristics; low shrink-swell potential and susceptibility to frost heave; seasonal high water table. | Medium to high compressibility: moderate shrink-swell potential and high susceptibility to frost heave in the subsoil; seasonal high water table. |
| Steff: St | Surface and underlying material: good; subject to flooding. | Not suitable | Underlying material: fair to poor; poor shear strength; medium compressibility; poor to fair stability; poor compaction characteristics; low shrink-swell potential; high susceptibility to frost heave; subject to flooding. | Medium compressibility in the underlying material: low shrink-swell potential; high susceptibility to frost heave; subject to flooding. |
| Stendal: Sx | Surface and underlying material: fair; low in organic-matter content; seasonal high water table; subject to flooding. | Not suitable | Underlying material: fair to poor; poor shear strength; medium compressibility; poor to fair stability; poor compaction characteristics; low shrink-swell potential; high susceptibility to frost heave; subject to flooding; seasonal high water table. | Medium compressibility; low shrink-swell potential; high susceptibility to frost heave; subject to flooding; seasonal high water table. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Underlying material: fair to poor shear strength; fair to good stability; fair to poor compaction characteristics; low to moderate shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow to moderate seepage rate; seasonal high water table; subject to flooding; suitable for pit ponds. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; moderate permeability. | Not needed except to divert runoff from adjoining higher areas. | Not needed except where overflow water concentrates. |
| Subsoil: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping.<br>Underlying material: good to fair shear strength; fair to good stability; good compaction characteristics; low shrink-swell potential; moderate to high permeability when compacted; fair to good resistance to piping. | Rapid seepage rate in the underlying material; high water table; nearly level slopes; suitable for pit ponds. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; moderate permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Underlying material: poor shear strength; poor to fair stability; poor compaction characteristics; low shrink-swell potential; moderate to low permeability when compacted; poor resistance to piping. | Slow to rapid seepage rate; variable textures in the underlying material; subject to flooding. | Moderately well drained | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Underlying material: poor shear strength; poor compaction characteristics; low shrink-swell potential; moderate to low permeability when compacted; poor resistance to piping. | Slow to moderate seepage rate; seasonal high water table; subject to flooding; suitable for pit ponds. | Somewhat poorly drained; water table at a depth of 1 to 3 feet. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Stonelick: Sz | Surface and underlying material: fair or poor; sandy; subject to flooding. | Fair to good | Underlying material: fair to good; fair to good shear strength; slight compressibility; fair to poor stability; fair to good compaction characteristics; low shrink-swell potential; moderate to low susceptibility to frost heave. | Slight compressibility in the underlying material: low shrink-swell potential; moderate to low susceptibility to frost heave; subject to flooding. |
| Wakeland: Wa | Surface and underlying material: fair; moderate in organic-matter content; seasonal high water table; subject to flooding. | Not suitable | Underlying material: fair to poor; poor shear strength; medium compressibility; poor to fair stability; poor compaction characteristics; low shrink-swell potential; high susceptibility to frost heave; subject to flooding; seasonal high water table. | Medium compressibility; low shrink-swell potential; high susceptibility to frost heave; subject to flooding; seasonal high water table. |
| Weikert: BeF<br>For Berks part of BeF, see Berks series. | Surface and subsoil: very poor; channery and shaly material; bedrock at a depth of 10 to 20 inches; steep slope. | Not suitable | Subsoil: poor; 10 to 20 inches depth to rippable sandstone and shale bedrock. | 10 to 20 inches depth to rippable sandstone and shale bedrock; steep slope; cuts and fills needed; cuts difficult to vegetate where sandstone and shale are exposed. |
| Westland: Wc | Surface: fair; somewhat clayey.<br>Subsoil: poor; clayey; somewhat gravelly; seasonal high water table. | Good below a depth of 40 to 60 inches. | Subsoil: fair to poor; fair shear strength; medium to high compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave.<br>Underlying material: very good; good to fair shear strength; very slight compressibility; fair to good stability; good compaction characteristics; low shrink-swell potential and susceptibility to frost heave; seasonal high water table. | Medium to high compressibility in the subsoil; moderate shrink-swell potential; high susceptibility to frost heave; subject to ponding. |
| Whitaker: Wh | Surface: good.<br>Subsoil: fair or poor; somewhat clayey; seasonal high water table. | Fair for sand; variable textures in underlying material. | Subsoil and underlying material: poor to fair; fair shear strength; slight to medium compressibility; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. | Slight to medium compressibility in the subsoil; moderate shrink-swell potential; high susceptibility to frost heave; seasonal high water table. |

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Underlying material: fair to good shear strength; fair to poor stability; fair to good compaction characteristics; low shrink-swell potential; moderate to high permeability when compacted; fair resistance to piping. | Rapid seepage rate; too sandy and gravelly to hold water; subject to flooding. | Not needed; well drained. | Not needed; well drained. | Not needed except where overflow water concentrates. |
| Underlying material: poor shear strength; poor to fair stability; poor compaction characteristics; low shrink-swell potential; moderate to low permeability when compacted; poor resistance to piping. | Slow to moderate seepage rate; seasonal high water table; subject to flooding; suitable for pit ponds. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; moderate permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil: 10 to 20 inches depth to rippable sandstone and shale bedrock. | Shallow over bedrock; slow to moderate seepage. | Not needed; well drained. | Steep slope | Steep slope. |
| Subsoil: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: good to fair shear strength; fair to good stability; good compaction characteristics; low shrink-swell potential; moderate to high permeability when compacted; fair to good resistance to piping. | Rapid seepage rate in the underlying material; seasonal high water table; nearly level slope; suitable for pit ponds. | Very poorly drained; water table at a depth of 0 to 1 foot; ponding of surface water; slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. Underlying material: fair shear strength; fair stability; fair to good compaction characteristics; moderate shrink-swell potential; moderate permeability when compacted; poor resistance to piping. | Moderate to rapid seepage rate in the underlying material; high water table; nearly level; suitable for pit ponds. | Somewhat poorly drained; water table at a depth of 1 to 3 feet; moderate permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |

TABLE 7.—*Interpretations of*

| Soil series and map symbols | Suitability as a source of— | | | Soil features affecting— |
|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Highway location |
| Wilbur: Wu | Surface and underlying material: good; subject to flooding. | Not suitable | Underlying material: fair to poor; poor shear strength; medium compressibility; poor to fair stability; poor compaction characteristics; low shrink-swell potential; high susceptibility to frost heave; subject to flooding. | Medium compressibility in the underlying material; low shrink-swell potential; high susceptibility to frost heave; subject to flooding. |
| Xenia: XeB2 | Surface: good. Subsoil: fair or poor; somewhat clayey. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength: medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; cuts and fills needed. |
| Zanesville: ZaB2, ZaC2, ZaC3. | Surface: fair; low in organic-matter content. Subsoil: poor; fragipan; lower part contains channery and shale fragments in places; bedrock at a depth of 40 to 80 inches. | Not suitable | Subsoil and underlying material: fair to poor; fair shear strength; medium to high compressibility; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential and susceptibility to frost heave; sandstone and shale bedrock at a depth of 40 to 80 inches. | Medium to high compressibility in the subsoil; moderate shrink-swell potential and susceptibility to frost heave; sandstone and shale bedrock at a depth of 40 to 80 inches; cuts and fills needed; difficult to vegetate where the fragipan or bedrock is exposed in cuts. |
| Zipp: Zp | Surface and subsoil: poor or very poor; clayey and plastic. | Not suitable | Subsoil and underlying material: poor to very poor; poor shear strength; high compressibility; fair to poor stability; fair to poor compaction characteristics; high shrink-swell potential; moderate susceptibility to frost heave; seasonal high water table. | High compressibility in subsoil; high shrink-swell potential; moderate susceptibility to frost heave; seasonal high water table; subject to ponding. |

as the suburbs of Columbus and other towns expand into the rural areas. The rapidity with which developments have expanded in the past has led to many problems. These problems clearly show the need for careful planning and for a broad understanding of the physical and economic aspects involved when land use is changed.

This soil survey helps to plan these developments and to solve problems that arise as land use changes. Planning officials and developers, as well as homeowners and others, can find useful information in the soil maps, in the text, and in the tables in this survey. The detailed soil maps at the back of this survey are useful to show the location of each of the soils in the county. The colored general soil map that precedes the detailed soil maps shows the pattern of the major soils within the county. All of the soils are discussed in detail in the section "Descriptions of the Soils."

The soils are evaluated for Town and Country Planning only to a depth of five feet or less. Soils are rated on the basis of three classes of soil limitations. A rating of *slight* means that for the intended use, it is relatively free of limitations and the facility is easily created, improved, or maintained. A *moderate* rating means that limitations need to be recognized, but that they can be overcome with good management and

*engineering properties of soils*—Continued

| Soil features affecting—Continued | | | | |
|---|---|---|---|---|
| Dams, dikes, levees, and embankments | Pond reservoir areas | Farm drainage | Terraces and diversions | Grassed waterways |
| Underlying material: poor shear strength; poor to fair stability; poor compaction characteristics; low shrink-swell potential; moderate to low permeability when compacted; fair resistance to piping. | Slow to rapid seepage rate; variable textures in the underlying material; subject to flooding. | Moderately well drained | Not needed except to divert runoff from adjoining higher areas. | Usually not needed except where a concentrated flow of runoff water comes from adjoining higher areas. |
| Subsoil and underlying material: fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; good resistance to piping. | Slow seepage rate | Moderately well drained | Soil features favorable | Soil features favorable. |
| Subsoil and underlying material; fair shear strength; fair to good stability; fair to good compaction characteristics; moderate shrink-swell potential; low permeability when compacted; fair to good resistance to piping. | Slow to moderate seepage rate; sandstone and shale bedrock at a depth of 40 to 80 inches. | Not needed; well drained | Bedrock at a depth of 40 to 80 inches. | Difficult to vegetate in places where fragipan is exposed. |
| Subsoil and underlying material: poor shear strength; fair to poor stability; fair to poor compaction characteristics; high shrink-swell potential; low permeability when compacted; good resistance to piping. | Very slow seepage rate; seasonal high water table; suitable for pit ponds. | Very poorly drained; water table at a depth of 0 to 1 foot; ponding of surface water; very slow permeability. | Not needed except to divert runoff from adjoining higher areas. | Usually not needed where a concentrated flow of runoff water comes from adjoining higher areas. |

careful design. A *severe* rating means that limitations are severe enough to make the intended use questionable and that extreme measures are needed to overcome limitations.

In the paragraphs that follow, each town and country planning use is defined and the properties important in rating the limitations for such purposes are given. The information can be used, along with table 9, with information in other parts of the survey as a guide in the use of soils data for town and country planning. Before any construction projects, however, an onsite investigation should be made.

A section "Tree and Shrub Landscaping" provides information useful in giving land users a good basis in planning for the use of shrubs and trees. A table in this section provides information concerning types of trees or shrubs growing on various soils, desirable species to keep, and some species suitable for planting on sites for town and country uses.

*Houses With Basements.* Interpretations are for undisturbed soils that are evaluated to a depth of five feet for single-family dwellings and other structures that have similar foundation requirements. Excluded are buildings more than three stories high, and other buildings that have foundation loads exceeding those of three-story dwellings. The emphasis for rat-

TABLE 8.—*Engineering*

[Tests performed by Indiana State Highway Commission Research and Training Center, West Lafayette, Indiana,

| Soil name and location | Parent material | Report No. S71IN3 | Depth | Moisture density [1] | | Mechanical analysis [2] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Maximum dry density | Optimum moisture | Percentage passing sieve— | | | |
| | | | | | | 2-in | 1½ in | 1-in | ¾ in |
| | | | *In* | *Lb/ft* | *Pct* | | | | |
| Clermont silt loam: | | | | | | | | | |
| NW corner, SW¼, sec. 14, T. 8 N., R. 5 E. (Modal). | Loess over Illinoian Age till. | 3–1 | 0–7 | 108 | 15 | 100 | 100 | 100 | 100 |
| | | 3–2 | 7–16 | 113 | 15 | 100 | 100 | 100 | 100 |
| | | 3–3 | 16–24 | 107 | 16 | 100 | 100 | 100 | 100 |
| | | 3–4 | 24–35 | 106 | 18 | 100 | 100 | 100 | 100 |
| | | 3–5 | 35–70 | 111 | 15 | 100 | 100 | 100 | 100 |
| | | 3–6 | 70–110 | 112 | 16 | 100 | 100 | 100 | 100 |
| | | 3–7 | 110–143 | 111 | 17 | 100 | 100 | 100 | 100 |
| | | 3–8 | 143–200 | 124 | 11 | 100 | 100 | 100 | 100 |
| Fox loam: | | | | | | | | | |
| NE corner, sec. 1, T. 9 N., R. 5 E. (Modal). | Loam material over calcareous gravel and sand. | 4–1 | 0–7 | 112 | 15 | 100 | 100 | 100 | 100 |
| | | 4–2 | 7–13 | 116 | 13 | 100 | 100 | 100 | 100 |
| | | 4–3 | 13–26 | 110 | 18 | 100 | 100 | 100 | 100 |
| | | 4–4 | 26–33 | 119 | 12 | 100 | 100 | 100 | 100 |
| | | 4–5 | 35–60 | 112 | 10 | 100 | 100 | 100 | 97 |
| Otwell silt loam: | | | | | | | | | |
| SW corner, NW¼, sec. 11, T. 7 N., R. 4 E., low clay range. | Loess over stratified lacustrine material. | 1–1 | 0–5 | 105 | 18 | 100 | 100 | 100 | 100 |
| | | 1–2 | 5–8 | 108 | 16 | 100 | 100 | 100 | 100 |
| | | 1–3 | 8–19 | 106 | 18 | 100 | 100 | 100 | 100 |
| | | 1–4 | 19–30 | 107 | 18 | 100 | 100 | 100 | 100 |
| | | 1–5 | 30–42 | 113 | 15 | 100 | 100 | 100 | 100 |
| | | 1–6 | 42–58 | 109 | 16 | 100 | 100 | 100 | 100 |
| | | 1–7 | 58–79 | 116 | 14 | 100 | 100 | 100 | 100 |
| | | 1–8 | 79–112 | 113 | 16 | 100 | 100 | 100 | 100 |
| Rarden silt loam: | | | | | | | | | |
| SE corner, NW¼, sec. 34, T. 8 N., R. 4 E. (Modal). | Loess weathered from gray-green shale. | 2–1 | 0–3 | 95 | 20 | 100 | 100 | 100 | 100 |
| | | 2–2 | 3–8 | 106 | 19 | 100 | 100 | 100 | 100 |
| | | 2–3 | 8–18 | 104 | 17 | 100 | 100 | 100 | 100 |
| | | 2–4 | 18–26 | 104 | 20 | 100 | 100 | 100 | 100 |
| | | 2–5 | 26–38 | 110 | 17 | 100 | 100 | 100 | 100 |

[1] Based on the Moisture-density Relations of Soils Using 5.5-lb. Rammer and 12-in. Drop, AASHO Designation T. 99, Method A and one point determination.

[2] Mechanical analyses according to the AASHO Designation T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-sized 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-sized fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

ing soils for dwellings with basements is on the cost of excavation, the bearing strength of the foundation, and the drainage around the basement. The properly constructed basement will not only support the building without undue settling and cracking, but will also be dry throughout the year. Sound construction techniques should provide adequate drainage around the foundation or footer to prevent undue settlement and wet basements. Also considered are factors that influence installation of utility lines, such as those between the dwelling and the trunk lines. Excluded are interpretations for landscaping and lawns, roads and streets, and septic-tank absorption fields. Such interpretations are provided in other columns in this table. Soil characteristics affecting construction of dwellings with basements include internal drainage, flooding hazard, depth to bedrock, and slope. Onsite investigation is needed for specific placement of buildings and utility lines, and for detailed design of foundations.

*Houses Without Basements.* Interpretations are for undisturbed soils that are evaluated to a depth of five feet for single-family dwellings and other structures that have similar foundation requirements. Excluded are buildings more than three stories high and other buildings that have foundation loads exceeding those of three-story dwellings. The emphasis for rating soils for dwellings without basements is on shrink-swell potential of the soils, the bearing strength of the foundation, and drainage around the dwelling. Sound construction techniques should pro-

*test data*

in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

| Mechanical analysis [2]—Continued | | | | | | | | | | Liquid limit | Plasticity index | Classification | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage passing sieve—Continued | | | | | | Percentage smaller than— | | | | | | | |
| ⅜ in | No. 4 (4.7 mm) | No. 10 (2.0 mm) | No. 40 (0.42 mm) | No. 60 (0.25 mm) | No. 200 (0.074 mm) | 0.05 mm | 0.02 mm | 0.005 mm | 0.002 mm | | | AASHO [3] | Unified [4] |
| 100 | 100 | 99 | 95 | 89 | 82 | 75 | 50 | 13 | 5 | 25 | 1 | A-4(10) | ML |
| 100 | 100 | 96 | 93 | 90 | 83 | 79 | 57 | 20 | 14 | 25 | 4 | A-4(2) | ML |
| 100 | 100 | 100 | 100 | 98 | 93 | 91 | 73 | 37 | 30 | 34 | 14 | A-6(16) | CL |
| 100 | 100 | 100 | 96 | 93 | 88 | 84 | 67 | 32 | 24 | 39 | 17 | A-6(14) | CL |
| 100 | 100 | 99 | 96 | 93 | 85 | 80 | 63 | 26 | 22 | 31 | 12 | A-6(9) | CL |
| 100 | 99 | 98 | 97 | 93 | 83 | 75 | 59 | 28 | 19 | 27 | 13 | A-6(8) | CL |
| 100 | 99 | 98 | 93 | 86 | 69 | 61 | 47 | 24 | 13 | 32 | 15 | A-6(8) | CL |
| 99 | 93 | 91 | 81 | 72 | 52 | 45 | 36 | 19 | 8 | 19 | 4 | A-4(0) | ML |
| 99 | 98 | 97 | 84 | 63 | 50 | 47 | 35 | 12 | 4 | 24 | 5 | A-4-(0) | ML |
| 99 | 98 | 94 | 81 | 59 | 42 | 39 | 33 | 17 | 13 | 29 | 10 | A-4-(1) | CL |
| 97 | 94 | 87 | 66 | 43 | 32 | 29 | 26 | 21 | 18 | 34 | 12 | A-2-6-(1) | CL |
| 97 | 94 | 89 | 58 | 29 | 18 | 16 | 13 | 8 | 7 | ------- | NP | A-3 | SM |
| 89 | 77 | 66 | 28 | 11 | 4 | 3 | ------- | ------- | ------- | ------- | NP | A-3 | SW |
| 100 | 100 | 99 | 97 | 93 | 87 | 80 | 67 | 16 | 9 | 27 | 1 | A-4-(1) | ML |
| 100 | 100 | 100 | 98 | 96 | 90 | 87 | 66 | 22 | 13 | 25 | 2 | A-4-(1) | ML |
| 100 | 100 | 100 | 99 | 98 | 94 | 92 | 73 | 29 | 19 | 33 | 8 | A-4-(8) | ML |
| 100 | 100 | 100 | 99 | 97 | 91 | 88 | 67 | 32 | 23 | 34 | 11 | A-4-(10) | ML |
| 100 | 100 | 100 | 98 | 96 | 89 | 82 | 58 | 30 | 19 | 28 | 9 | A-4-(8) | CL |
| 100 | 100 | 100 | 99 | 96 | 90 | 87 | 69 | 37 | 28 | 30 | 11 | A-6-(8) | CL |
| 100 | 99 | 98 | 91 | 82 | 65 | 63 | 44 | 21 | 15 | 21 | 5 | A-4-(1) | ML |
| 100 | 100 | 100 | 93 | 85 | 69 | 62 | 47 | 22 | 12 | 30 | 11 | A-6-(6) | CL |
| 100 | 100 | 100 | 100 | 99 | 98 | 93 | 67 | 21 | 10 | 30 | 1 | A-4-(1) | ML |
| 99 | 98 | 96 | 95 | 94 | 92 | 88 | 72 | 36 | 24 | 30 | 5 | A-4-(5) | ML |
| 99 | 98 | 97 | 91 | 89 | 87 | 85 | 75 | 43 | 29 | 39 | 13 | A-6-(8) | ML |
| 99 | 98 | 97 | 95 | 94 | 91 | 85 | 73 | 43 | 34 | 44 | 16 | A-7-5(17) | ML |
| 100 | 100 | 100 | 94 | 92 | 88 | 85 | 72 | 36 | 24 | 39 | 13 | A-6-(14) | ML |

[3] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8). The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49.

[4] Unified Soil Classification System (*16*).

vide adequate drainage around the foundation or footing to prevent undue settling. Also considered are factors that influence installation of utility lines, such as those between the dwelling and the trunk lines. Excluded are interpretations for landscaping and lawns, roads and streets, and septic-tank absorption fields. Such interpretations are provided in other columns in this table. Soil characteristics affecting construction of dwellings without basements include internal drainage, flooding hazard, depth to bedrock, and slope. Onsite investigation is needed for specific placement of buildings and utility lines, and for detailed design of the foundations.

*Commercial or Light Industrial Development.* Interpretations are for buildings of three stories or less. Soils are important in the construction and maintenance of building foundations. The cost of excavation, the bearing strength of the foundation, and the drainage characteristics depend on the soil. Sound construction techniques should provide adequate drainage around the foundation or footing to prevent undue settling. Soil characteristics affecting commercial and light industrial sites include internal drainage, depth to the seasonal high water table, depth to bedrock, slope, flood hazard, shear strength, shrink-swell potential, and compressibility. In determining the degree of limitations for commercial or industrial development disposal of effluent from septic tanks was not considered.

*Landscaping and Lawns.* The establishment of

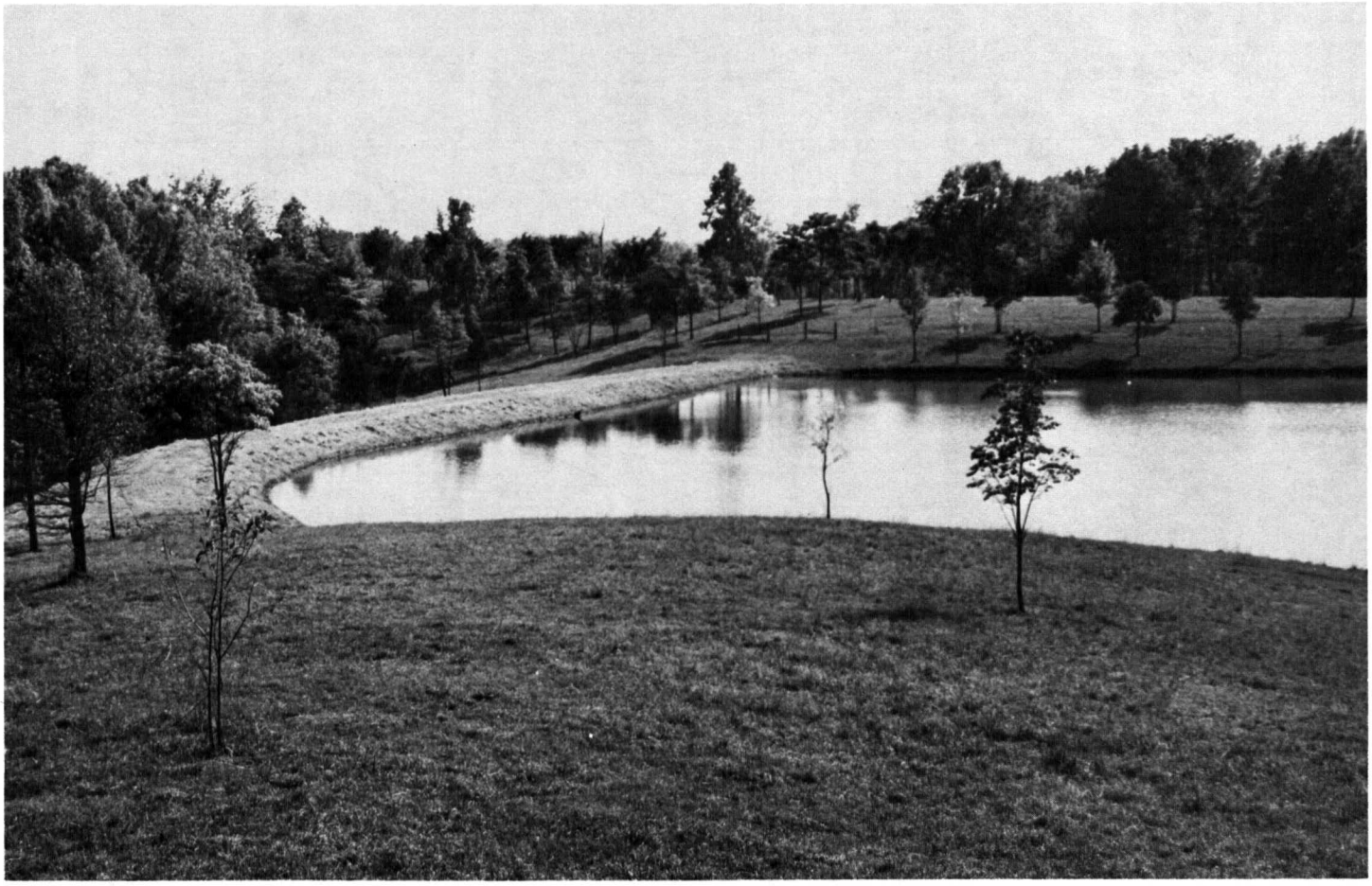

*Figure 22.*—**Pond in a draw of Hickory silt loam, 18 to 25 percent slopes, eroded. The pasture in the foreground is Hickory silt loam, 6 to 12 percent slopes, eroded.**

lawns and shrubs is important in most residential areas and around many commercial locations. Some soil characteristics which are limited for landscaping and lawns may not be limited for building purposes. Some landscaping problems can be overcome or dealt with, if the soil problems are understood. The soil characteristics affecting the establishment and maintenance of lawns and shrubs are slope, internal drainage, depth to the seasonal high water table, flooding and ponding hazard, available water capacity, droughtiness, soil erodibility, depth to bedrock, and slope.

*Local Roads, Streets, and Parking Lots.* These interpretations are for conditions that will support automobile traffic throughout the year. They consist of underlying local soil material, either cut or fill, which is the road subgrade; the base material of gravel, crushed rock, or lime or soil cement stabilized soil, which is the surface; and the actual road surface, generally asphalt or concrete, which is the pavement. The subgrade for roads, streets, and parking lots is built mainly from the soil at hand. Cuts and fills generally are limited to less than six feet. Soil characteristics that affect construction include internal drainage, depth to the seasonal high water table, depth to bedrock, slope, flooding or ponding hazard, susceptibility to frost heave, and shrink-swell potential.

*Septic Tank Absorption Fields.* Septic tanks that have an absorption field are used to dispose of sewage where central sewage facilities are unavailable. A well-designed system consists of a septic tank for holding solid waste, a distribution box for dispensing effluent, and a tile disposal field. Successful operation of the entire system depends upon the ability of the soil to absorb and filter the liquid effluent passed through the tile field. The presence of soil characteristics that impair proper absorption and filtering of the effluent cause health hazards as well as constitute a public nuisance. Soil characteristics affecting the operation of the tile absorption field include permeability, depth to the seasonal high water table, depth to bedrock, slope, and flooding or ponding hazard.

*Sewage Lagoons.* These are shallow lakes used to hold sewage for the time required for aerobic bacterial decomposition. A suitable site should provide an impoundment area and enough soil material to build the dam structure. The completed lagoon should be able to hold water with minimum seepage and should be able to prevent contamination of ground-water supplies. Soil characteristics affecting sewage lagoons are internal drainage, depth to the seasonal high water table, slope, depth to bedrock, coarse fragments, flooding or

ponding hazard, permeability, and content of organic matter.

*Sanitary Landfills.* These are disposal areas for trash and garbage. The soils are rated for a trench-type landfill, where hauling of cover material is unnecessary. A good sanitary landfill should operate without contaminating ground-water supplies, reducing esthetic land values, or causing health hazards. In addition, they should be usable during all seasons of the year. Fill areas that have been adequately compacted and covered can be used for parking areas, parks, recreation areas, and other valuable uses. Soil characteristics affecting the operation of a sanitary landfill include internal drainage, depth to bedrock, slope, flooding or ponding hazard, soil texture, and permeability.

Routine soil investigations generally are confined to depths of about 5 to 6 feet and many landfill operations use trenches as deep as 15 feet or more. Therefore, there is a need for a geologic investigation of the area to determine the potential for pollution of ground water as well as to obtain the design of the landfill. The soil survey is a valuable tool in selecting potential sites and in determining where additional investigations appear warranted.

### Tree and Shrub Landscaping [4]

This section provides information on the types of trees or shrubs growing on various soils, desirable species to keep, and some plant materials that are suitable for planting on specific sites for town and country uses.

Tree-covered tracts in the county must be evaluated for their benefits to the community. These wooded areas have long-time value for wind protection, wildlife, erosion control, recreation and education, air pollution, and environmental improvement.

*Wind protection.*—Scattered trees and wooded tracts tend to break up wind patterns and reduce wind velocity.

*Wildlife.*—Islands of woody cover are needed for songbirds and all forms of wildlife.

*Erosion control.*—A cover of trees is excellent for helping to control erosion and in many locations to serve as a filter strip for the streams and reservoirs of the county.

*Recreation and education.*—Trees enhance the value of sites for county parks, outdoor laboratories for schools, and nature areas.

*Air pollution.*—Trees are increasingly becoming recognized for their role in reducing air pollution.

*Environmental improvement.*—Wooded tracts and scenic beauty help to create a more healthful and better environment.

In table 10 the soils of Bartholomew County have been placed in five broad groups to give land users a good basis for planning the use of shrubs for environmental improvement. In this table a listing is made for some of the trees and shrubs that grow naturally on each of the five soil groups and should be retained, where possible, when developing an area for more intensive use. It also lists many trees and shrubs suitable for planting for a wide variety of environmental-improvement projects. To determine the soil grouping refer to the "Guide to Mapping Units" at the back of this survey.

The table "Tree and Shrub Plantings" does not attempt to list all plants which grow or that are suitable for planting on the various soils. Assistance in arranging plants, other materials suited to various sites, and sources of plants can be obtained from local landscape architects, commercial nurseries, or forestry specialists.

## *Formation and Classification of Soils*

This section consists of three parts. The first part relates how the factors of soil formation have affected the development of soils in Bartholomew County. The second explains the system of soil classification currently used and places each soil series in the classes of that system. In the third part, laboratory data are used to explain some aspects of soil formation in Bartholomew County. Table 12 provides physical and chemical properties of selected soils.

### Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Some of the processes involved in the formation of soil horizons in the soils of this county are the accumulation of organic matter; the solution, transfer, and reprecipitation of calcium carbonates and bases; the liberation, reduction, and transfer of iron; and the

[4] By JOHN O. HOLWAGER, woodland conservationist, Soil Conservation Service.

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Avonburg: AvA | Severe: somewhat poorly drained, seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; medium to low shear strength, medium to high compressibility; low to moderate shrink-swell potential; high susceptibility to frost heave. |
| AvB2 | Severe: somewhat poorly drained, seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; medium to low shear strength, medium to high compressibility; low to moderate shrink-swell potential; high susceptibility to frost heave. |
| Ayrshire: Ay | Severe: somewhat poorly drained, seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; medium to low shear strength, slight to medium compressibility; low to moderate shrink-swell potential; high susceptibility to frost heave. |
| Bartle: Ba | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; medium to low shear strength; medium to high compressibility; low to moderate shrink-swell potential; high susceptibility to frost heave. |
| Berks: BeF. For Weikert part of BeF, see Weikert series. | Severe: steep slope; shallow over bedrock. | Severe: steep slope; shallow over bedrock. | Severe: steep slope; bedrock at a depth of 20 to 40 inches. |
| Bloomfield: BmC | Moderate: 6 to 12 percent slope; low shrink-swell potential. | Moderate: 6 to 12 percent slope; low shrink-swell potential. | Moderate: 6 to 12 percent slope; fair to good shear strength; slight to very slight compressibility; low shrink-swell potential and susceptibility to frost heave. |
| Bonnie: Bo | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; low shrink-swell potential; subject to flooding. | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; moderate shrink-swell potential; subject to flooding. | Severe: subject to flooding; poorly drained; seasonal high water table at a depth of 0 to 1 foot; fair to poor shear strength; medium to high compressibility; low shrink-swell potential; high susceptibility to frost heave. |
| Brookston: Br | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; moderate to high shrink-swell potential. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; moderate to high shrink-swell potential. | Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot; subject to ponding; fair to poor shear strength; medium to high compressibility; moderate to high shrink-swell potential and susceptibility to frost heave. |

See footnotes at end of table.

*for town and country planning*

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: seasonal high water table; some shrubs not adapted; lawns damaged if used during wet periods. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential; high susceptibility to frost heave. | Severe: very slow permeability; seasonal high water table at a depth of 1 to 3 feet. | Moderate: permeability is very slow in fragipan; somewhat poorly drained.[1] | Moderate: seasonal high water table; somewhat poorly drained; silt loam and silty clay loam material affects trafficability. |
| Moderate: seasonal high water table; some shrubs not adapted; lawns damaged if used during wet periods. | Moderate: 2 to 6 percent slopes hinder site development; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential; high susceptibility to frost heave. | Severe: very slow permeability; seasonal high water table at a depth of 1 to 3 feet. | Moderate: 2 to 6 percent slopes; somewhat poorly drained. | Moderate: seasonal high water table; somewhat poorly drained; silt loam and silty clay loam material affects trafficability. |
| Moderate: seasonal high water table; some shrubs not adapted; lawns damaged if used during wet periods; somewhat poorly drained. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential; high susceptibility to frost heave. | Severe: seasonal high water table at a depth of 1 to 3 feet; moderate permeability; somewhat poorly drained. | Moderate: somewhat poorly drained; permeability is moderate: sandy material somewhat adversely affects use for building embankments. | Moderate: seasonal high water table; somewhat poorly drained. |
| Moderate: somewhat poorly drained; seasonal high water table; some shrubs not adapted; lawns damaged if used during wet periods. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low to moderate shrink-swell potential. | Severe: very slow permeability; seasonal high water table at a depth of 1 to 3 feet. | Moderate: permeability is very slow in fragipan; somewhat poorly drained.[1] | Moderate: somewhat poorly drained; silty material somewhat hinders trafficability. |
| Severe: steep slope; shallow over bedrock. | Severe: steep slope; bedrock at a depth of 20 to 40 inches. | Severe: steep slope; shallow over bedrock. | Severe: steep slope; shallow over bedrock. | Severe: steep slope; shallow over bedrock. |
| Moderate: droughty | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; low shrink-swell potential and susceptibility to frost heave. | Moderate: 6 to 12 percent slope; moderately rapid possible pollution of ground water. | Severe: moderately rapid to rapid permeability; 6 to 12 percent slope. | Severe: material too sandy to provide good cover; hazard of free leachate flow to ground water. |
| Severe: subject to flooding; poorly drained; seasonal high water table. | Severe: subject to flooding; poorly drained; seasonal high water table at a depth of 0 to 1 foot; low shrink-swell potential; susceptibility to frost heave. | Severe: subject to flooding; poorly drained; seasonal high water table; slow permeability. | Severe: subject to flooding; seasonal high water table; poorly drained. | Severe: subject to flooding; poorly drained; seasonal high water table. |
| Severe: high water table at a depth of 0 to 1 foot; subject to ponding; very poorly drained; lawns subject to damage if used when soil is wet. | Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot; subject to ponding; moderate to high shrink-swell potential and susceptibility to frost heave. | Severe: high water table; very poorly drained; subject to ponding; slow permeability. | Severe: very poorly drained. | Severe: subject to ponding in depressions; seasonal high water table; very poorly drained; clayey material hinders trafficability. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Burnside: Bu | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; good to fair shear strength; slight compressibility; low shrink-swell potential and susceptibility to frost heave. |
| Camden: Ca | Slight | Slight | Slight |
| Celina: CeB2 | Moderate: moderately well drained; seasonal high water table at a depth of 3 to 6 feet; moderate shrink-swell potential. | Slight | Slight |
| Cincinnati: | | | |
| CnB2 | Slight | Slight | Slight |
| CnC2 | Moderate: 6 to 12 percent slope; moderate shrink-swell potential. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| CnC3 | Moderate: 6 to 12 percent slope; moderate shrink-swell potential. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| CnD2 | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| CnD3 | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Clermont: Cr | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot. | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot. | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; fair shear strength; medium to high compressibility; moderate shrink-swell potential; high susceptibility to frost heave. |
| Corydon: CyF | Severe: steep slope; shallow over bedrock. | Severe: steep slope; shallow over bedrock. | Severe: steep slope; bedrock at a depth of less than 20 inches. |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: subject to flooding; lawns and landscape subject to damage by overflow. | Severe: subject to flooding; low shrink-swell potential and susceptibility to frost heave. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Slight | Slight | Slight | Severe: less than 6 feet deep to moderately rapidly permeable material. | Severe: less than 6 feet deep to moderately rapidly permeable material. |
| Slight | Slight for roads; moderate for parking lots; 2 to 6 percent slope. | Severe: moderately slow permeability. | Moderate: 2 to 6 percent slope. | Slight. |
| Slight | Slight for roads; moderate for parking lots; 2 to 6 percent slope. | Severe: very slow permeability. | Moderate: 2 to 6 percent slope. | Slight. |
| Slight | Moderate: 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: very slow permeability. | Severe: 6 to 12 percent slope. | Slight. |
| Moderate: severely eroded. | Moderate: 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: very slow permeability. | Severe: 6 to 12 percent slope. | Slight. |
| Moderate: strongly sloping; hazard of erosion. | Severe: 12 to 18 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: slope; very slow permeability. | Severe: 12 to 18 percent slope. | Moderate: 12 to 18 percent slope. |
| Severe: severely eroded; strongly sloping. | Severe: 12 to 18 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: slope; very slow permeability. | Severe: 12 to 18 percent slope. | Moderate: 12 to 18 percent slope. |
| Severe: high water table at a depth of 0 to 1 foot; poorly drained; lawns damaged if used when soil is wet. | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; moderate shrink-swell potential; high susceptibility to frost heave. | Severe: poorly drained; seasonal high water table; very slow permeability in the subsoil. | Severe: poorly drained; seasonal high water table.[1] | Severe: seasonal high water table; poorly drained. |
| Severe: steep slope; shallow over bedrock. | Severe: steep slope; bedrock at a depth of less than 20 inches. | Severe: steep slope; shallow over bedrock. | Severe: steep slope; bedrock at a depth of 10 to 20 inches. | Severe: steep slope; bedrock at a depth of 10 to 20 inches. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Crosby: CzA | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair to poor shear strength; medium to high compressibility; moderate to high shrink-swell potential; high susceptibility to frost heave. |
| CzB2 | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair to poor shear strength; medium to high compressibility; moderate to high shrink-swell potential; high susceptibility to frost heave. |
| Dubois: Du | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential; high susceptibility to frost heave. |
| Eel: Ee | Severe: subject to flooding; moderately well drained. | Severe: subject to flooding; moderately well drained. | Severe: subject to flooding; seasonal high water table at a depth of 3 to 6 feet; fair to poor shear strength; medium to high compressibility; low to moderate shrink-swell potential; moderate susceptibility to frost heave. |
| Fincastle: FcA | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair shear strength; medium to high compressibility; moderate to high shrink-swell potential; high susceptibility to frost heave. |
| FcB2 | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair shear strength; medium to high compressibility; moderate to high shrink-swell potential; high susceptibility to frost heave. |
| Fox: FoA | Slight | Slight | Slight |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; some shrubs not adapted; lawns damaged if used during wet periods. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate to high shrink-swell potential; high susceptibility to frost heave. | Severe: slow permeability; seasonal high water table at a depth of 1 to 3 feet. | Moderate: slow permeability; somewhat poorly drained. | Moderate: seasonal high water table; somewhat poorly drained. |
| Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; some shrubs not adapted; lawns damaged if used during wet periods. | Moderate: 2 to 6 percent slope; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate to high shrink-swell potential; high susceptibility to frost heave. | Severe: slow permeability; seasonal high water table at a depth of 1 to 3 feet. | Moderate: slope; somewhat poorly drained. | Moderate: seasonal high water table at a depth of 1 to 3 feet; somewhat poorly drained. |
| Moderate: seasonal high water table; some shrubs not adapted; lawns damaged if used during wet periods. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate shrink-swell potential; high susceptibility to frost heave. | Severe: seasonal high water table at a depth of 1 to 3 feet; very slow permeability. | Moderate: somewhat poorly drained; very slow permeability.[1] | Moderate: seasonal high water table at a depth of 1 to 3 feet; somewhat poorly drained. |
| Moderate: subject to flooding; floodwaters may damage landscape planting. | Severe: subject to flooding; seasonal high water table at a depth of 3 to 6 feet; low to moderate shrink-swell potential; moderate susceptibility to frost heave. | Severe: subject to flooding; moderate permeability. | Severe: subject to flooding. | Severe: subject to flooding. |
| Moderate: seasonal high water table; lawns damaged if used during wet periods. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate to high shrink-swell potential; high susceptibility to frost heave. | Severe: seasonal high water table at a depth of 1 to 3 feet; slow permeability. | Moderate: somewhat poorly drained; slow permeability. | Moderate: seasonal high water table at a depth of 1 to 3 feet; somewhat poorly drained. |
| Moderate: seasonal high water table; lawns damaged if used during wet periods. | Moderate: 2 to 6 percent slope: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate to high shrink-swell potential; high susceptibility to frost heave. | Severe: seasonal high water table at a depth of 1 to 3 feet; slow permeability. | Moderate: 2 to 6 percent slope; somewhat poorly drained. | Moderate: seasonal high water table at a depth of 1 to 3 feet; somewhat poorly drained. |
| Moderate: somewhat droughty. | Slight | Slight: rapid permeability in underlying sand and gravel; pollution of ground water in places. | Severe: porous sand and gravel at a depth of about 2 to 4 feet; very rapidly permeable in sand and gravel. | Severe: porous sand and gravel at a depth of 2 to 4 feet; hazard of free leachate flow of ground water. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Fox—continued. | | | |
| FoB2 | Slight | Slight | Slight |
| FxC3 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair shear strength; medium to high compressibility; low shrink-swell potential and susceptibility to frost heave. |
| Genesee: Ge | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; fair to poor shear strength; medium to high compressibility; low shrink-swell potential; moderate susceptibility to frost heave. |
| Gilpin: | | | |
| GpD2 | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| GpD3 | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| GpE | Severe: 18 to 25 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 18 to 25 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 18 to 25 percent slope; bedrock at a depth of 20 to 40 inches; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Gullied land: Gu. Properties too variable for reliable estimates. | | | |
| Haymond: Ha | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; poor shear strength; medium compressibility; low shrink-swell potential; moderate to high susceptibility to frost heave. |
| Hennepin: HeF | Severe: steep slope | Severe: steep slope | Severe: steep slope; fair shear strength; medium to high compressibility; low to moderate shrink-swell potential; moderate susceptibility to frost heave. |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: somewhat droughty. | Slight for roads. Moderate for parking lots; 2 to 6 percent slope. | Slight: rapid permeability in underlying sand and gravel; pollution of ground water in places. | Severe: porous sand and gravel at a depth of about 2 to 4 feet; very rapidly permeable in sand and gravel. | Severe: porous sand and gravel at a depth of 2 to 4 feet; hazard of free leachate flow of ground water. |
| Severe: severely eroded; shallow over sand and gravel; droughty. | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; low shrink-swell potential and susceptibility to frost heave. | Moderate: 6 to 12 percent slope; rapid permeability in underlying sand and gravel; pollution of ground water in places. | Severe: porous sand and gravel at a depth of about 2 to 4 feet; very rapidly permeable in sand and gravel; slope. | Severe: porous sand and gravel at a depth of about 2 to 4 feet; hazard of free leachate flow of ground water. |
| Moderate: subject to flooding; floodwater damages landscape plantings in places. | Severe: subject to flooding; low shrink-swell potential; moderate susceptibility to frost heave. | Severe: subject to flooding; moderate permeability. | Severe: subject to flooding. | Severe: subject to flooding. |
| Moderate: 12 to 18 percent slope; subject to erosion. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. |
| Severe: 12 to 18 percent slope; severely eroded. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. |
| Severe: 18 to 25 percent slope; subject to erosion. | Severe: 18 to 25 percent slope; bedrock at a depth of 20 to 40 inches; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 18 to 25 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 18 to 25 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. |
| Moderate: subject to flooding; floodwater damages landscape plantings in places. | Severe: subject to flooding; low shrink-swell potential; moderate to high susceptibility to frost heave. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Severe: steep slope; severe erosion hazard. | Severe: steep slope; low to moderate shrink-swell potential; moderate susceptibility to frost heave. | Severe: steep slope. | Severe: steep slope. | Severe: steep slope. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Henshaw: Hh | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair shear strength; medium to high shrink-swell potential; moderate susceptibility to frost heave. |
| Hickory: | | | |
| HkC2 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| HkD2 | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| HkE2 | Severe: 18 to 25 percent slope. | Severe: 18 to 25 percent slope. | Severe: 18 to 25 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| HkF | Severe: steep slope | Severe: steep slope | Severe: steep slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| HoC3 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| HoD3 | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Landes: La | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; fair to good shear strength; slight compressibility; low shrink-swell potential; moderate susceptibility to frost heave. |
| Martinsville: | | | |
| MaA, MbA, MbB2 | Slight | Slight | Slight |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; lawns damaged if used when wet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate shrink-swell potential; high susceptibility to frost heave. | Severe: seasonal high water table at a depth of 1 to 3 feet; moderately slow permeability. | Moderate: permeability is moderately slow; somewhat poorly drained. | Moderate: seasonal high water table; somewhat poorly drained. |
| Slight | Moderate: 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to to frost heave. | Moderate: 6 to 12 percent slope; lower end of moderate permeability. | Severe: slope | Slight. |
| Moderate: 12 to 18 percent slope; erodible. | Severe: 12 to 18 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 12 to 18 percent slope. | Severe: slope | Moderate: 12 to 18 percent slope. |
| Severe: 18 to 25 percent slope; erodible. | Severe: 18 to 25 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 18 to 25 percent slope. | Severe: slope | Moderate: 18 to 25 percent slope. |
| Severe: steep slope; severe erosion hazard. | Severe: steep slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: steep slope | Severe: slope | Moderate: 18 to 25 percent slope. |
| Moderate: 6 to 12 percent slope; severely eroded. | Moderate: 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Moderate: 6 to 12 percent slope; lower end of moderate permeability. | Severe: slope | Slight. |
| Severe: 12 to 18 percent slope; severely eroded. | Severe: 12 to 18 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 12 to 18 percent slope. | Severe: slope | Moderate: 12 to 18 percent slope. |
| Moderate: subject to flooding; flooding may damage landscape plantings in places; somewhat droughty. | Severe: subject to flooding; low shrink-swell potential; moderate susceptibility to frost heave. | Severe: subject to flooding; rapid permeability in underlying sand and gravel; possible pollution of ground water. | Severe: subject to flooding. | Severe: subject to flooding. |
| Slight | Slight | Slight: moderate permeability. | Severe: less than 5 feet deep to moderately rapidly permeable material. | Severe: porous underlying material at a depth of 3½ to 5 feet; hazard of leachate flowing into underground water. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| McGary: Mc | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; poor shear strength; high compressibility; high shrink-swell potential; moderate susceptibility to frost heave. |
| Medway: Md | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Miami: | | | |
| MmB2 | Slight | Slight | Slight |
| MmC2 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| MmD2 | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| MoB3 | Slight | Slight | Slight |
| MoC3 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| MoD3 | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope; fair shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Milton: | | | |
| MtA | Severe: bedrock at a depth of 20 to 40 inches. | Moderate: bedrock at a depth of 20 to 40 inches. | Moderate: bedrock at a depth of 20 to 40 inches; fair to poor shear strength; medium to high compressibility; moderate to high shrink-swell potential; moderate susceptibility to frost heave. |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; lawns damaged if used when wet. | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; high shrink-swell potential; moderate susceptibility to frost heave. | Severe: very slow permeability; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained.[1] | Severe: somewhat poorly drained; silty clay and clay textures are difficult to work and are not suitable for cover material. |
| Moderate: subject to flooding; flooding damages landscape plantings in places. | Severe: subject to flooding; moderate shrink-swell potential and susceptibility to frost heave. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Slight | Slight | Moderate: 2 to 6 percent slope; lower end of moderate permeability. | Moderate: slope | Slight. |
| Slight | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Moderate: 6 to 12 percent slope; lower end of moderate permeability. | Severe: slope | Slight. |
| Moderate: 12 to 18 percent slope; erodible. | Severe: 12 to 18 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Moderate: 12 to 18 percent slope. |
| Moderate: severely eroded. | Slight | Moderate: 2 to 6 percent slope; lower end of moderate permeability. | Moderate: slope | Slight. |
| Moderate: 6 to 12 percent slope; severely eroded. | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Moderate: 6 to 12 percent slope; lower end of moderate permeability. | Severe: slope | Slight. |
| Severe: 12 to 18 percent slope; severely eroded. | Severe: 12 to 18 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Moderate: 12 to 18 percent slope. |
| Moderate: somewhat droughty. | Moderate: bedrock at a depth of 20 to 40 inches; moderate to high shrink-swell potential; moderate susceptibility to frost heave. | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Milton—continued. | | | |
| MtB2 | Severe: 2 to 6 percent slope; bedrock at a depth of 20 to 40 inches. | Moderate: 2 to 6 percent slope; bedrock at a depth of 20 to 40 inches. | Moderate: 2 to 6 percent slope; bedrock at a depth of 20 to 40 inches; fair to poor shear strength; medium to high compressibility; moderate to high shrink-swell potential; moderate susceptibility to frost heave. |
| MtC2 | Severe: 6 to 12 percent slope; bedrock at a depth of 20 to 40 inches. | Moderate: 6 to 12 percent slope; bedrock at a depth of 20 to 40 inches. | Severe: 6 to 12 percent slope; bedrock at a depth of 20 to 40 inches; fair to poor shear strength; medium to high compressibility; moderate to high shrink-swell potential; moderate susceptibility to frost heave. |
| Nineveh: NgA, NgB2, NnA | Slight | Slight | Slight |
| Ockley: OcA | Slight | Slight | Slight |
| Otwell: | | | |
| OtB2 | Slight | Slight | Slight |
| OtC2 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| OtC3 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| OtD2 | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope. | Severe: 12 to 18 percent slope; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Peoga: Pe | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot. | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot. | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; fair shear strength; medium to high compressibility; moderate shrink-swell potential; high susceptibility to frost heave. |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: somewhat droughty. | Moderate: 2 to 6 percent slope; bedrock at a depth of 20 to 40 inches; moderate to high shrink-swell potential; moderate susceptibility to frost heave. | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. |
| Moderate: somewhat droughty. | Severe: 6 to 12 percent slope; bedrock at a depth of 20 to 40 inches; moderate to high shrink-swell potential; moderate susceptibility to frost heave. | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. | Severe: bedrock at a depth of 20 to 40 inches. |
| Moderate: somewhat droughty. | Slight | Slight: very rapid permeability in underlying sand and gravel; possible pollution of ground water. | Severe: underlying material is rapidly permeable. | Severe: porous sand and gravel at a depth of about 2 to 4 feet; hazard of free leachate flow to ground water. |
| Slight | Slight | Slight: very rapid permeability in underlying sand and gravel; possible pollution of ground water. | Severe: underlying material is rapidly permeable. | Severe: porous sand and gravel at a depth of 4 to 5 feet; hazard of free leachate flow to ground water. |
| Slight | Slight | Severe: very slow permeability. | Moderate: 2 to 6 percent slope. | Slight. |
| Slight | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: very slow permeability. | Severe: 6 to 12 percent slope. | Slight. |
| Moderate: 6 to 12 percent slope; severely eroded. | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: very slow permeability. | Severe: 6 to 12 percent slope. | Slight. |
| Moderate: 12 to 18 percent slope; erodible. | Severe: 12 to 18 percent slope; moderate shrink-swell potential and susceptibility to frost heave. | Severe: 12 to 18 percent slope; very slow permeability. | Severe: 12 to 18 percent slope. | Moderate: 12 to 18 percent slope. |
| Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; lawns damaged if used when wet. | Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; moderate shrink-swell potential and high susceptibility to frost heave. | Severe: poorly drained; seasonal high water table; very slow permeability. | Severe: poorly drained; seasonal high water table.[1] | Severe: seasonal high water table; poorly drained. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Princeton: | | | |
| PrB | Slight | Slight | Slight |
| PrC2 | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope. | Moderate: 6 to 12 percent slope; fair to good shear strength; slight compressibility; low shrink-swell potential and susceptibility to frost heave. |
| Rarden: | | | |
| RaC2 | Moderate: 6 to 12 percent slope; soft shale bedrock at a depth of 20 to 40 inches. | Moderate: 6 to 12 percent slope; soft shale bedrock at a depth of 20 to 40 inches. | Moderate: 6 to 12 percent slope; soft shale bedrock at a depth of 20 to 40 inches; fair to poor shear strength; high compressibility; moderate to high shrink-swell potential; moderate susceptibility to frost heave. |
| RaD2 | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches; fair to poor shear strength; high compressibility; moderate to high shrink-swell potential; moderate susceptibility to frost heave. |
| ReD3 | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches. | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches; fair to poor compressibility; moderate to high shrink-swell potential; moderate susceptibility to frost heave. |
| Rensselaer: Rf, Rs | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; fair shear strength; slight to medium compressibility; moderate shrink-swell potential; high susceptibility to frost heave. |
| Riverwash: Rh. Properties too variable for reliable estimates. | | | |
| Rockcastle: RkF | Severe: steep slope; soft shale bedrock at a depth of 20 to 40 inches. | Severe: steep slope; soft shale bedrock at a depth of 20 to 40 inches. | Severe: steep slope; soft shale bedrock at a depth of 20 to 40 inches. |
| Rodman: RnF | Severe: steep slope; loose gravel and sand at a depth of 8 to 15 inches. | Severe: steep slope; loose gravel and sand at a depth of 8 to 15 inches. | Severe: steep slope; soft shale bedrock at a depth of 20 to 40 inches. |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: somewhat droughty. | Slight for roads. Moderate for parking lots; 2 to 6 percent slope; low shrink-swell potential and susceptibility to frost heave. | Slight | Severe: underlying material has rapid permeability at a depth of 6 feet. | Severe:[2] underlying material has rapid permeability at a depth of 6 feet. |
| Moderate: somewhat droughty. | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; low shrink-swell potential and susceptibility to frost heave. | Moderate: 6 to 12 percent slope. | Severe: slope; rapid permeability in underlying material. | Severe: rapid permeability in underlying material.[2] |
| Moderate: somewhat droughty. | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; soft shale bedrock at a depth of 20 to 40 inches; moderate to high shrink-swell potential and moderate susceptibility to frost heave. | Severe: bedrock at a depth of 20 to 40 inches; slope. | Severe: soft shale bedrock at a depth of 20 to 40 inches; slope. | Severe: soft shale bedrock at a depth of 20 to 40 inches. |
| Moderate: 12 to 18 percent slope; erodible; somewhat droughty. | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches; moderate to high shrink-swell potential; moderate susceptibility to frost heave. | Severe: bedrock at a depth of 20 to 40 inches; slope. | Severe: soft shale bedrock at a depth of 20 to 40 inches; slope. | Severe: soft shale bedrock at a depth of 20 to 40 inches. |
| Severe: 12 to 18 percent slope; severely eroded; somewhat droughty. | Severe: 12 to 18 percent slope; soft shale bedrock at a depth of 20 to 40 inches; moderate to high shrink-swell potential; moderate susceptibility to frost heave. | Severe: bedrock at a depth of 20 to 40 inches; slope. | Severe: soft shale bedrock at a depth of 20 to 40 inches; slope. | Severe: soft shale bedrock at a depth of 20 to 40 inches. |
| Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; moderate shrink-swell potential; high susceptibility to frost heave. | Severe: high water table at a depth of 0 to 1 foot; very poorly drained; subject to ponding; slow permeability in subsoil. | Severe: porous material at a depth of less than 5½ feet; permeability more than 2 inches per hour. | Severe: subject to ponding; high water table at a depth of 0 to 1 foot; very poorly drained. |
| Severe: steep slope; severe erosion hazard; droughty. | Severe: steep slope; soft shale bedrock at a depth of 20 to 40 inches. | Severe: steep slope | Severe: steep slope | Severe: steep slope. |
| Severe: steep slope; severe erosion hazard; droughty. | Severe: steep slope; loose gravel and sand at a depth of 8 to 15 inches. | Severe: steep slope | Severe: steep slope; rapid permeability; sand and gravel at a depth of 8 to 15 inches. | Severe: steep slope; porous sand and gravelly material not good cover; hazard of free leachate flow to ground water. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Ross: Ro | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Rp | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Rossmoyne: RsB2 | Moderate: moderately well drained; seasonal high water table at a depth of 3 to 6 feet. | Slight | Slight |
| Russell: RuB2 | Slight | Slight | Slight |
| Saranac: Sa, Sc | Severe: very poorly drained; subject to flooding; seasonal high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to flooding; seasonal high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to flooding; seasonal high water table at a depth of 0 to 1 foot; poor shear strength; high compressibility; high shrink-swell potential; moderate to high susceptibility to frost heave. |
| Shoals: Sh | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair to poor compressibility; low to moderate shrink-swell potential; high susceptibility to frost heave. |
| Sleeth: Sm | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair shear strength; medium to high compressibility; moderate shrink-swell potential; high susceptibility to frost heave. |
| Steff: St | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; poor shear strength; medium compressibility; low shrink-swell potential; high susceptibility to frost heave. |
| Stendal: Sx | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; poor shear strength; medium compressibility; low shrink-swell potential; high susceptibility to frost heave. |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: subject to flooding; floodwaters damage landscape plantings in places. | Severe: subject to flooding; moderate shrink-swell potential and susceptibility to frost heave. | Severe: subject to flooding; moderate permeability. | Severe: subject to flooding. | Severe: subject to flooding. |
| Moderate: subject to flooding; floodwaters damage landscape plantings in places. | Severe: subject to flooding; moderate shrink-swell potential and susceptibility to frost heave. | Severe: subject to flooding; moderate permeability. | Severe: subject to flooding. | Severe: subject to flooding. |
| Slight | Slight for roads. Moderate for parking lots; 2 to 6 percent slope. | Severe: very slow permeability. | Moderate: slope | Slight. |
| Slight | Slight for roads. Moderate for parking lots; 2 to 6 percent slope. | Moderate: lower end of moderate permeability. | Moderate: slope | Slight. |
| Severe: subject to flooding; very poorly drained; high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to flooding; seasonal high water table at a depth of 0 to 1 foot; high shrink-swell potential; moderate to high susceptibility to frost heave. | Severe: very poorly drained; subject to flooding; seasonal high water table. | Severe: subject to flooding; seasonal high water table; very poorly drained. | Severe: subject to flooding; very poorly drained; seasonal high water table. |
| Moderate: subject to flooding; floodwaters damage landscape plantings in places. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; seasonal high water table; somewhat poorly drained. | Severe: subject to flooding. |
| Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; lawns damaged if used when wet. | Moderate: somewhat poorly drainded; seasonal high water table at a depth of 1 to 3 feet; moderate shrink-swell potential; high susceptibility to frost heave. | Severe: seasonal high water table at a depth of 1 to 3 feet; moderate permeability. | Severe: stratified material at a depth of less than 5 feet allows for possible rapid seepage rate. | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; underlying porous material may allow leachate to flow into ground water. |
| Moderate: subject to flooding; floodwaters damage landscape plantings in places. | Severe: subject to flooding; low shrink-swell potential; high susceptibility to frost heave. | Severe: subject to flooding; seasonal high water table at a depth of 3 to 6 feet. | Severe: subject to flooding. | Severe: subject to flooding. |
| Moderate: subject to flooding; floodwaters damage landscape plantings in places. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low shrink-swell potential; high susceptibility to frost heave. | Severe: subject to flooding; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding. | Severe: subject to flooding; seasonal high water table. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Stonelick: Sz | Severe: subject to flooding | Severe: subject to flooding | Severe: subject to flooding; fair to good shear strength; slight compressibility; low shrink-swell potential; moderate to low susceptibility to frost heave. |
| Wakeland: Wa | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; poor shear strength; medium compressibility; low shrink-swell potential; high susceptibility to frost heave. |
| Weikert: BeF<br>For Berks part of BeF, see Berks series. | Severe: steep slope | Severe: steep slope | Severe: steep slope |
| Westland: Wc | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; fair shear strength; medium to high compressibility; moderate shrink-swell potential; high susceptibility to frost heave. |
| Whitaker: Wh | Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; fair shear strength; slight to medium compressibility; moderate shrink-swell potential; high susceptibility to frost heave. |
| Wilbur: Wu | Severe: subject to flooding; moderately well drained. | Severe: subject to flooding; moderately well drained. | Severe: subject to flooding; moderately well drained; poor shear strength; medium compressibility; low shrink-swell potential; high susceptibility to frost heave. |
| Xenia: XeB2 | Moderate: moderately well drained; seasonal high water table at a depth of 3 to 6 feet. | Slight | Slight |
| Zanesville:<br>ZaB2 | Moderate: 2 to 6 percent slope; bedrock at a depth of 40 to 80 inches. | Slight | Slight |
| ZaC2 | Moderate: 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches. | Moderate: 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches. | Moderate: 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches; fair shear strength; medium compressibility; moderate shrink-swell potential and susceptibility to frost heave. |

See footnotes at end of table.

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Severe: subject to flooding; floodwaters damage landscape plantings in places; somewhat droughty. | Severe: subject to flooding; low shrink-swell potential; moderate to low frost heave. | Severe: subject to flooding; moderate permeability; estimated percolation rate faster than 45 minutes per inch. | Severe: subject to flooding. | Severe: subject to flooding. |
| Moderate: subject to flooding; floodwaters damage landscape plantings in places. | Severe: subject to flooding; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; low shrink-swell potential; high susceptibility to frost heave. | Severe: subject to flooding; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding. | Severe: subject to flooding; seasonal high water table at a depth of 1 to 3 feet. |
| Severe: steep slope; bedrock at a depth of 10 to 20 inches. | Severe: steep slope; bedrock at a depth of 10 to 20 inches. | Severe: steep slope; bedrock at a depth of 10 to 20 inches. | Severe: steep slope; bedrock at a depth of 10 to 20 inches. | Severe: steep slope; bedrock at a depth of 10 to 20 inches. |
| Severe: seasonal high water table at a depth of 0 to 1 foot; subject to ponding; very poorly drained. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; moderate shrink-swell potential; high susceptibility to frost heave. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; slow permeability. | Severe: porous sand and gravel at a depth of about 3½ to 6½ feet; sand and gravel layers and rapid permeability. | Severe: subject to ponding in depressions; high water table; very poorly drained; underlain by porous sand and gravel; hazard of free leachate flow to ground water. |
| Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; lawns damaged if used when wet. | Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate shrink-swell potential; high susceptibility to frost heave. | Severe: seasonal high water table at a depth of 1 to 3 feet; moderate permeability. | Severe: stratified material at a depth of 4½ to 5 feet allows for rapid seepage rate. | Severe: stratified silty and sandy material at a depth of 4½ to 5 feet; hazard of free leachate flow to ground water. |
| Moderate: subject to flooding; floodwaters damage landscape plantings in places. | Severe: subject to flooding; moderately well drained; low shrink-swell potential; high susceptibility to frost heave. | Severe: subject to flooding; seasonal high water table at a depth of 1 to 3 feet. | Severe: subject to flooding. | Severe: subject to flooding. |
| Slight | Slight for roads. Moderate for parking lots; 2 to 6 percent slope. | Severe: moderately slow permeability. | Moderate: slope | Slight. |
| Slight | Slight for roads. Moderate for parking lots; 2 to 6 percent slope. | Severe: very slow permeability; bedrock at a depth of 40 to 80 inches. | Moderate: 2 to 6 percent slope; bedrock at a depth of 40 to 80 inches. | Moderate: bedrock at a depth of 40 to 80 inches. |
| Slight | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches; moderate shrink-swell potential and susceptibility to frost heave. | Severe: very slow permeability; bedrock at a depth of 40 to 80 inches. | Severe: 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches. | Moderate: bedrock at a depth of 40 to 80 inches. |

TABLE 9.—*Degree and kind of limitations*

| Soil series and map symbols | Limitations for— | | |
|---|---|---|---|
| | Houses with basements | Houses without basements | Commercial use and light industry |
| Zanesville—continued ZaC3 | Moderate: 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches. | Moderate: 6 to 12 percent slope; bedrock at a depth 40 to 80 inches. | Moderate: 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches; fair shear strength; medium compressibility; moderate shrink-swell potential and susceptibility to frost heave. |
| Zipp: Zp | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; some low areas subject to flooding. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; some low areas subject to flooding. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; some low areas subject to flooding; poor shear strength; high compressibility; high shrink-swell potential; moderate susceptibility to frost heave. |

[1] If the floor of the lagoon is in very slowly permeable material, at least two feet thick, the rating is slight.

formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons.

The accumulation of organic matter in the upper part of the profile has been important in the formation of the A1 horizon. In general, the soils that have the most content of organic matter have the thickest or darkest surface horizons and produce the most grass in a natural environment. Such soils as Avonburg silt loam have a surface layer that is low in content of organic matter, whereas Ross silt loam has a thick dark-colored surface layer that has a high content of organic matter.

Carbonates and bases have been leached from the upper part of the horizon in most of the soils of the county. This leaching has contributed to the development of the horizon. The removal of carbonates from the upper part of the horizon of a soil generally precedes the translocation of silicate clay minerals.

The clay accumulates in pores and forms films on the surface along which water moves. In the soils of Bartholomew County leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation. The Cincinnati, Miami, and Princeton soils are examples of soils that have translocated silicate clays that have accumulated in the B2t horizon in the form of clay films.

The reduction and transfer of iron, a process called gleying, is evident in the poorly drained Clermont soil and in the very poorly drained Brookston soils. The gray color in the subsoil horizons indicates reduction and loss of iron. Some horizons have mottles, which indicate segregation of iron.

### *Parent material*

Parent material influences the textural, chemical, and mineral properties of soils. Parent materials in Bartholomew County are extremely variable. They consist of loess and windblown sands of Wisconsin Age; outwash of Wisconsin Age; lacustrine material of Wisconsin and Illinoian Age; till of Illinoian and Wisconsin Age; residuum from sandstone, shale, and limestone bedrock that, in some places, is covered with a thin layer of glacial drift; and alluvium along the streams.

Before the glacial period, this area was dissected by streams. The preglacial topography determines the most important features in the western part of the county and in areas where the glacial drift is thin. In areas covered by drift, ice erosion, acting on the landscape, has rounded the existing hills and filled some valleys. In areas where till is 20 to 30 feet or more thick, the landscape mainly is formed by streams entrenching into the till and forming a dendritic drainage pattern. Bartholomew County was affected by the last three ice ages: the Kansan, Illinoian, and Wisconsin. The Kansan and Illinoian covered all of the county except for the Knobstone area (*6*). In the Knobstone area ice was pushed up the valleys and in places overrode part of the hills. The Wisconsin glacier covered most of the eastern half of the county.

As the ice receded from the uplands, a mantle of mixed stones, silt, and clay, known as glacial till, was left in place over the bedrock. The melting ice produced a large amount of water which carried large amounts of sand and gravel. Sand and gravel were deposited in stratified layers as glacial outwash. Examples of soils formed in glacial outwash are Fox and Nineveh soils.

The Driftwood River, Flatrock River and East Fork of the White River were major drainage channels for the melt water from the Wisconsin Glacier, so for a period of time after the glacier receded from Bartholomew County the terrace areas were repeat-

*for town and country planning*—Continued

| Limitations for—Continued | | | | |
|---|---|---|---|---|
| Landscaping and lawns | Local roads, streets, and parking lots | Septic tank absorption fields | Sewage lagoons | Sanitary landfills |
| Moderate: severely eroded. | Moderate for roads. Severe for parking lots; 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches; moderate shrink-swell potential and susceptibility to frost heave. | Severe: very slow permeability. | Severe: 6 to 12 percent slope; bedrock at a depth of 40 to 80 inches. | Moderate: bedrock at a depth of 40 to 80 inches. |
| Severe: subject to ponding and flooding; very poorly drained; high water table at a depth of 0 to 1 foot. | Severe: very poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot; high shrink-swell potential and susceptibility to frost heave. | Severe: very poorly drained; subject to ponding; high water table; very slow permeability. | Severe: subject to ponding; very poorly drained; high water table at a depth of 0 to 1 foot; clayey.[1] | Severe: subject to ponding; high water table at a depth of 0 to 1 foot; very poorly drained. |

[1] In areas where the sandy deposit is over till there is slight limitation.

edly flooded. The effect of the melting Wisconsin Glacier, therefore, continued to affect the county until the ice had receded out of the East Fork of the White River watershed. During the period of alternate flooding and drying, no vegetation was on the flood plains and outwash terraces. No plant cover was present to keep the soil material from blowing, and the prevailing southwesterly winds transported silt and sand onto the uplands. The areas of windblown sand lie just east of the outwash terraces. The Princeton and Bloomfield soils formed in these aeolian-sand deposits. The silty material, or loess, was transported farther than the sand. The silty loess was deposited as a mantle on top of the till. The Russell and Fincastle soils formed in a mantle of loess and the underlying till.

The till on the ridges ranges from a few inches to more than 50 feet in thickness (*6*). The till material consists of a mixture of local bedrock material along with material that has been transported from hundreds of miles to the north. Cincinnati and Rossmoyne soils are examples of soils formed in Illinoian till. Miami and Crosby soils are examples of soils that formed in the Wisconsin till.

When the ice receded, lakes formed in many valleys that were blocked by glacial drift, rock divides, or backwater areas away from the faster flowing current of the melt-water stream. In these temporary glacial lakes, sand and silt were deposited by moving water, and clay was deposited by very slowly moving or still water. Lakebeds were associated with both the Illinoian Age and Wisconsin Age Glacier. Otwell and Dubois soils formed in the finer textured lacustrine material of the Illinoian period. The McGary soils formed in the fine-textured deposits of Wisconsin Age. The Martinsville and Whitaker soils formed in the silty or sandy deposits of Wisconsin Age.

The Norman Upland is in the western part of the county, west of the east-facing Knobstone escarpment. In Bartholomew County, the escarpment rises 250 to 350 feet above the Scottsburg lowland to the east (*6*). The bedrock of this area is mainly interbedded sandstone, siltstone, and shale (fig. 23) of the group of Mississippian Age (*6*). The tops of the ridges have a mantle of loess. The Zanesville soils formed in the loess and material that weathered from bedrock. Such soils as Berks and Weikert are on the side slopes and formed in thin loess and material that weathered from bedrock. Near the base of the Knobstone escarpment are areas of gray-green shale. This shale has very little interbedded sandstone or siltstone. Rockcastle and Rarden soils formed on this shale.

Sediment deposited by water is the parent material of soils on the bottom lands. Some of this sediment, mainly near areas of Illinoian till, is strongly acid. Stendal and Bonnie soils formed in such sediment. Neutral or calcareous sediment is on bottom lands along drainage areas of soils that formed in Wisconsin drift. Genesee and Ross soils formed in this neutral or calcareous sediment.

### *Climate*

The temperature in Bartholomew County generally is in the midcontinental range. Large variations in temperature occur. The average daily maximum temperature is 88° F. in July and the average daily minimum temperature is 21° in January.

Annual precipitation averages 40.9 inches. Precipitation is rather evenly distributed throughout the year, but is slightly heavier in the spring and early summer than it is in the fall. The heavy rainfall has leached plant nutrients from the surface layer of the soil and has prevented the accumulation of free calcium carbonates.

TABLE 10.—*Tree and shrub plantings*

| Group and series or land type | Description | Trees and shrubs to— | | | |
|---|---|---|---|---|---|
| | | Retain at homesites and in parks | Plant for windbreaks, screens, and sound barriers | Plant for beauty and shade | Plant to attract songbirds and wildlife |
| 1. Bonnie<br>Brookston<br>Clermont<br>Peoga<br>Rensselaer<br>Saranac<br>Shoals<br>Stendal<br>Wakeland<br>Westland<br>Zipp | Somewhat poorly drained, poorly drained, and very poorly drained silty, loamy, and clayey soils that are level and in depressions; seasonal high water table at depth of 0 to 3 feet; some soils subject to ponding and flooding. | Pin oak, bur oak, shingle oak, sycamore, sweetgum, Red River birch. | White pine, Norway spruce, arborvitae, Lombardy poplar, gray dogwood, silky dogwood, laurelleaf willow, tall and medium purple willow. | White pine, white spruce, baldcypress, sycamore, sweetgum, pin oak. | Arborvitae, black spruce, gray dogwood, redosier dogwood, elderberry, Amur honeysuckle, buttonbush. |
| 2. Avonburg<br>Ayrshire<br>Bartle<br>Cincinnati<br>Crosby<br>Dubois<br>Fincastle<br>Henshaw<br>McGary<br>Otwell<br>Rossmoyne<br>Sleeth<br>Whitaker<br>Zanesville | Well drained, moderately well drained and somewhat poorly drained, silty and loamy, level to strongly sloping soils. Somewhat poorly drained soils have a seasonal high water table at a depth of 1 to 3 feet. Some of the somewhat poorly drained soils have a fragipan. Moderately well drained and well drained soils in this group have a very slowly permeable fragipan. | Bur oak, pin oak, white oak, scarlet oak, sugar maple, blackgum, tulippoplar. | White pine, Norway spruce, white spruce, hemlock, autumn-olive, amur honeysuckle, highbush cranberry, blackhaw, serviceberry, rose of Sharon. | White pine, white spruce, baldcypress, basswood, Cornelian-cherry, cutleaf sumac. | White spruce, autumn-olive, Amur honeysuckle, highbush cranberry, spicebush, blackhaw, mapleleaf viburnum, serviceberry, cutleaf sumac. |
| 3. Camden<br>Celina<br>Eel<br>Genesee<br>Haymond<br>Hickory<br>Martinsville<br>Medway<br>Miami<br>Milton<br>Ockley<br>Princeton<br>Ross<br>Russell<br>Steff<br>Wilbur<br>Xenia | Well drained and moderately well drained, silty and loamy, level to steep soils. The moderately well drained soils have a seasonal high water table at a depth of 3 to 6 feet and the well drained soils have a seasonal high water table below a depth of 6 feet. Some soils are subject to flooding. The Milton soils have limestone bedrock at a depth of 20 to 40 inches. | Red oak, white oak, black walnut, tulippoplar, sugar maple, sycamore, hackberry. | White pine, red pine, Norway spruce, hemlock, autumn-olive. | White pine, red pine, Norway spruce, tulippoplar, black gum, thornless honeylocust, mountain ash, Norway maple, flowering dogwood, basswood, redbud, white birch. | Hemlock, black locust, mountain ash, flowering dogwood, basswood, redbud, autumn-olive, Amur honeysuckle, blackhaw, serviceberry, hawthorn. |
| 4. Bloomfield<br>Burnside<br>Fox<br>Landes<br>Nineveh<br>Stonelick | Well-drained, sandy and loamy, nearly level to moderately sloping soils that have a water table at a depth of more than 6 feet. | Red oak, white oak, shingle oak, scarlet oak, black walnut, blackgum. | Red pine, Austrian pine, white pine, forsythia, hazelnut, lilac, tamarix, autumn-olive. | Red pine, white pine, black locust, scarlet oak, blackgum, flowering dogwood. | Black locust, forsythia, hazelnut, privet, Jersey-tea, flowering dogwood. |
| 5. Berks<br>Corydon<br>Gilpin<br>Gullied land<br>Hennepin<br>Rarden<br>Riverwash<br>Rockcastle<br>Rodman | Level to steep areas of shallow and moderately deep, well drained and excessively drained soils that have very low, low, or moderate available water capacity. | Sycamore, Red River birch, ash, red oak. | Red pine, white pine, autumn-olive, black haw, hazelnut, forsythia, lilac, staghorn sumac, flowering quince. | Red pine, white pine, scarlet oak, thornless honeylocust, Russian olive. | Virginia pine, Austrian pine, autumn-olive, blackhaw, serviceberry, hazelnut, staghorn sumac, flowering dogwood. |

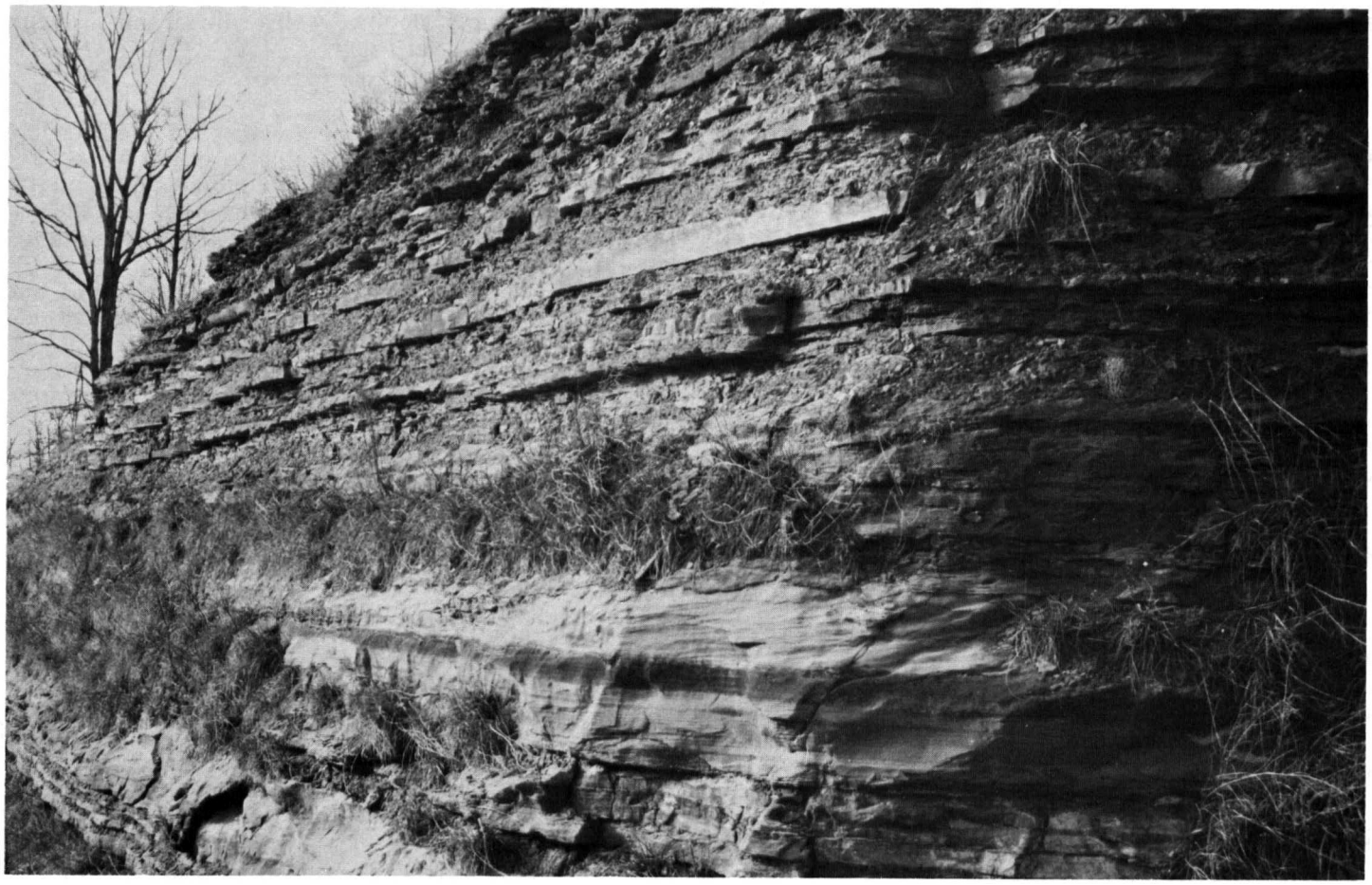

*Figure 23.*—**Interbedded sandstone, siltstone, and shale beneath a thin loess mantle. Berks, Weikert, and Gilpin soils formed in material weathered from this bedrock.**

The climate is so uniform throughout the area that differences among the soils cannot be attributed to differences in climate.

Climatic forces act upon rocks to form the parent material from which the soils formed, but many of the more important soil characteristics would not develop if it were not for the activity of living organisms. If it were not for the changes brought about by the presence of plants and animals, the soils would consist merely of residual or transported materials derived from weathered rock, although some soils might have definite layers that formed through addition of alluvial material by differential weathering or leaching.

Climate, acting alone on the parent material, is largely destructive. It causes the soluble materials to be washed out of the soils. If combined with plants and animal activity, climatic processes are constructive. A reversible cycle is established between intake and outgo of plant nutrients. Plants draw nutrients from the lower part of the soil profile; then when the plants die, the surface soil is renewed in varying degrees by the plant nutrients that are returned to the upper part of the soil. In Bartholomew County the climate is such that leaching is greater than replacement. This accounts for the fact that most of the soils are strongly weathered, leached, acid, and low in fertility. Clermont and Otwell soils are examples of such soils.

### *Plant and animal life*

Before Bartholomew County was settled the native vegetation was most important in the complex of living organisms that affect soil development. Plants, micro-organisms, earthworms, and other forms of life that live on and in the soil contribute to its morphology. Bacteria and fungi are micro-organisms that affect the soils. They cause plant waste to decompose and to be incorporated into the soil. The higher forms of plants return organic matter to the soil and transfer plant nutrients from the lower part to the upper part of the soil profile.

Bartholomew County was, at one time, almost completely covered with hardwood trees. Common species were tulip-poplar, oak, hickory, elm, maple, and ash. A comparatively small amount of organic matter derived from the forest became incorporated in the soils while they were forming. In forested areas of uplands that have never been cleared, thin layers of forest litter and leaf mold cover the soil. A small amount of organic matter from decayed leaves and twigs is mixed throughout the topmost 1 or 2 inches of the surface layer of the soil. Cincinnati and Miami soils are exam-

ples of soils that formed mainly under hardwood trees. An area parallels the Driftwood River and Flatrock River in which the native vegetation consisted mainly of mixed hardwood trees and prairie grasses.

A large amount of organic matter from the grasses was incorporated into the surface layer. Nineveh soil is an example of a soil that formed under mixed grasses, and forests. In a few areas where Ross and Medway soils formed, the native vegetation was mainly grasses. In areas of Brookston and Rensselaer soils, the native vegetation was swamp grasses and sedges as well as water-tolerant trees. These soils were covered with water much of the time, and as the organic material fell into the water, it slowly decayed and accumulated.

The vegetation is fairly uniform, except for areas of mixed grasses and hardwoods. Major differences in the soils, therefore, cannot be explained on the basis of differences in vegetation. Although some comparatively minor variations in the vegetation are associated with different soils, these variations are probably chiefly the result, and not the cause, of the differences in soils.

### *Relief*

The relief of Bartholomew County ranges from nearly level on bottom lands, terraces, and upland flats to very steep on uplands and terrace breaks. Most of the county has been greatly dissected by erosion and by streams. The lowest point in Bartholomew County is about 560 feet above sea level and is located in the southern part of the county where the East Fork of the White River enters Jackson County. The highest point is 1,018 feet above sea level and is located on Taylor Hill just west of Harrison Lakes.

Variations in relief have affected the drainage and development of the soils in the county. The influence of relief upon soil formation affects drainage, runoff, and other water effects, including normal and accelerated erosion.

Differences in relief have radically affected moisture and air relationships within the soil. Soils that formed in the same type of parent material in steep areas are less strongly developed than those in nearly level to sloping areas. This difference in soil formation is caused by rapid normal erosion, the reduced percolation of water through the soil material, and the lack of water in the soil necessary for the vigorous growth of plants that influence soil formation. The degree of soil profile formation within a given time, on a given parent material, and under the same type of vegetation, depends largely on the amount of water that passes through the soil material.

Because of variations in relief in Bartholomew County, several different soils have formed from the same kind of parent material. A good example of the way relief has affected the soils that formed in the same kind of parent material is the Cincinnati catena of soils that formed in loess and the underlying till. Avonburg soils are nearly level and are somewhat poorly drained. They are gray, and mottled, and permeability is slow. The Cincinnati soils are gently sloping to strongly sloping, well drained, and brown; and permeability is very slow.

### *Time*

Differences in time account for most of the soil differences that are not attributable to other factors of soil formation. The soils of Bartholomew County range in age from very old to very young. In general, the older soils have a greater degree of horizon differentiation than the younger soils.

Most soils that formed on the smoother parts of the uplands and on older stream terraces have a well-defined soil profile. These soils are old or mature. They formed in materials that are less resistant to weathering or that have been in place long enough for the formation of distinct horizons.

The soil materials on first bottoms are immature because the parent materials are young and new materials are deposited periodically. Soils on steep slopes, such as the Hennepin soil, generally are immature, because geological erosion removes the soil material nearly as fast as it accumulates; also, runoff is greater and less water percolates down through the soil. Some kinds of parent rock are so resistant to weathering that soil formation is very slow even though other conditions are favorable. Weikert soils are an example of soils that formed on weather-resistant rock. A mature soil is one that has formed A and B horizons that were produced by the natural processes of soil formation. An immature soil has little or no horizon differentiation.

In Bartholomew County the oldest soils formed in loess and the underlying residuum that weathered from shale and sandstone bedrock. Zanesville soils are examples of soils that formed from loess and shale and sandstone residuum.

Cincinnati and Rossmoyne soils are examples of the second oldest soils that formed in glacial till of Illinoian Age. They have well-developed profiles and are considered to be mature or nearly so.

The third oldest soils are those that formed in old lakebed (lacustrine) deposits and old alluvium more than 50,000 years old that are associated with the Illinoian drift. These soils formed in the lacustrine material left after the old lakes of the Illinoian period were drained, and in alluvium washed from upland till soon after the Illinoian drift was deposited. Otwell, Dubois, and Bartle soils are examples of these soils. They have well-formed profiles and are considered to be mature or nearly so. They are leached as deeply or nearly as deeply as those that formed in Illinoian drift, but are leached to a much greater depth than soils that formed in more recent glacial till of Wisconsin Age.

The fourth oldest soils are in the eastern part of the county that has a glacial deposit of Wisconsin Age 12,000 to 22,000 years old. From the vicinity of Clifty Creek south to the county line is a 20- to 40-inch loess mantle over the till where the Russell and Fincastle soils formed. This area is only slightly older than the area north of Clifty Creek where the loess is less than 20 inches deep over the till in which Crosby and

Miami soils formed. These soils are not so deeply leached as those soils that formed in Illinoian drift.

The soils on terraces overlying gravel and sand deposited during the Wisconsin glacial period are only slightly younger than the soils formed in the Wisconsin till drift. They formed in gravel and sand deposits left by the melt water of the Wisconsin Age glacier. Soils of the Fox, Nineveh, and Martinsville series are examples of soils on these terraces. These terraces are mainly along the Driftwood River, Flatrock River, East Fork of the White River, and Clifty Creek. During the time these terraces were being deposited, or soon thereafter, sand was blown from these areas onto the adjacent uplands. The Princeton and Bloomfield soils formed on these dune-shaped sand deposits. These are mature soils that are less thoroughly or deeply leached than those that developed in Illinoian drift.

The youngest soils in Bartholomew County are the steep shallow soils and the alluvial soils on present flood plains.

Such shallow residual soils as Corydon, Rodman, and Weikert are mostly on steep slopes where natural erosion is nearly as rapid as soil formation. The alluvial soils are on bottom lands where new materials are deposited periodically. Genesee, Haymond, and Eel soils are examples of the young bottom land soils.

## Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and was later revised (*10*).

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*8, 13*).

The current system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 11, the soil series of Bartholomew County are placed in five categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

SUBORDER. Each order is subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (Aqu, meaning water or wet, and *ent* from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequences of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquents (*Hapl,* meaning simple horizons, *aqu* for wetness or water, and *ent,* from Entisols).

SUBGROUP. Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Hapludalfs (a typical Hapludalf).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (see table 11). An example is the fine-loamy, mixed, mesic family of Typic Hapludalfs.

TABLE 11.—*Soil series classified according to the current system of classification*

| Series | Family | Subgroup | Order |
|---|---|---|---|
| Avonburg | Fine-silty, mixed, mesic | Aeric Fragiaqualfs | Alfisols. |
| Ayrshire | Fine-loamy, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Bartle | Fine-silty, mixed, mesic | Aeric Fragiaqualfs | Alfisols. |
| Berks | Loamy-skeletal, mixed, mesic | Typic Dystrochrepts | Inceptisols. |
| Bloomfield | Coarse-loamy, mixed, mesic | Psammentic Hapludalfs | Alfisols. |
| Bonnie | Fine-silty, mixed, acid, mesic | Typic Fluvaquents | Entisols. |
| Brookston | Fine-loamy, mixed, mesic | Typic Argiaquolls | Mollisols. |
| Burnside | Loamy-skeletal, mixed, acid, mesic | Typic Udifluvents | Entisols. |
| Camden | Fine-silty, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Celina | Fine, mixed, mesic | Aquic Hapludalfs | Alfisols. |
| Cincinnati | Fine-silty, mixed, mesic | Typic Fragiudalfs | Alfisols. |
| Clermont | Fine-silty, mixed, mesic | Typic Ochraqualfs | Alfisols. |
| Corydon | Clayey, mixed, mesic | Lithic Argiudolls | Mollisols. |
| Crosby | Fine, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Dubois | Fine-silty, mixed, mesic | Aeric Fragiaqualfs | Alfisols. |
| Eel | Fine-loamy, mixed, nonacid, mesic | Aquic Udifluvents | Entisols. |
| Fincastle | Fine-silty, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Fox | Fine-loamy over sandy or sandy skeletal, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Genesee | Fine-loamy, mixed, nonacid, mesic | Typic Udifluvents | Entisols. |
| Gilpin | Fine-loamy, mixed, mesic | Typic Hapludults | Ultisols. |
| Haymond | Coarse-silty, mixed, nonacid, mesic | Typic Udifluvents | Entisols. |
| Hennepin | Fine-loamy, mixed, mesic | Typic Eutrochrepts | Inceptisols. |
| Henshaw | Fine-silty, mixed, mesic | Aquic Hapludalfs | Alfisols. |
| Hickory | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Landes | Coarse-loamy, mixed, mesic | Fluventic Hapludolls | Mollisols. |
| Martinsville [1] | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| McGary | Fine, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Medway | Fine-loamy, mixed, mesic | Fluvaquentic Hapludolls | Mollisols. |
| Miami | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Milton | Fine, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Nineveh | Fine-loamy over sandy or sandy skeletal, mixed, mesic | Typic Argiudolls | Mollisols. |
| Ockley | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Otwell | Fine-silty, mixed, mesic | Typic Fragiudalfs | Alfisols. |
| Peoga | Fine-silty, mixed, mesic | Typic Ochraqualfs | Alfisols. |
| Princeton | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Rarden [2] | Clayey, mixed, mesic | Aquic Hapludults | Ultisols. |
| Rensselaer | Fine-loamy, mixed, mesic | Typic Argiaquolls | Mollisols. |
| Rockcastle | Fine, mixed, mesic | Typic Dystrochrepts | Inceptisols. |
| Rodman | Sandy-skeletal, mixed, mesic | Typic Hapludolls | Mollisols. |
| Ross | Fine-loamy, mixed, mesic | Cumulic Hapludolls | Mollisols. |
| Rossmoyne | Fine-silty, mixed, mesic | Aquic Fragiudalfs | Alfisols. |
| Russell | Fine-silty, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Saranac | Fine, mixed, mesic | Fluvaquentic Haplaquolls | Mollisols. |
| Shoals | Fine-loamy, mixed, nonacid, mesic | Aeric Fluvaquents | Entisols. |
| Sleeth | Fine-loamy, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Steff [3] | Fine-silty, mixed, mesic | Fluvaquentic Dystrochrepts | Inceptisols. |
| Stendal | Fine-silty, mixed, acid, mesic | Aeric Fluvaquents | Entisols. |
| Stonelick | Coarse-loamy, mixed (calcareous), mesic | Typic Udifluvents | Entisols. |
| Wakeland | Coarse-silty, mixed, nonacid, mesic | Aeric Fluvaquents | Entisols. |
| Weikert | Loamy-skeletal, mixed, mesic | Lithic Dystrochrepts | Inceptisols. |
| Westland | Fine-loamy, mixed, mesic | Typic Argiaquolls | Mollisols. |
| Whitaker | Fine-loamy, mixed, mesic | Aeric Ochraqualfs | Alfisols. |
| Wilbur | Coarse-silty, mixed, mesic | Aquic Udifluvents | Entisols. |
| Xenia | Fine-silty, mixed, mesic | Aquic Hapludalfs | Alfisols. |
| Zanesville | Fine-silty, mixed, mesic | Typic Fragiudults | Ultisols. |
| Zipp | Fine, mixed, nonacid, mesic | Typic Haplaquepts | Inceptisols. |

[1] Martinsville sandy loam, 0 to 2 percent slopes (MaA), is a taxadjunct to the Martinsville series because it is sandier throughout than is defined as within the range for the Martinsville series.

[2] These soils are taxadjuncts to the Rarden series because they do not exhibit the wetness characteristics defined as within the range of the Rarden series.

[3] This soil is a taxadjunct to the Steff series because the fine stratification below the Ap horizon is not within the defined range of the Steff series.

## Laboratory Data [5]

Laboratory data for some soils are included here to help explain some aspects of soil genesis—how the parent material was deposited and how soil horizons formed. Data are reported for the Avonburg, Dubois, and Rossmoyne soils. The analyses are from the profiles described in the section "Descriptions of the Soils." For both the Rossmoyne and Avonburg soils, there are differences in the depths of the lower horizons between those profiles in the section "Descriptions of the Soils" and in the laboratory data. The similar soils de-

[5] By DONALD P. FRANZMEIER, associate professor of agronomy, Purdue University.

scribed were nearly adjacent in the mapping unit, but did have variations in the lower horizons. Particle-size analysis and organic-carbon content were determined by soil scientists in the Purdue Laboratory, and pH, extractable phosphorus, and extractable potassium were determined by the Purdue Plant and Soil Analysis Laboratory.

The methods and procedures used to obtain the laboratory data are described in the following paragraphs. Physical and chemical properties of selected soils are given in table 12.

*Oxidizable organic carbon* was determined by the Walkley-Black method which involved oxidation of organic carbon by potassium dichromate and sulfuric acid.

*Particle-size analysis.* Organic matter was destroyed if the organic-carbon content was more than 2 percent. Clay content was determined after dispersion by a Calgon solution and overnight shaking. Following the clay determination the suspension was passed through a number 50 sieve and the same fraction was collected, dried, and weighed. Silt content was determined by difference.

*pH* was determined using a glass electrode pH meter on a 1:1 soil-water suspension.

*Extractable phosphorus* was determined by the Bray P-1 test. The soil was extracted with a 0.025N HCl and 0.03N $NH_4F$ solution and phosphorus was determined by the molybdophosphoric blue colorimetric method.

*Extractable potassium* was extracted with neutral IN ammonium acetate and determined using an atomic adsorption spectrophotometer.

The phosphorus and potassium determinations were the routine tests for available nutrients and are reported as pounds per acre. The assumption was made that the plow layer of an acre of soil weighs 2,000,000 pounds.

In the moderately well drained Rossmoyne soil the upper five horizons, to a depth of 35 inches, are high in silt, ranging from 67 to 77 percent, and low in sand, ranging from 2 to 7 percent, constituting a particle-size distribution that is typical of windblown silt or loess. Within these horizons is evidence that clay moved from the A horizon, that is about 16 to 17 percent clay, to the B horizon, that is about 24 to 29 percent clay.

The two lowest horizons, below a depth of 58 inches, are lower in content of silt and higher in content of sand than the upper horizons. This material probably derived from glacial till. The change in parent materials, from loess in the upper part of the profile to glacial till in the lower part, is indicated by the "II" of the designations of the lower horizons. The Bx2 horizon is intermediate in texture, but is more similar to the material in the upper part and is included with it.

The clay content doubles, from 21 to 42 percent, between the Bx2 horizon and the IIB2tb horizon. This sharp change in content of clay could mean that an earlier soil had been formed, was eroded to within its B2t horizon, and was subsequently buried by deposits of loess.

According to these interpretations, the Rossmoyne soil probably formed as follows: A few hundred thousand years ago, the Illinoian glacier deposited calcareous glacial till. During the next interglacial period a well-developed soil formed from this till. The content of clay in the B horizon of this soil was 42 percent compared to 16 percent content of clay in the parent material. The soil was subsequently eroded and was covered by loess that was deposited about the time the Wisconsin glacier retreated from the northern part of the county about 20,000 years ago. Since that time the soil formed by accumulation of organic matter in the surface horizon, leaching of carbonates from the loess, movement of clay within the profile, and development of the fragipan.

The low pH values indicate that most of the bases have been leached from the Rossmoyne soil. Some potassium remains, the concentration of which is related to content of clay. Very little extractable phosphorus remains in this soil.

The Avonburg soils formed in the same kind of parent materials as Rossmoyne soils but Avonburg soils are on flatter landscapes and are somewhat poorly drained. The horizon sequence of these two soils is similar and they probably had similar histories. The content of clay in the Avonburg soil, however, does not sharply increase in the lower part of the profile. It appears that a change in parent material from loess to glacial till occurs at a depth of about 75 inches, because at this depth content of sand and clay increases, which suggests the existence of a former B horizon that has since been buried. The horizons between a depth of 39 and 75 inches are intermediate in particle-size distribution between the horizons above and those below these depths. The small increase in extractable phosphorus in the Bx3 horizon suggests that it was at one time a surface horizon.

The interpretation of data suggests that there were two parent materials for Avonburg and Rossmoyne soils. The material near the contact that is intermediate in texture seems to be a mixture of the two materials. It is possible, however, that this material is a separate deposit between the late Wisconsin loess and the Illinoian till and that the soil formed from three parent materials. A possibility also exists that two stages of soil formation occurred before the present one. In defining the soil series the lower limit of the loess has been considered to be near the upper textural change—at a depth of 35 inches in Rossmoyne and 39 inches in Avonburg soils. The Rossmoyne and Avonburg soils as described for their respective series have a lower limit of loess based on an observed increase in the amount of sand grains; however, the depths described were not substantiated by the laboratory data, but indicated that the change from loess to till was deeper. The material between the depth of loess as indicated in the series description and that indicated as a change in the laboratory data has an uncertain origin and needs further study.

The Dubois soil formed from silty material that is thought to have been deposited in a former lakebed because the IIC horizon is stratified. The upper part of the soil, however, probably developed from loess. The high content of clay in the B2t horizon, the clay

TABLE 12.—*Physical and chemical*

[Absence of information indicates that a quantity of

| Soil | Depth from surface | Horizon | Size class and diameter of particles | | | | |
|---|---|---|---|---|---|---|---|
| | | | Sand | | | | |
| | | | Very coarse (2–1 mm) | Coarse (1–0.5 mm) | Medium (0.5–0.25 mm) | Fine (0.25–0.1 mm) | Very fine (0.1–0.05 mm) |
| | *In* | | *Pct* | *Pct* | *Pct* | *Pct* | *Pct* |
| Rossmoyne silt loam | 0–7 | Ap | 0.3 | 1.0 | 1.5 | 2.2 | 1.9 |
| | 7–12 | Az | 0.3 | 0.9 | 1.0 | 2.0 | 2.0 |
| | 12–17 | B1t | | | 0.4 | 0.6 | 0.5 |
| | 17–25 | B2t | 0.1 | 0.3 | 0.5 | 0.8 | 0.4 |
| | 25–35 | Bx1 | 0.2 | 0.5 | 0.8 | 1.3 | 1.3 |
| | 35–58 | Bx2 | 0.5 | 2.5 | 4.0 | 7.4 | 5.6 |
| | 58–180 | IIB2tb | 1.1 | 3.4 | 5.1 | 9.1 | 8.4 |
| | 180–190 | C | 4.5 | 6.6 | 8.7 | 15.2 | 13.0 |
| Avonburg silt loam | 0–7 | Ap | 0.8 | 4.0 | 5.1 | 7.6 | 5.7 |
| | 7–18 | Az | 0.6 | 2.6 | 3.9 | 6.3 | 4.6 |
| | 18–27 | B2lt | 0.3 | 2.3 | 2.8 | 4.5 | 3.2 |
| | 27–39 | Bx1 | 0.7 | 2.4 | 0.2 | 5.6 | 4.1 |
| | 39–63 | Bx2 | 0.8 | 3.2 | 5.3 | 8.3 | 5.6 |
| | 63–75 | Bx3 | 0.5 | 2.8 | 5.0 | 8.5 | 6.2 |
| | 75–150 | IIB2b | 1.0 | 3.9 | 6.5 | 11.1 | 8.1 |
| | 150–160 | IIC | 4.5 | 7.4 | 8.4 | 14.0 | 10.7 |
| Dubois silt loam | 0–12 | Ap | 0.5 | 1.2 | 1.4 | 2.3 | 4.1 |
| | 12–16 | A2 | 0.6 | 1.0 | 1.1 | 2.0 | 3.8 |
| | 16–22 | B1 | 0.6 | 0.8 | 0.7 | 1.6 | 2.8 |
| | 22–27 | B2t | 0.1 | 0.3 | 0.5 | 1.2 | 2.8 |
| | 27–43 | IIBx1 | 0.2 | 0.5 | 0.5 | 1.7 | 2.9 |
| | 43–66 | IIBx2 | | 0.1 | 0.5 | 2.1 | 4.8 |
| | 66–150 | IIC | | 0.2 | 0.4 | 1.8 | 7.0 |

films, and the clay particles oriented parallel to each other, suggest that a great deal of clay moved into this horizon from those horizons above it. In the fragipan, both silt and clay appear to have moved downward through the cracks around the large prisms, because the profile description indicated the presence of both silt coatings and clay films on prism faces. The Dubois subsoil is very acid, indicating that most of the bases have been leached from these horizons.

## *General Nature of the County*

The following sections have been included to give other important facts about Bartholomew County that can be beneficial to the users of this soil survey.

The sections include a brief history of Bartholomew County along with a brief explanation of the climate, relief and drainage, farming, and water supply.

### History

The Delaware Indians lived in Bartholomew County until about 1818. In 1818 a treaty opened up land north of Fort Vallonia; this land included Bartholomew County. The County was surveyed in 1819 and the sale of land began in 1820.

The County was organized on February 15, 1821 (*11*). It originally included a part of Brown County and all of Jackson County. The County was named for an illustrious pioneer Indian fighter, General Joseph Bartholomew. The townships, except for Ohio, are named for the streams that pass through them.

Jasper Cox, a Virginian, was the first settler. He settled on Haw Creek in 1819. Most of the settlers came from Ohio, Kentucky, Virginia, and North Carolina.

The Haw Patch land was occupied first. It mainly consists of Nineveh and Fox soils. The Wisconsin till plain areas in the eastern part of the County were settled next. Most of the Illinoian till plain and Knobstone unglaciated areas, were not settled until 1833. Most of this land was settled by Prussian immigrants.

Columbus, the county seat, was laid out in 1821 on a 60-acre tract of land. In 1850 the population was 1,008 and in 1970 it was 27,141. Bartholomew County had a population of 5,476 in 1930 and a population of 57,022 in 1970.

### Water Supply

In Bartholomew County the quantity of water available for use from wells is related to the geologic mate-

*properties of selected soils*

less than the minimum reported value was detected]

| Size class and diameter of particles—Continued | | | USDA texture | Organic carbon | Reaction | Extractable— | |
|---|---|---|---|---|---|---|---|
| Silt (0.05–0.002 mm) | Clay (less than 0.002 mm) | Greater than 2 mm | | | | Phosphorus | Potassium |
| *Pct* | *Pct* | *Pct* | | *Pct* | *pH* | *Lbs per acre* | *Lbs per acre* |
| 77.4 | 15.7 | | Silt loam | 1.33 | 6.4 | 3 | 75 |
| 76.6 | 17.2 | | Silt loam | .64 | 5.2 | 1 | 45 |
| 74.2 | 24.3 | | Silt loam | | 5.0 | 0 | 60 |
| 71.0 | 26.9 | | Heavy silt loam | | 4.8 | 0 | 75 |
| 67.3 | 28.6 | | Silty clay loam | | 4.8 | 1 | 105 |
| 59.0 | 21.0 | | Silt loam | | 4.8 | 0 | 60 |
| 30.5 | 42.4 | | Clay | | 5.3 | 0 | 135 |
| 36.0 | 16.0 | 5.9 | Loam | | 8.0 | 3 | 90 |
| 66.1 | 10.7 | | Silt loam | .87 | 7.1 | 4 | 30 |
| 66.0 | 16.0 | | Silt loam | .29 | 5.6 | 1 | 45 |
| 57.5 | 29.4 | | Silty clay loam | | 4.6 | 1 | 150 |
| 63.2 | 23.8 | | Silt loam | | 4.8 | 0 | 105 |
| 56.8 | 20.0 | | Silt loam | | 5.5 | 0 | 90 |
| 56.0 | 21.0 | | Silt loam | | 6.6 | 2 | 75 |
| 42.0 | 27.4 | | Clay loam | | 7.2 | 0 | 105 |
| 38.0 | 17.0 | 1 | Loam | | 8.2 | 0 | 90 |
| 74.8 | 15.7 | | Silt loam | 1.28 | 7.4 | 45 | 105 |
| 73.3 | 18.2 | | Silt loam | .52 | 6.8 | 4 | 60 |
| 72.5 | 21.0 | | Silt loam | | 4.8 | 0 | 60 |
| 61.9 | 33.2 | | Silty clay loam | | 4.7 | 0 | 120 |
| 66.2 | 28.0 | | Silty clay loam | | 4.7 | 1 | 120 |
| 66.6 | 25.9 | | Silt loam | | 4.8 | 1 | 105 |
| 63.1 | 27.5 | | Silt loam | | 5.9 | 0 | 105 |

rial of the area. The best source of water is the terrace overlying gravel and sand. Columbus' water supply is from terraces along the Driftwood River, Flatrock River, and East Fork of the White River. Rural water systems are also supplied from these terraces. Some irrigation water is pumped from wells in these terraces.

In upland areas of Wisconsin till, the depth to and quantity of water depends on the thickness and composition of the till. Most water in this area comes from gravel and sand strata within the till. In places the Wisconsin till is relatively thin over limestone. In some areas the wells extend into the stone and are not as reliable a source of water as those in the areas of deeper till.

In areas of Illinoian drift the reliability of wells as a source of water is variable. A few wells yield enough water for household and livestock needs; however, most do not. Some rural water lines have been built. Many ponds have been built to water livestock.

In the unglaciated Knobstone area of the county, wells generally do not produce enough water for household needs. Many ponds have been built to provide for household and livestock water. Rural water lines have been built in places.

## Relief and Drainage

The relief of Bartholomew County ranges from nearly flat to very steep. In the eastern part of the county the upland topography is mainly nearly level to gently sloping, except for the areas near draws. The relief in the area is formed by the dendritic stream pattern that is entrenched into the till plain. The deeper entrenchments are near the streams. The terrace areas are mainly nearly level except for the steep breaks between the terrace and bottom lands. In the western part of the county, in areas overlying Illinoian drift, the relief is nearly level to moderately sloping, except near the entrenched drainageways. The relief in this area is mainly the result of the entrenchments of the natural drainage systems into the till. In the far western part of the county the relief ranges from steep on the hillsides to gently sloping on tops of ridges. These unglaciated hills are the most prominent features on the landscape. The east-facing prominent hills are part of the Knobstone escarpment.

The drainage system of Bartholomew County formed mainly during periods of glaciation. The valleys of the Driftwood River, Flatrock River, East Fork of the White River, and Clifty Creek formed by the melt water of the Wisconsin glacier. All of the streams and tributaries in the county drain into the

East Fork of the White River except for Salt Creek, which flows west into Brown County.

## Climate [6]

Batholomew County has an invigorating climate because of the interplay of both tropical and polar air masses in the area throughout the year. Pleasant and cloudless days are interspersed with rainy days, and this results in frequent variations of the weather. In summer months, when moisture utilization is high, a month of below average rainfall can affect lawns, pastures, and crops. Table 13 provides temperature and precipitation data compiled from records at Columbus City Sewage Plant. Probability data for the occurrence of specified temperature in spring and in fall are given in table 14.

Passing fronts and associated centers of low and high air pressure cause weather changes every few days. In general, high pressure areas cause lower temperatures, lower humidity, and sunny days. An approaching low pressure area causes higher temperatures, higher southerly winds, higher humidity, and rain or showers. Frontal activity is greatest in the spring and least later in summer and early in fall.

Precipitation is rather evenly distributed throughout the year. Spring and early summer rains generally exceed fall precipitation. The spring rains generally are reliable and insure a good supply of soil moisture in summer when evaporation losses exceed rainfall. A

[6] By LAWRENCE A. SCHAAL, climatologist for Indiana, National Weather Service, U.S. Department of Commerce.

TABLE 13.—*Temperature and precipitation data*

[Data from Columbus, City Sewage Plant]

| Month | Temperature | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Average monthly maximum | Average monthly minimum | Average monthly total | One year in 10 will have— | | Days having snow cover of 1 inch or more | Average depth of snow on days with snow cover of 1 inch or more |
| | | | | | | Less than— | More than— | | |
| | °F | °F | °F | °F | *Inches* | *Inches* | *Inches* | | *Inches* |
| January | 40 | 21 | 62 | −3 | 3.4 | 0.9 | 8.5 | 4 | 2 |
| February | 43 | 23 | 64 | 2 | 2.7 | .9 | 4.5 | 3 | 3 |
| March | 53 | 31 | 76 | 13 | 4.0 | 1.2 | 7.7 | 2 | 3 |
| April | 65 | 41 | 84 | 25 | 4.2 | 1.7 | 7.1 | 0 | 0 |
| May | 76 | 51 | 90 | 35 | 4.3 | 1.6 | 7.7 | 0 | 0 |
| June | 84 | 60 | 94 | 47 | 3.9 | 1.5 | 6.6 | 0 | 0 |
| July | 88 | 64 | 96 | 52 | 3.7 | 1.7 | 6.4 | 0 | 0 |
| August | 87 | 61 | 96 | 49 | 3.3 | 1.8 | 5.4 | 0 | 0 |
| September | 81 | 53 | 94 | 38 | 2.9 | .7 | 6.6 | 0 | 0 |
| October | 70 | 42 | 86 | 26 | 2.4 | .6 | 4.7 | 0 | 0 |
| November | 54 | 32 | 75 | 15 | 3.2 | 1.2 | 6.1 | 1 | 3 |
| December | 42 | 24 | 63 | 4 | 2.9 | 1.1 | 6.0 | 2 | 2 |
| Year | 65 | 42 | [1] 99 | [2] −6 | 40.9 | 32.2 | 54.5 | 12 | 3 |

[1] Average annual maximum temperature.

[2] Average annual minimum temperature.

TABLE 14.—*Probability of last freezing temperature in spring and first in fall*

[Data from Columbus, City Sewage Plant]

| Probability | Dates for given probability and temperature of— | | | | |
|---|---|---|---|---|---|
| | 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 25 | April 7 | April 18 | May 2 | May 12 |
| 2 years in 10 later than | March 18 | April 1 | April 12 | April 27 | May 8 |
| 5 years in 10 later than | March 4 | March 19 | March 29 | April 16 | April 27 |
| Fall: | | | | | |
| 1 year in 10 earlier than | November 8 | October 31 | October 21 | October 7 | September 25 |
| 2 years in 10 earlier than | November 15 | November 5 | October 25 | October 12 | September 30 |
| 5 years in 10 earlier than | November 27 | November 16 | November 4 | October 25 | October 10 |

severe drought has never been experienced in the county, but one or two dry periods generally occur every summer.

The probability of extreme rainfall in a few hours is as follows:

| Frequency in 100 years | Rain in 1 hour | 6 hours | 12 hours |
|---|---|---|---|
| 4 | 2.6 | 4.0 | 4.4 |
| 10 | 2.2 | 3.2 | 3.7 |
| 20 | 1.9 | 2.9 | 3.4 |

Snowfall varies greatly from winter to winter. The average total seasonal fall is 11 inches, but in a single month as much as 12 inches has fallen, and as much as 8 inches has fallen in a single day.

On sunny days relative humidity varies from about 40 percent in the early afternoon to about 90 percent at sunrise. In a typical day, relative humidity rises and falls much as temperature does, but the highest humidity generally occurs with minimum temperature and the lowest humidity occurs with maximum temperature. The dry air behind cold fronts lowers humidity and the moist warm southerly winds cause higher humidity.

The average number of days a year on which one-tenth inch or more precipitation falls is 75, of which four occur in September, and nine in May.

The average number of days a year when the air temperature exceeds 90° F is 42, 14 of which occur in July. The temperature generally is 0° or colder four days each year.

The prevailing winds are southwesterly; however, in one or two of the winter months, the prevailing winds are northwesterly. Damaging winds have three sources. In order of diminishing area coverage but increasing intensity, they are low pressure centers, thunderstorms, and tornadoes. Only 6 tornadoes have been reported in the county since 1916. The number of days that have lightning or thunder average about 44 a year. Very few of these storms are of sufficient intensity to injure people or property.

October is the sunniest month, in which only 11 days are cloudy, whereas 12 are clear. In the winter months, 6 days a month generally are clear but 19 are cloudy. Another measure of sunshine is the percent of maximum possible sunshine. This ranges from 40 percent in January to 70 percent in August.

Additional information is available in "Local Climatological Data—Indianapolis" and "Local Climatological Data—Louisville," National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and in "Climatological Summary—Columbus, Indiana," Climatography of the United States, No. 20–12, by Lawrence A. Schaal, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

## Industries, Transportation, and Markets

Columbus, the county seat of Bartholomew County, has many different industries. Some of the smaller companies produce component parts or provide services to the larger industries. Columbus is located on the well-drained Fox and Nineveh soils that formed in loamy outwash overlying gravel and sand, and which provide good sites for industrial development. The gravel deposits provide a good source of gravel and sand. Several gravel pits are in operation. In places the depth to limestone is fairly shallow and in these areas limestone is quarried.

Bartholomew County is served by several state highways as well as U.S. Highway 31 and Interstate Highway 65. Columbus is located on Interstate Highway 65 between Indianapolis, Indiana, and Louisville, Kentucky. The Penn Central Railroad that runs from Indianapolis, Indiana, to Louisville, Kentucky, also serves Columbus. Penn Central Railroad also runs between Columbus and Madison, Indiana, which is on the Ohio River.

Grain markets are mainly local elevators in the county. From these elevators grain is shipped by truck or railroad to larger terminals. Kentucky distilleries buy corn in this area.

The major livestock market is Louisville, Kentucky, for the southern part of Bartholomew County; Indianapolis for the northern part; and Cincinnati for the eastern part.

## Farming

Farming is one of the major businesses in Bartholomew County. In the eastern part of the county, most land is used to grow grain and to feed livestock (fig. 24). In the western part of the county most farms are of the general type. There is more grass in this area. Some tree farms are in the steeper areas of the western part of the county.

According to the U.S. Census of Agriculture, in 1969 there were 183,649 acres or 71.1 percent of the land in farms. Farms numbered 1,027 in 1969, a reduction of 2 since 1964. Full-farm owners have increased from 583 in 1964 to 616 in 1969. Tenant farmers numbered 149 in 1964 and 112 in 1969 (*15*).

The major crop is corn, of which 48,409 acres were grown in 1969. Soybeans were grown on 27,674 acres and wheat was grown on 11,970 acres. In recent years the acreage planted to grain sorghum has increased. Most planting is on the terrace and sandier bottom lands.

Melons are grown on some sandy soils. Pasture plants and hay are the main crops on the more sloping areas or areas that are too steep to be cultivated. In 1969, 17,001 acres were in pasture, 7,025 acres were in hay, and 20,413 acres were in woodland (*15*).

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*Figure 24.*—**Typical farmstead in an area of Fincastle and Brookston soils. Fincastle silt loam, 2 to 4 percent slopes, eroded, is in the foreground.**

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## *Glossary*

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alkali soil.** Generally, a highly alkaline soil. Specifically an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

**Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern.

**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.

**Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

**Catena.** A sequence, or "chain," of soils on a landscape, developed from one kind of parent material but having different characteristics because of differences in relief and drainage.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard and brittle; little affected by moisting.

**Contour.** An inaginary line connecting points of equal elevation on the surface of the soil.

**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.

**Contour stripcropping.** Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Cover crop.** A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

**Deciduous.** Refers to plants that lose their leaves at maturity, or at certain seasons. Contrasts with evergreen.

**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.

**Drainage class** (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

*Excessively drained* soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

*Somewhat excessively drained* soils are also very permeable and are free from mottling throughout their profile.

*Well-drained* soils are nearly free from mottling and are commonly of intermediate texture.

*Moderately well drained* soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

*Somewhat poorly drained* soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

*Poorly drained* soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

*Very poorly drained soils* are wet nearly all the time. They have a dark-gray or black surface and are gray or light gray, with or without mottling, in the deeper parts of the profile.

**Drift** (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift materials deposited by glaciers and by streams and lakes associated with them.

**Effluent.** The outflow of water from a subterranean storage space. The term is also used in reference to gases and other liquids.

**Eluviation.** The movement of material from one place to another within the soil, in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial.

**Erosion.** The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

**Fertility, soil.** The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

**First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Fragipan.** A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

**Gleization.** The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the lower horizons, as a result of waterlogging with poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil.

**Gravelly soil material.** From 15 to 50 per cent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

**Green manure** (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. 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.

**Immature soil.** A soil lacking clearly defined horizons because the soil-forming forces have acted on the parent material only a relatively short time since it was deposited or exposed.

**Internal soil drainage.** The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

**Leaching.** The removal of soluble materials from soils or other material by percolating water.

**Lime.** Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soil. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.

**Loess.** Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

**Mature soil.** Any soil with well-developed soil horizons having characteristics produced by the natural processes of soil formation and in near equilibrium with its present environment.

**Mechanical analysis** (soils). The percentage of the various sizes of individual mineral particles, or separates, in the soil. Also, a laboratory method of determining soil texture.

**Mineral soil.** Soil composed mainly of inorganic (mineral) material and low in content of organic material. Its bulk density is greater than that of organic soil.

**Moraine** (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are these: Terminal, lateral, medial, ground.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

**Mottling, soil.** Irregular marking 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.

**Nutrient, plant.** Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil and carbon, hydrogen, and oxygen obtained largely from the air and water, are plant nutrients.

**Parent material.** Disintegrated and partly weathered rock from which soil has formed.

**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.*

**pH value.** A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

**Phase, soil.** A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil series, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

**Plastic** (soil consistence). Capable of being deformed without being broken.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plow layer.** The soil ordinarily moved in tillage; equivalent to surface soil.

**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* |
|---|---|
| Extremely acid | Below 4.5 |
| Very strongly acid | 4.5 to 5.0 |
| Strongly acid | 5.1 to 5.5 |
| Medium acid | 5.6 to 6.0 |
| Slightly acid | 6.1 to 6.5 |
| Neutral | 6.6 to 7.3 |
| Mildly alkaline | 7.4 to 7.8 |
| Moderately alkaline | 7.9 to 8.4 |
| Strongly alkaline | 8.5 to 9.0 |
| Very strongly alkaline | 9.1 and higher |

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Rill.** A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

**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 groundwater 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.

**Second bottom.** The first terrace above the normal flood plain of a stream.

**Sedimentary rock.** A rock composed of particles deposited from suspension in water. The chief sedimentary rocks are conglomerate, from gravel; sandstone, from sand; shale, from clay; and limestone, from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sands have been consolidated into sandstone.

**Series, soil.** A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

**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.

**Stripcropping.** Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

**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 grain* (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 layer.** A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon, has no depth limit.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

**Terrace** (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Tilth, soil.** The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Upland** (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

**Water table.** The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

**Weathering.** All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

**Wilting point** (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

## 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. The suitability of the soils for use as cropland is discussed in the soil descriptions. The capability classification is discussed on pages 67 to 76. For facts about woodland, turn to the section beginning on page 76. For facts about wildlife, turn to the section beginning on page 79. Other information is given in tables as follows:

Acreage and extent, table 1, page 15.
Predicted yields, table 2, page 77.
Engineering uses of soils, tables 6, 7, and 8, pages 96 through 131.

Limitations for town and country planning, table 9, page 134.
Tree and shrub plantings, table 10, page 156.

| Map symbol | Mapping unit | Page | Capability unit | | Tree and shrub group | Woodland group |
|---|---|---|---|---|---|---|
| | | | Symbol | Page | Number | Symbol |
| AvA | Avonburg silt loam, 0 to 2 percent slopes | 16 | IIw-3 | 70 | 2 | 3w5 |
| AvB2 | Avonburg silt loam, 2 to 4 percent slopes, eroded | 16 | IIw-3 | 70 | 2 | 3w5 |
| Ay | Ayrshire fine sandy loam | 17 | IIw-2 | 70 | 2 | 3w5 |
| Ba | Bartle silt loam | 18 | IIw-3 | 70 | 2 | 3w5 |
| BeF | Berks and Weikert soils, 25 to 50 percent slopes | 18 | VIIe-2 | 75 | 5 | 3rl2 |
| BmC | Bloomfield loamy fine sand, 6 to 12 percent slopes | 19 | IIIe-12 | 73 | 4 | 2s15 |
| Bo | Bonnie silt loam | 20 | IIIw-10 | 74 | 1 | 2wll |
| Br | Brookston silty clay loam | 21 | IIw-1 | 70 | 1 | 2wll |
| Bu | Burnside loam | 22 | IIs-7 | 71 | 4 | 1o8 |
| Ca | Camden silt loam, 0 to 2 percent slopes | 23 | I-1 | 68 | 3 | 1o1 |
| CeB2 | Celina silt loam, 2 to 6 percent slopes, eroded | 24 | IIe-1 | 69 | 3 | 1o1 |
| CnB2 | Cincinnati silt loam, 2 to 6 percent slopes, eroded | 25 | IIe-7 | 69 | 2 | 3d9 |
| CnC2 | Cincinnati silt loam, 6 to 12 percent slopes, eroded | 25 | IIIe-7 | 72 | 2 | 3d9 |
| CnC3 | Cincinnati silt loam, 6 to 12 percent slopes, severely eroded | 25 | IVe-7 | 74 | 2 | 3d9 |
| CnD2 | Cincinnati silt loam, 12 to 18 percent slopes, eroded | 26 | IVe-7 | 74 | 2 | 3d9 |
| CnD3 | Cincinnati silt loam, 12 to 18 percent slopes, severely eroded | 26 | VIe-1 | 75 | 2 | 3d9 |
| Cr | Clermont silt loam | 27 | IIIw-12 | 74 | 1 | 2wll |
| CyF | Corydon stony silt loam, 25 to 40 percent slopes | 27 | VIIe-2 | 75 | 5 | 3d7 |
| CzA | Crosby silt loam, 0 to 2 percent slopes | 28 | IIw-2 | 70 | 2 | 3w5 |
| CzB2 | Crosby silt loam, 2 to 4 percent slopes, eroded | 28 | IIe-12 | 70 | 2 | 3w5 |
| Du | Dubois silt loam | 29 | IIw-13 | 70 | 2 | 3w5 |
| Ee | Eel silt loam | 30 | I-2 | 68 | 3 | 1o8 |
| FcA | Fincastle silt loam, 0 to 2 percent slopes | 31 | IIw-2 | 70 | 2 | 3w5 |
| FcB2 | Fincastle silt loam, 2 to 4 percent slopes, eroded | 31 | IIe-12 | 70 | 2 | 3w5 |
| FoA | Fox loam, 0 to 2 percent slopes | 32 | IIs-1 | 71 | 4 | 1o1 |
| FoB2 | Fox loam, 2 to 6 percent slopes, eroded | 33 | IIe-9 | 69 | 4 | 1o1 |
| FxC3 | Fox complex, 6 to 12 percent slopes, severely eroded | 33 | IVe-9 | 75 | 4 | 1o1 |
| Ge | Genesee loam, | 33 | I-2 | 68 | 3 | 1o8 |
| GpD2 | Gilpin silt loam, 12 to 18 percent slopes, eroded | 34 | VIe-1 | 75 | 5 | 3o10 |
| GpD3 | Gilpin silt loam, 12 to 18 percent slopes, severely eroded | 34 | VIIe-1 | 75 | 5 | 3o10 |
| GpE | Gilpin silt loam, 18 to 25 percent slopes | 34 | VIe-1 | 75 | 5 | 3o10 |
| Gu | Gullied land | 35 | VIIe-1 | 75 | 5 | 4r3 |
| Ha | Haymond silt loam | 35 | I-2 | 68 | 3 | 1o8 |
| HeF | Hennepin loam, 18 to 40 percent slopes | 36 | VIIe-1 | 75 | 5 | 1r2 |
| Hh | Henshaw silt loam | 36 | IIw-2 | 70 | 2 | 3w5 |
| HkC2 | Hickory silt loam, 6 to 12 percent slopes, eroded | 37 | IIIe-1 | 71 | 3 | 1r2 |
| HkD2 | Hickory silt loam, 12 to 18 percent slopes, eroded | 37 | IVe-1 | 74 | 3 | 1r2 |
| HkE2 | Hickory silt loam, 18 to 25 percent slopes, eroded | 37 | VIe-1 | 75 | 3 | 1r2 |
| HkF | Hickory silt loam, 25 to 50 percent slopes | 38 | VIIe-1 | 75 | 3 | 1r2 |
| HoC3 | Hickory silty clay loam, 6 to 12 percent slopes, severely eroded | 38 | IVe-1 | 74 | 3 | 1r2 |
| HoD3 | Hickory silty clay loam, 12 to 18 percent slopes, severely eroded | 39 | VIe-1 | 75 | 3 | 1r2 |
| La | Landes gravelly sandy loam, gravelly substratum | 39 | IIs-7 | 71 | 4 | o23 |
| MaA | Martinsville sandy loam, 0 to 2 percent slopes | 40 | I-1 | 68 | 3 | 1o1 |

GUIDE TO MAPPING UNITS--Continued

| Map symbol | Mapping unit | Page | Capability unit | | Tree and shrub group | Woodland group |
|---|---|---|---|---|---|---|
| | | | Symbol | Page | Number | Symbol |
| MbA | Martinsville loam, 0 to 2 percent slopes | 40 | I-1 | 68 | 3 | 1o1 |
| MbB2 | Martinsville loam, 2 to 6 percent slopes, eroded | 41 | IIe-1 | 69 | 3 | 1o1 |
| Mc | McGary silt loam | 41 | IIIw-6 | 73 | 2 | 3w5 |
| Md | Medway silty clay loam | 42 | I-2 | 68 | 3 | o23 |
| MmB2 | Miami silt loam, 2 to 6 percent slopes, eroded | 42 | IIe-1 | 69 | 3 | 1o1 |
| MmC2 | Miami silt loam, 6 to 12 percent slopes, eroded | 43 | IIIe-1 | 71 | 3 | 1o1 |
| MmD2 | Miami silt loam, 12 to 18 percent slopes, eroded | 43 | IVe-1 | 74 | 3 | 1o1 |
| MoB3 | Miami clay loam, 2 to 6 percent slopes, severely eroded | 44 | IIIe-1 | 71 | 3 | 1o1 |
| MoC3 | Miami clay loam, 6 to 12 percent slopes, severely eroded | 44 | IVe-1 | 74 | 3 | 1o1 |
| MoD3 | Miami clay loam, 12 to 18 percent slopes, severely eroded | 44 | VIe-1 | 75 | 3 | 1o1 |
| MtA | Milton silt loam, 0 to 2 percent slopes | 45 | IIs-4 | 71 | 3 | 3o10 |
| MtB2 | Milton silt loam, 2 to 6 percent slopes, eroded | 45 | IIIe-8 | 72 | 3 | 3o10 |
| MtC2 | Milton silt loam, 6 to 12 percent slopes, eroded | 45 | IVe-8 | 75 | 3 | 3o10 |
| NgA | Nineveh loam, 0 to 2 percent slopes | 46 | IIs-1 | 71 | 4 | 1o1 |
| NgB2 | Nineveh loam, 2 to 6 percent slopes, eroded | 46 | IIe-9 | 69 | 4 | 1o1 |
| NnA | Nineveh gravelly loam, 0 to 2 percent slopes | 46 | IIs-1 | 71 | 4 | 1r2 |
| OcA | Ockley loam, 0 to 2 percent slopes | 47 | I-1 | 68 | 3 | 1o1 |
| OtB2 | Otwell silt loam, 2 to 6 percent slopes, eroded | 48 | IIe-7 | 69 | 2 | 3d9 |
| OtC2 | Otwell silt loam, 6 to 12 percent slopes, eroded | 48 | IIIe-7 | 72 | 2 | 3d9 |
| OtC3 | Otwell silt loam, 6 to 12 percent slopes, severely eroded | 48 | IVe-7 | 74 | 2 | 3d9 |
| OtD2 | Otwell silt loam, 12 to 18 percent slopes, eroded | 48 | IVe-7 | 74 | 2 | 3d9 |
| Pe | Peoga silt loam | 49 | IIIw-12 | 74 | 1 | 2w11 |
| PrB | Princeton fine sandy loam, 2 to 6 percent slopes | 50 | IIe-11 | 69 | 3 | 1r2 |
| PrC2 | Princeton fine sandy loam, 6 to 12 percent slopes, eroded | 50 | IIIe-13 | 73 | 3 | 1r2 |
| RaC2 | Rarden silt loam, 6 to 12 percent slopes, eroded | 51 | IVe-8 | 75 | 5 | 5d22 |
| RaD2 | Rarden silt loam, 12 to 18 percent slopes, eroded | 51 | VIe-1 | 75 | 5 | 5d22 |
| ReD3 | Rarden silty clay loam, 12 to 18 percent slopes, severely eroded | 51 | VIIe-1 | 75 | 5 | 5d22 |
| Rf | Rensselaer loam | 52 | IIw-1 | 70 | 1 | 2w11 |
| Rg | Rensselaer clay loam | 52 | IIw-1 | 70 | 1 | 2w11 |
| Rh | Riverwash | 52 | VIIIs-1 | 76 | 5 | 4r16 |
| RkF | Rockcastle silty clay loam, 18 to 35 percent slopes | 53 | VIIe-2 | 75 | 5 | 5d22 |
| RnF | Rodman gravelly loam, 25 to 45 percent slopes | 53 | VIIs-1 | 76 | 5 | 4f19 |
| Ro | Ross silt loam | 54 | I-2 | 68 | 3 | o23 |
| Rp | Ross silty clay loam | 54 | I-2 | 68 | 3 | o23 |
| RsB2 | Rossmoyne silt loam, 2 to 6 percent slopes, eroded | 55 | IIe-7 | 69 | 2 | 3d9 |
| RuB2 | Russell silt loam, 2 to 6 percent slopes, eroded | 56 | IIe-1 | 69 | 3 | 1o1 |
| Sa | Saranac silt loam, overwash | 56 | IIIw-9 | 74 | 1 | 2w11 |
| Sc | Saranac silty clay loam | 57 | IIIw-9 | 74 | 1 | 2w11 |
| Sh | Shoals silt loam | 57 | IIw-7 | 70 | 1 | 2w13 |
| Sm | Sleeth loam | 58 | IIw-2 | 70 | 2 | 3w5 |
| St | Steff silt loam | 59 | I-2 | 68 | 3 | 1o8 |
| Sx | Stendal silt loam | 59 | IIw-7 | 70 | 1 | 2w13 |
| Sz | Stonelick sandy loam | 60 | IIs-7 | 71 | 4 | 1o8 |
| Wa | Wakeland silt loam | 60 | IIw-7 | 70 | 1 | 2w13 |
| Wc | Westland clay loam | 61 | IIw-1 | 70 | 1 | 2w11 |
| Wh | Whitaker loam | 62 | IIw-2 | 70 | 2 | 3w5 |
| Wu | Wilbur silt loam | 63 | I-2 | 68 | 3 | 1o8 |
| XeB2 | Xenia silt loam, 2 to 6 percent slopes, eroded | 64 | IIe-1 | 69 | 3 | 1o1 |
| ZaB2 | Zanesville silt loam, 2 to 6 percent slopes, eroded | 65 | IIe-7 | 69 | 2 | 3d9 |
| ZaC2 | Zanesville silt loam, 6 to 12 percent slopes, eroded | 65 | IIIe-7 | 72 | 2 | 3d9 |
| ZaC3 | Zanesville silt loam, 6 to 12 percent slopes, severely eroded | 66 | IVe-7 | 74 | 2 | 3d9 |
| Zp | Zipp silty clay loam | 67 | IIIw-2 | 73 | 1 | 2w11 |

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