SOIL SURVEY OF

Boone County, Indiana

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

Issued February 1975

Major fieldwork for this soil survey was done in the period 1966–70. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. 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 Boone County Soil and Water Conservation District. Financial assistance was made available by the Board of Commissioners of Boone County.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification and the tree and shrub suitability classification of each. It also shows the page where each soil is described and the page for the capability unit 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 the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

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

Game managers, sportsmen, and others can find general information about the common kinds of wildlife and their habitat needs in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for recreation areas in the section "Recreation."

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

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

Newcomers in Boone 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 sections "Climate" and "Additional Facts About the County."

Cover: **Young soybean plants on Ragsdale silty clay loam. Soybeans are one of the main crops grown in Boone County.**

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

BOONE COUNTY, in the central part of Indiana (fig. 1), has an area of 273,280 acres, or 427 square miles. Lebanon is the county seat.

Farming, mainly cash grain and livestock, is the main enterprise in the county. Corn, soybeans, and wheat are the main crops. Much of the county has poor natural drainage and needs extensive systems of artificial drainage.

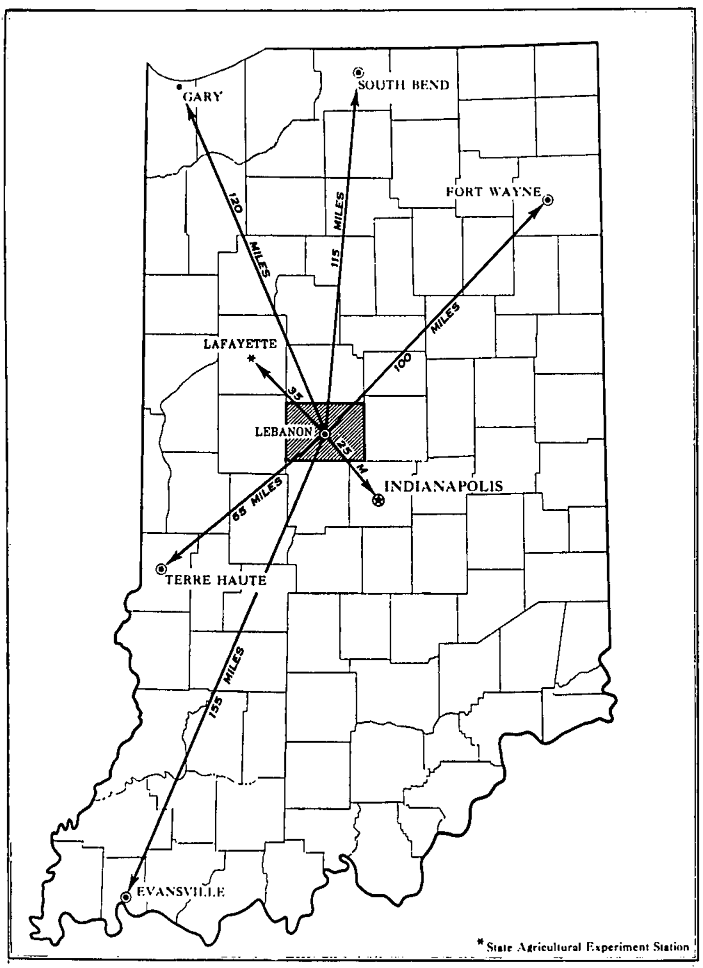

Figure 1.—Location of Boone County in Indiana.

In the past few years, housing has been developing extensively in the rural areas of the county, especially around Zionsville and Lebanon. Industry in Lebanon and Indianapolis, in Marion County, provides employment for a large number of people who reside in Boone County.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Boone 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 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 soil 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. Fincastle and Fox, 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 man's use of the soils. 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, Fox silt loam, 2 to 6 percent slopes, eroded, is one of three phases within the Fox series.

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

The areas delineated 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. Only one such kind of mapping unit, the soil complex, is shown on the soil map of Boone County.

A soil complex consists of areas of two or more soils, so intermingled 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 two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Crosby-Miami silt loams, 2 to 6 percent slopes, eroded, is an example of a soil complex.

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

Soil scientists observed how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or bench mark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They 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 current methods of use and management.

General Soil Map

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

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed 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 texture described in the legend of each association is that of the surface layer of the dominant soils. Of the two dominant soils in association 1, for example, one has a surface layer of silty clay loam (moderately fine texture) and the other a surface layer of silt loam (medium texture).

The six soil associations in Boone County are described on the following pages.

1. Ragsdale-Fincastle Association

Deep, very poorly drained and somewhat poorly drained, moderately fine textured and medium-textured, nearly level soils formed in silts and silt-covered glacial till on uplands

Association 1 consists of nearly level and depressional soils that formed in silty material or in loess and underlying glacial till (fig. 2). It makes up about 20 percent of the land area of Boone County. About 50 percent of the association consists of Ragsdale soils and about 35 percent of Fincastle soils. The remaining 15 percent is minor soils.

Ragsdale soils are nearly level or depressional and are very poorly drained. They have a black, moderately fine textured surface layer and a gray, mottled, moderately fine textured subsoil. Depth to the underlying silt loam ranges from 30 to 52 inches.

Fincastle soils are nearly level, at slightly higher elevations than Ragsdale soils, and are somewhat poorly drained. They have a dark grayish-brown, medium-textured surface layer and a grayish-brown, mottled, moderately fine textured subsoil. Depth to the underlying, medium-textured glacial till ranges from 36 to 70 inches.

The rest of the association is made up mainly of well-drained Miami soils and somewhat poorly drained Reesville soils.

Permeability is slow in the soils of this association. The water table is seasonally high, and runoff is slow, very slow, or ponded.

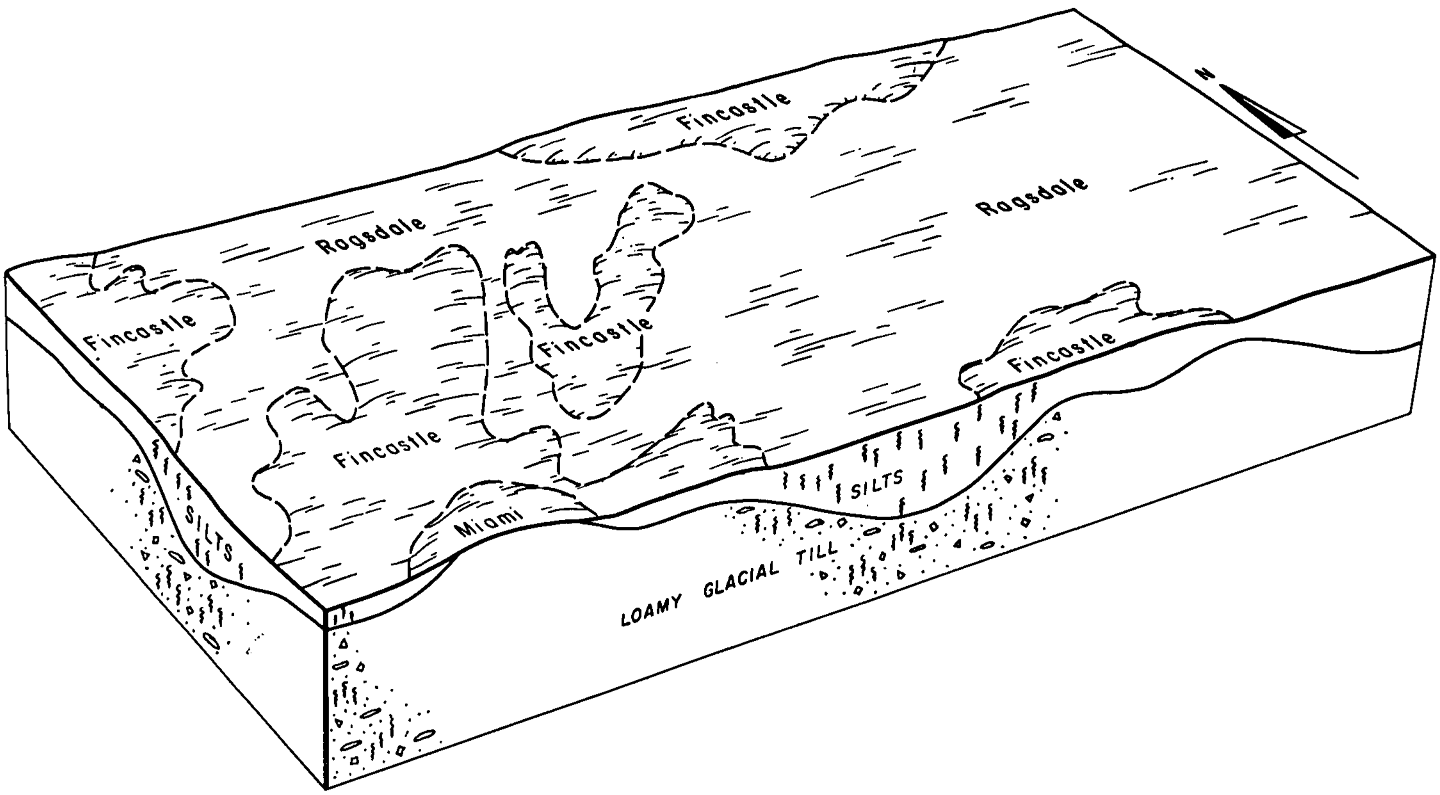

Figure 2.—**General pattern of soils, topography, and underlying material in the Ragsdale-Fincastle association.**

The soils are suited to crops and pasture. Wetness is the main limitation that affects the use of these soils for crops. If artificially drained and properly managed, they can be used intensively for row crops. Corn, soybeans, small grain, and hay are the main crops. A few small tracts are wooded.

For nonfarm uses some limitations must be overcome. For example, the limitation for septic tank systems is severe.

2. Brookston-Crosby Association

Deep, very poorly drained and somewhat poorly drained, moderately fine textured and medium-textured, nearly level soils formed in glacial till on uplands

Association 2 consists of nearly level and depressional soils that formed in glacial till (fig 3). This association makes up 56 percent of the land area of Boone County and is the largest association in the county. About 45 percent of the association consists of Brookston soils and about 40 percent of Crosby soils. The remaining 15 percent is minor soils.

Brookston soils are nearly level or depressional and are very poorly drained. They have a black, moderately fine textured surface layer and a gray, mottled, moderately fine textured subsoil. Depth to the underlying, medium-textured glacial till ranges from 30 to 50 inches.

Crosby soils are nearly level and are somewhat poorly drained. They are at slightly higher elevations than Brookston soils. They have a dark grayish-brown, medium-textured surface layer and a grayish-brown, mottled, moderately fine textured subsoil. Depth to the underlying, medium-textured glacial till ranges from 24 to 40 inches.

The rest of the association is made up mainly of well-drained Miami soils.

Permeability is slow in the soils of this association. The water table is seasonally high, and runoff is slow, very slow, or ponded.

The soils are suited to crops and pasture. Wetness is the main limitation that affects the use of these soils for crops. If artificially drained and properly managed, they can be used intensively for row crops. Corn, soybeans, small grain, and hay are the main crops. A few small tracts are wooded.

For nonfarm uses, some limitations must be overcome. For example, the limitation for septic tank systems is severe.

3. Miami-Crosby Association

Deep, well-drained and somewhat poorly drained, medium-textured and moderately fine textured, nearly level to moderately steep soils formed in glacial till on uplands

Association 3 consists of nearly level to moderately steep soils that formed in glacial till (fig. 4). This association makes up 13 percent of the land area of Boone

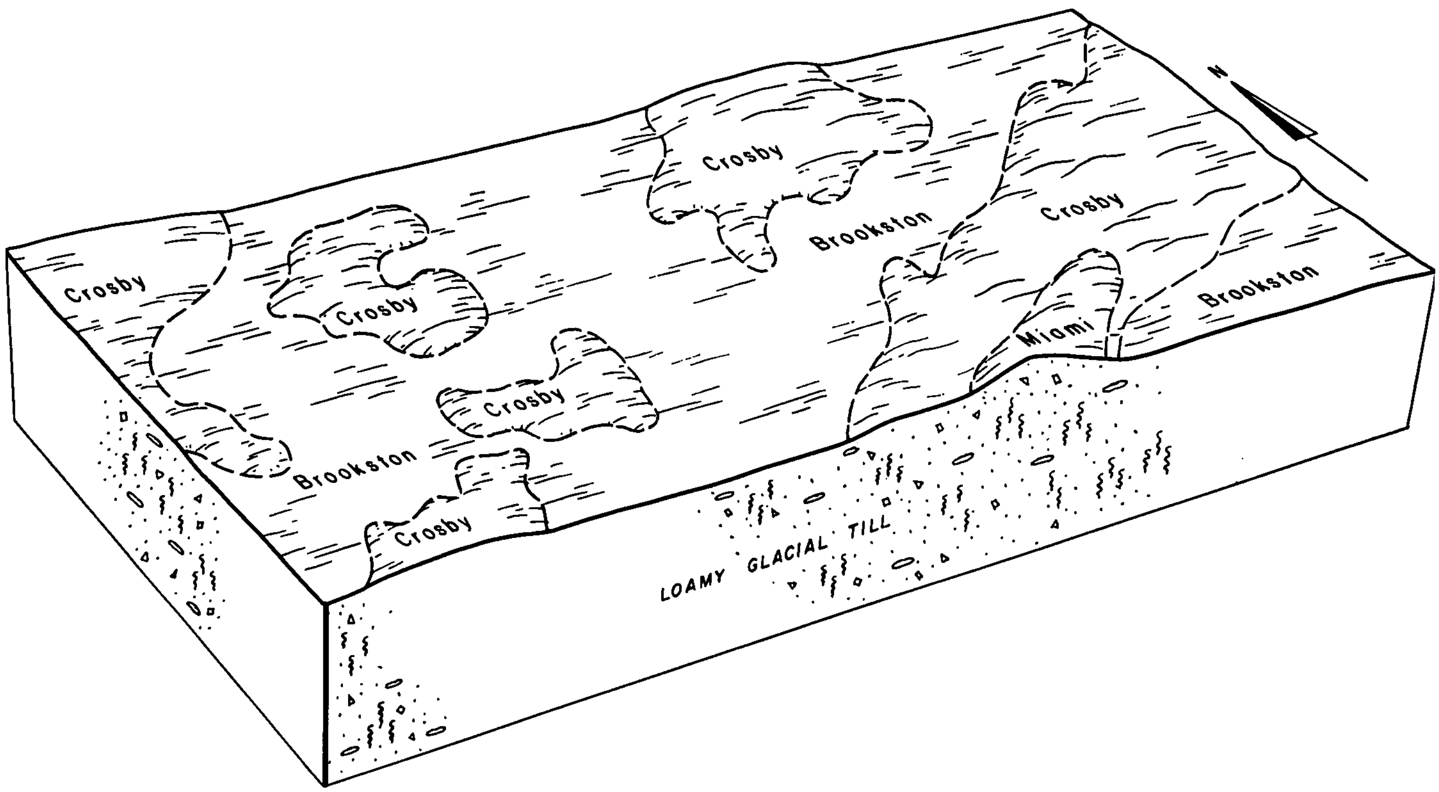

***Figure 3.*—General pattern of soils, topography, and underlying material in the Brookston-Crosby association.**

County. About 75 percent of the association consists of Miami soils and about 15 percent of Crosby soils. The remaining 10 percent is minor soils.

Miami soils are nearly level to moderately steep and are well drained. They are on the sides of natural drainageways and are in areas adjacent to soils on bottom lands. They have a dark grayish-brown, medium-textured surface layer and a brown and dark yellowish-brown, moderately fine textured subsoil. Depth to the underlying, medium-textured glacial till ranges from 24 to 42 inches.

Crosby soils are nearly level and are somewhat poorly drained. They are adjacent to Miami soils. They have a dark grayish-brown, medium-textured surface layer and a grayish-brown, mottled, moderately fine textured subsoil. Depth to the underlying, medium-textured glacial till ranges from 24 to 40 inches.

The rest of the association is made up mainly of very poorly drained Brookston soils and well-drained Hennepin soils. Some small areas of alluvium are also in the association.

Permeability is moderate or slow in the soils of this association. Runoff ranges from slow to very rapid. The water table is seasonally high.

The soils are suited to crops, pasture, and woodland. The hazard of erosion and insufficient moisture are the main limitations that affect the use of these soils for crops. Corn, soybeans, small grain, and hay are the main crops on the nearly level and gently sloping soils. The more sloping soils are suited to pasture and woodland. Many soils in the association are wooded, and these are mainly steeper soils.

For nonfarm uses, some limitations must be overcome. The limitation for septic tank systems is severe on soils that have slopes of more than 12 percent. Soils that have slopes of less than 12 percent have moderate or severe limitations for septic tank systems.

4. Genesee-Shoals Association

Deep, well-drained and somewhat poorly drained, medium-textured, nearly level soils formed in alluvial deposits on bottom lands

Association 4 consists of nearly level soils that are subject to flooding (fig. 5). This association makes up about 4 percent of the land area of Boone County. About 60 percent of the association consists of Genesee soils and about 30 percent of Shoals soils. The remaining 10 percent is minor soils.

Genesee soils are well drained. They are adjacent to streams. They have a dark-brown, medium-textured surface layer and a brown, medium-textured subsoil. Depth to the underlying medium-textured alluvial material ranges from 30 to 40 inches.

Shoals soils are somewhat poorly drained. They are intermingled with Genesee soils, and are adjacent to sloping uplands and outwash plains. They have a dark grayish-brown, medium-textured surface layer and a grayish-brown, mottled, medium-textured subsoil. Depth to the underlying medium-textured alluvial material ranges from 30 to 40 inches.

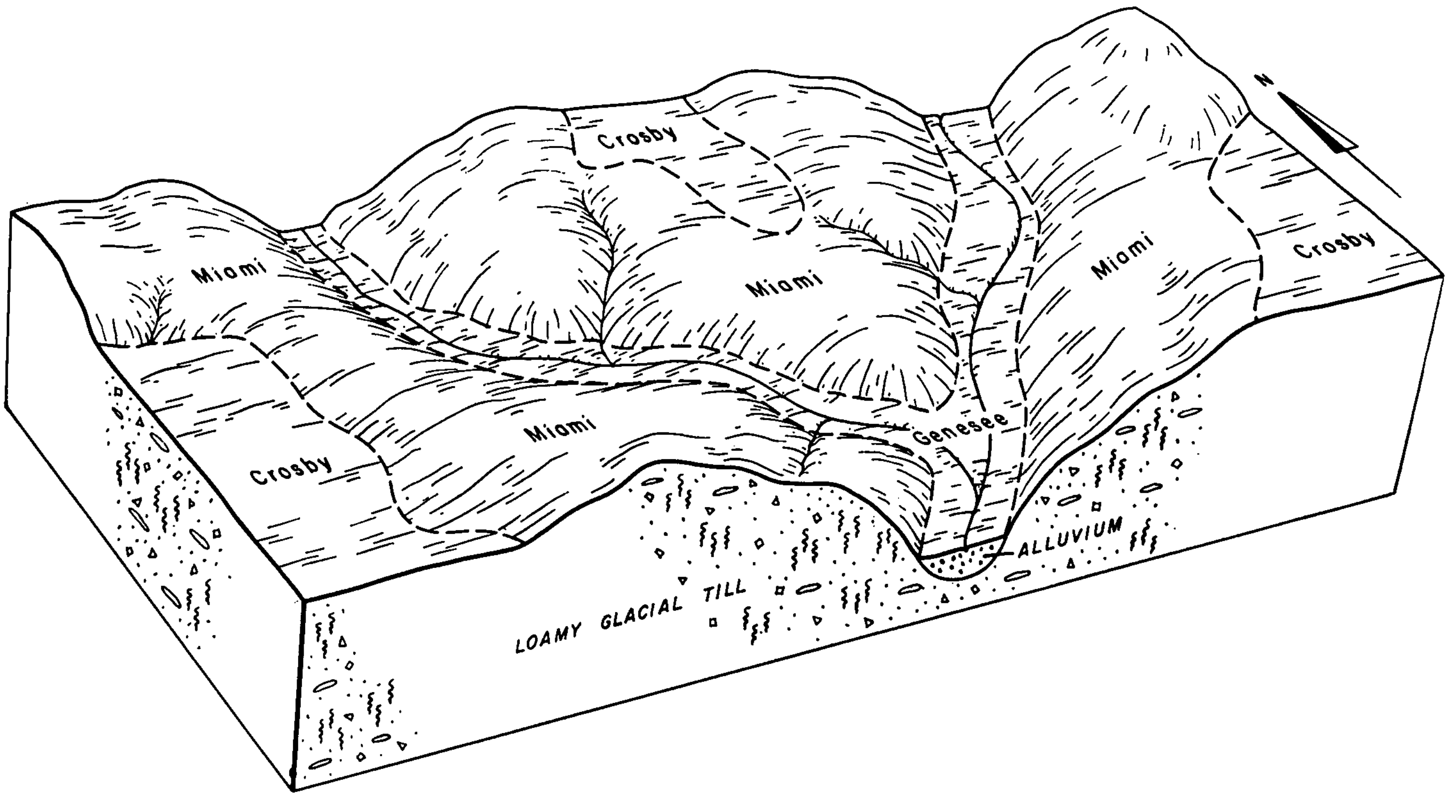

***Figure 4*.—General pattern of soils, topography, and underlying material in the Miami-Crosby association. On the adjacent bottom lands are soils of the Genesee-Shoals association.**

The rest of the association is made up mainly of very poorly drained Sloan soils.

Permeability is moderate in the soils of this association. Runoff is slow. The water table is seasonally high in Shoal soils.

The soils are suited to crops and pasture. Although the hazard of floods affects the use of these soils, limitations of Genesee soils are few for farm uses. Wetness is a limitation in Shoals soils, but it can be controlled by artificial drainage. Under proper management, the soils of this association can be used intensively for row crops. Corn and soybeans are the main crops. Native trees or pasture areas are on many of the dissected bottom lands adjacent to small, meandering streams.

For nonfarm uses the flood hazard is a severe limitation.

5. Ockley-Fox Association

Deep and moderately deep over sand and gravel, well-drained, medium-textured, nearly level to moderately sloping soils formed in glacial outwash material on outwash plains

Association 5 consists of nearly level to moderately sloping, well-drained soils that formed in glacial outwash (fig. 6). It makes up about 2 percent of the land area of Boone County. About 50 percent of the association consists of Ockley soils and about 20 percent of Fox soils. The remaining 30 percent is minor soils.

Ockley soils are nearly level and gently sloping. They have a dark-brown, medium-textured surface layer and a dark-brown and reddish-brown, moderately fine textured subsoil. Depth to the underlying sand and gravel ranges from 42 to 60 inches.

Fox soils are nearly level to moderately sloping. They have a dark grayish-brown, medium-textured surface layer and a dark-brown and dark yellowish-brown, moderately fine textured subsoil. Depth to the underlying sand and gravel ranges from 30 to 40 inches.

The rest of the association is made up mainly of somewhat poorly drained Sleeth soils and very poorly drained Westland soils.

Permeability is moderate in the soils of this association. Runoff is medium or slow.

The soils are suited to crops and pasture. The hazard of erosion and insufficient moisture are the main limitations that affect the use of these soils for crops. If properly managed, the nearly level soils can be used intensively for row crops. Corn, soybeans, small grain, and hay are the main crops. Many sloping soils are wooded.

Limitations are few for nonfarm uses. Water in shallow wells close to septic systems is likely to become contaminated because of the underlying loose sand and gravel.

6. Mahalasville-Whitaker Association

Deep, very poorly drained and somewhat poorly drained, moderately fine textured and medium-textured, nearly level soils formed in glacial outwash material on outwash plains

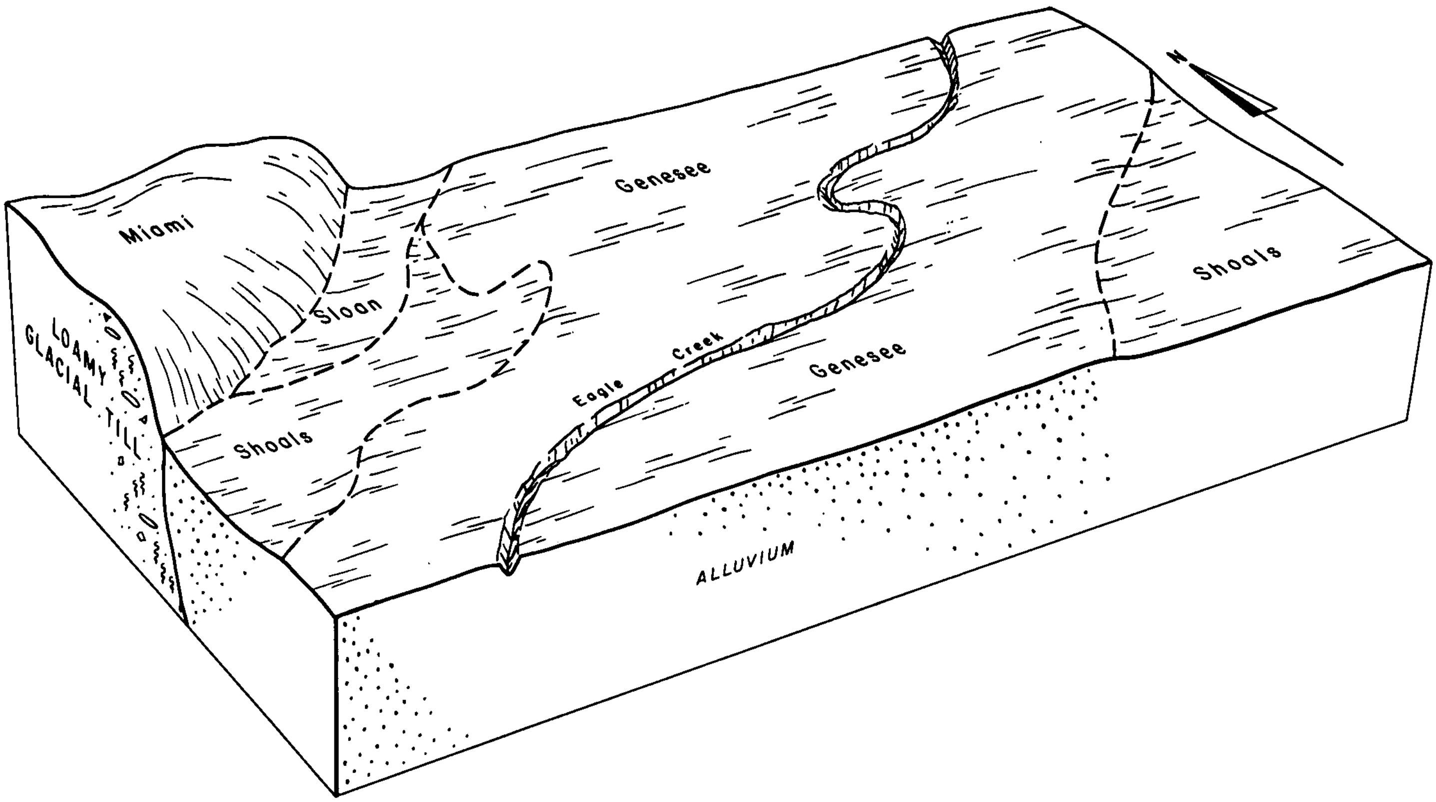

Figure 5.—**General pattern of soils, topography, and underlying material in the Genesee-Shoals association. On the adjacent uplands are soils of the Miami-Crosby association.**

Association 6 consists of nearly level and depressional soils that formed in glacial outwash (fig. 7). This association makes up 5 percent of the land area of Boone County. About 80 percent of this association is Mahalasville soils and about 15 percent is Whitaker soils. The remaining 5 percent is minor soils.

Mahalasville soils are nearly level or depressional and are very poorly drained. They are adjacent to drainage ditches. They have a black, moderately fine textured surface layer and a gray, mottled, moderately fine textured subsoil. Depth to the underlying stratified sand, silt, and clay ranges from 36 to 60 inches.

Whitaker soils are nearly level and are somewhat poorly drained. They are intermingled with Mahalasville soils. They have a dark grayish-brown, medium-textured surface layer and a grayish-brown, mottled, moderately fine textured subsoil. Depth to the underlying stratified sand, silt, and clay ranges from 36 to 60 inches.

The rest of this association is made up mainly of well-drained Ockley soils.

Permeability is slow or moderate in the soils of this association. Runoff is slow, very slow, or ponded. The water table is seasonally high.

The soils are suited to crops. Wetness is the main limitation that affects the use of these soils for crops. If artificially drained and properly managed, they can be used intensively for row crops. Corn, soybeans, small grain, and hay are the main crops.

For nonfarm uses, some limitations must be overcome. For example, the limitation for septic tank systems is severe.

Descriptions of the Soils

In this section the soils of Boone County are described in detail. The procedure is to describe first a soil series and then the mapping units in that soil series. To get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which it belongs.

The description of each soil series contains two descriptions of one representative soil profile: a short one that gives the information most readers want, and a much more detailed one that scientists, engineers, and others can use in making highly technical interpretations. If the profile of an individual soil differs from the representative profile, the differences are stated in the soil description, unless they are differences that are apparent from the soil name. Unless otherwise stated, the colors given in the descriptions are those of a moist soil.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At the end of the description of each mapping unit are listed the capability unit and the tree and shrub suitability group in which the mapping unit has been placed. The page where each capability

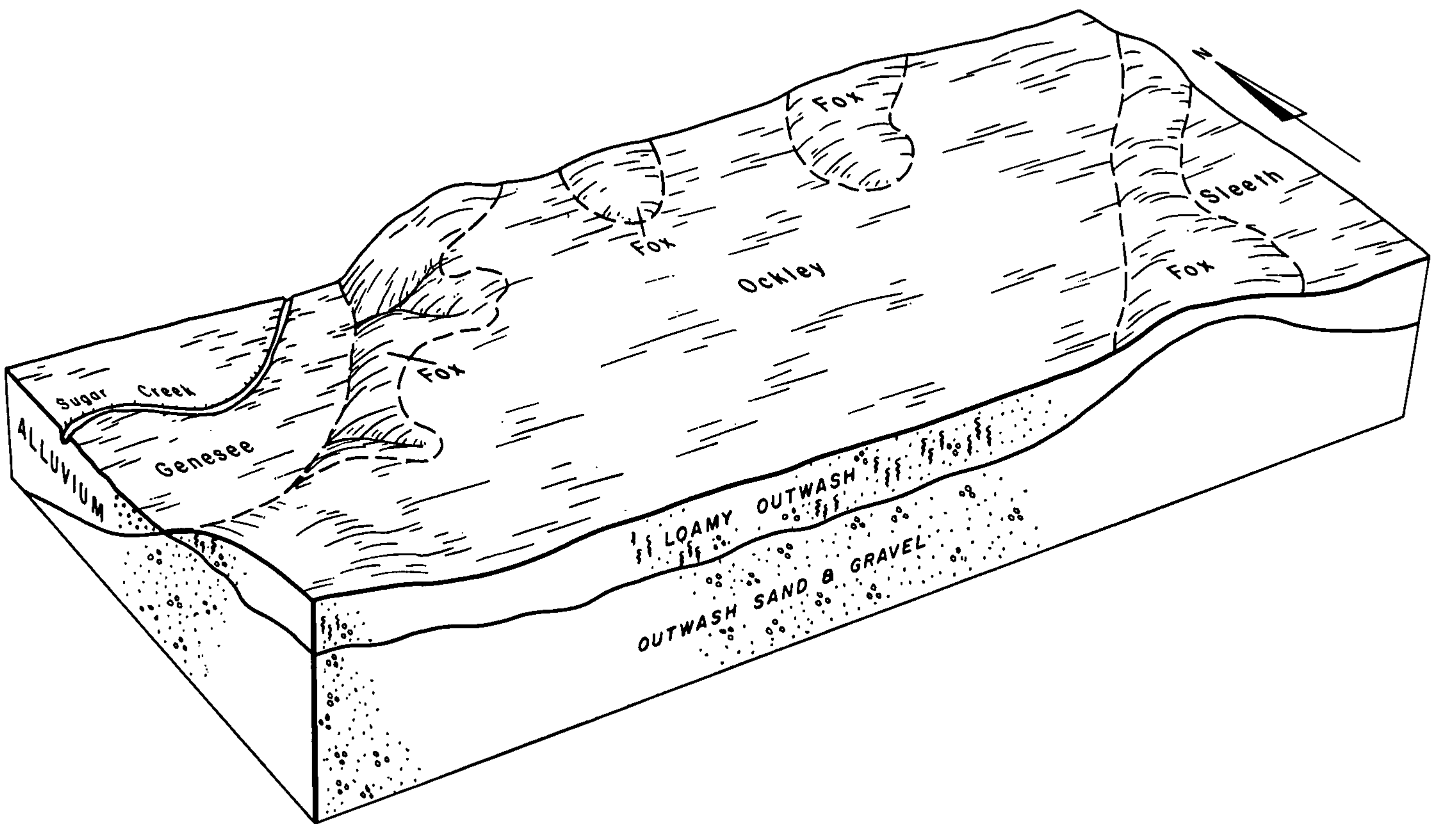

***Figure 6.*—General pattern of soils, topography, and underlying material in the Ockley-Fox association. On the adjacent bottom lands are soils of the Genesee-Shoals association.**

group is described can be found readily by referring to the "Guide to Mapping Units."

For more general information about the soils, the reader can refer to the section "General Soil Map," in which the broad patterns of soils are described. The soil map at the back of this soil survey shows the location and distribution of the mapping units, and the "Guide to Mapping Units" gives the page on which each is described. The approximate acreage and proportionate extent of each mapping unit are shown in table 1, p. 9. Many terms used in describing the soil series and mapping units are defined in the Glossary, and some are defined in the section "How This Survey Was Made." More detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).[1]

Brookston Series

The Brookston series consists of deep, very poorly drained, nearly level soils that are in depressions on uplands. These soils formed in 24 to 36 inches of silty sediment and the underlying loam glacial till. The sediment contained some sand and glacial pebbles. The native vegetation consisted of water-tolerant hardwoods and grasses.

In a representative profile the surface layer is about 13 inches of black silty clay loam. The subsoil is about 26 inches thick. The upper 8 inches is dark-gray, mottled silty clay loam; the next 7 inches is gray, mottled silty clay loam; and the lower 11 inches is light olive-gray, mottled clay loam. The substratum, at a depth of 39 inches, is brown, mottled, calcareous loam.

Permeability is slow, and available water capacity is high. Runoff is very slow or is ponded. The water table is seasonally high.

Representative profile of Brookston silty clay loam (in a cultivated field 100 feet south and 350 feet west of the northeast corner of sec. 11, T. 19 N., R. 2 E.):

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

A1—7 to 13 inches, black (10YR 2/1) silty clay loam; strong, medium, angular blocky structure; firm; few small pebbles; neutral; clear, wavy boundary.

B21tg—13 to 21 inches, dark-gray (10YR 4/1) silty clay loam; common, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; firm; thin, spotty, dark-gray (10YR 4/1) clay films on faces of peds; many small pebbles; neutral; gradual, wavy boundary.

B22tg—21 to 28 inches, gray (10YR 5/1) silty clay loam; many, medium, faint, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; thick dark-gray (10YR 4/1) clay films on faces of peds; many small pebbles; neutral; clear, wavy boundary.

IIB23tg—28 to 39 inches, light olive-gray (5Y 6/2) clay loam; common, medium, distinct, brown (7.5YR 5/4) mottles; weak, coarse, subangular blocky structure; firm; thick gray (10YR 5/1) clay films on faces of peds; many small pebbles; neutral; clear, wavy boundary.

[1] Italic numbers in parentheses refer to Literature Cited, p. 54.

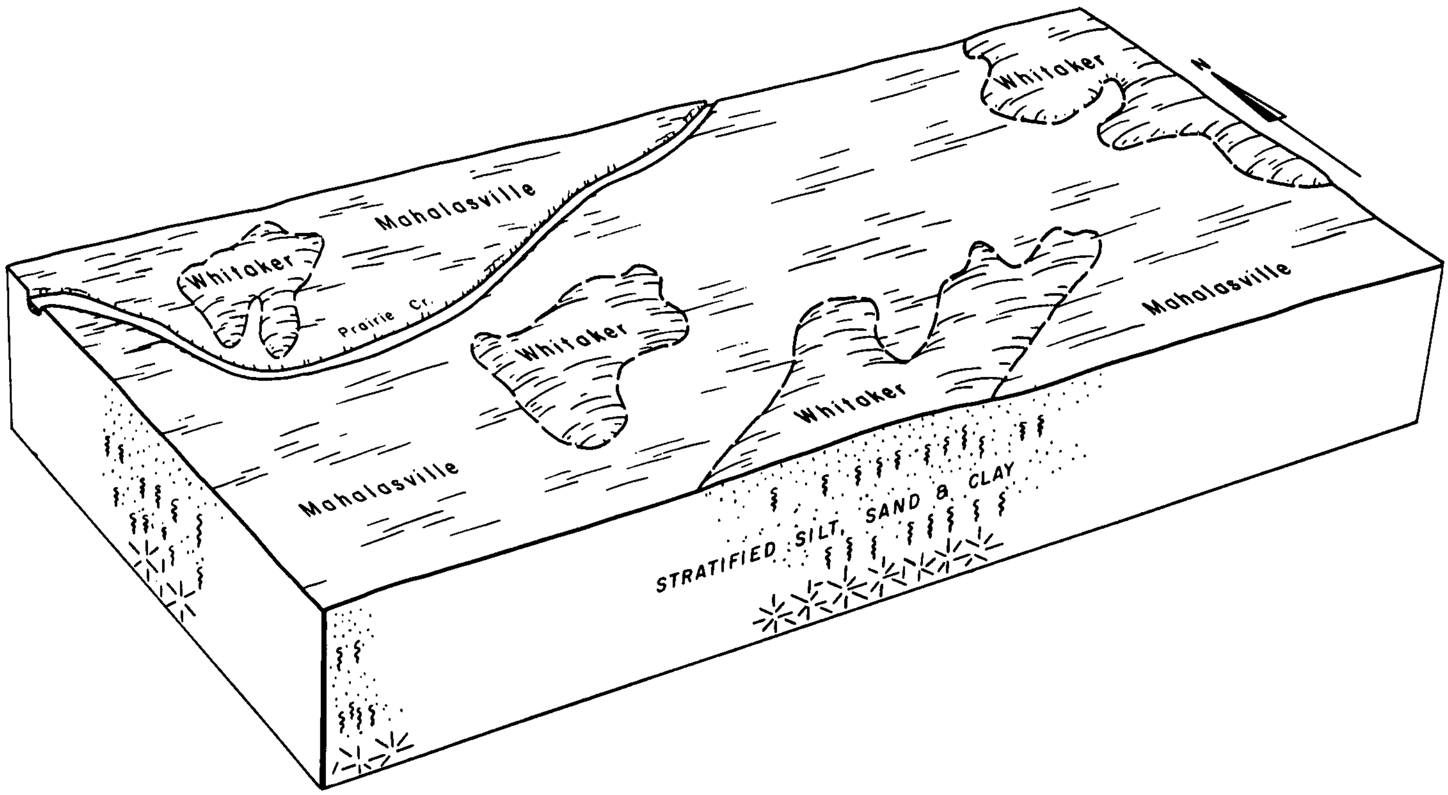

Figure 7.—**General pattern of soils, topography, and underlying material in the Mahalasville-Whitaker association.**

IIC—39 to 60 inches, brown (10YR 5/3) loam; many, coarse, faint, gray (10YR 6/1) and yellowish-brown (10YR 5/6) mottles; massive; friable; many small pebbles; moderately alkaline; calcareous.

The A horizon ranges from 11 to 18 inches in thickness. It is black (10YR 2/1) to very dark grayish brown (10YR 3/2). In the B horizon, the color ranges from 10YR through 5Y to N (neutral) in hue and from 4 through 6 in value; the chroma is 1 or 2. The color of mottles in the B horizon is 10YR or 7.5YR in hue and ranges from 4 through 6 in value and from 1 through 8 in chroma. The C horizon is loam or silt loam. The solum is 30 to 50 inches thick.

Brookston soils are similar to Mahalasville, Ragsdale, and Westland soils. They have more sand in the subsoil than Mahalasville and Ragsdale soils, and they have less sand and gravel in the lower part of the subsoil and in the substratum than Westland soils.

Brookston silt loam, overwash (0 to 2 percent slopes) (Br).—Some areas of this soil are in depressions at the base of gentle to steep slopes, and some are in drainageways. This soil is adjacent to gently sloping to steep soils that are eroded or severely eroded. The profile of this soil is similar to the one described as representative of the series, except that the original surface layer has been covered with 10 to 20 inches of loamy material washed down from the adjacent slopes. In cultivated areas the surface layer is grayish brown.

The content of organic matter is low in this soil. Wetness is the main limitation that affects use and management.

If this Brookston soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management it can be used intensively for row crops. Its limitations for uses associated with residential development are severe. Capability unit IIw–1; tree and shrub suitability group 1.

Brookston silty clay loam (0 to 2 percent slopes) (Bs).—Some of this soil occupies large areas within which are irregularly shaped islands of lighter colored soils, and some of it is in drainageways and small depressions surrounded by lighter colored soils. This soil has the profile described as representative of the series.

Included with this soil in mapping were some areas in which the subsoil contains less sand than that in the representative profile and some in which the subsoil contains more clay. Also included were small areas of Crosby, Fincastle, and Ragsdale soils. Wet depressions less than 2 acres in size are shown on the soil map by a wet spot symbol, and areas of muck less than 2 acres in size are shown by a muck symbol.

The content of organic matter is high in this soil. Wetness is the main limitation that affects use and management.

If this Brookston soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management it can be used intensively for row crops. Its limitations for uses associated with residential development are severe. Capability unit IIw–1; tree and shrub suitability group 1.

Crosby Series

The Crosby series consists of deep, somewhat poorly drained, nearly level and gently sloping soils on uplands. These soils formed in loamy glacial till covered in places

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

Soil	Acres	Percent	Soil	Acres	Percent
Brookston silt loam, overwash	190	0. 1	Miami clay loam, 2 to 6 percent slopes, severely eroded	410	0. 1
Brookston silty clay loam	74, 000	27. 1	Miami clay loam, 6 to 12 percent slopes, severely eroded	1, 100	. 4
Crosby silt loam, 0 to 3 percent slopes	74, 000	27. 1	Miami clay loam, 12 to 18 percent slopes, severely eroded	200	. 1
Crosby-Miami silt loams, 2 to 6 percent slopes, eroded	3, 250	1. 2	Ockley silt loam, 0 to 2 percent slopes	3, 150	1. 2
Fincastle silt loam, 0 to 3 percent slopes	22, 250	8. 1	Ockley silt loam, 2 to 6 percent slopes, eroded	1, 200	. 4
Fox silt loam, 0 to 2 percent slopes	490	. 2	Ragsdale silty clay loam	30, 750	11. 3
Fox silt loam, 2 to 6 percent slopes, eroded	520	. 2	Reesville silt loam	580	. 2
Fox silt loam, 6 to 12 percent slopes, eroded	540	. 2	Shoals silt loam	4, 100	1. 5
Genesee silt loam	6, 900	2. 5	Sleeth silt loam	860	. 3
Hennepin loam, 25 to 50 percent slopes	720	. 3	Sloan silt loam	750	. 3
Mahalasville silty clay loam	12, 900	4. 7	Westland silty clay loam	1, 350	. 5
Miami silt loam, 0 to 2 percent slopes	1, 450	. 5	Whitaker silt loam	3, 300	1. 2
Miami silt loam, 2 to 6 percent slopes, eroded	23, 250	8. 5			
Miami silt loam, 6 to 12 percent slopes, eroded	3, 400	1. 2			
Miami silt loam, 12 to 18 percent slopes, eroded	1, 350	. 5			
Miami silt loam, 18 to 25 percent slopes, eroded	320	. 1	Total	273, 280	100. 0

by a layer of loess as much as 20 inches thick. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 7 inches of dark grayish-brown silt loam. The subsoil is about 22 inches thick. It is grayish-brown and brown, mottled clay loam. The substratum, at a depth of 29 inches, is yellowish-brown, mottled, calcareous loam.

Available water capacity is high, and permeability is slow. The content of organic matter is moderate. The water table is seasonally high.

Representative profile of Crosby silt loam, 0 to 3 percent slopes (in a cultivated field 75 feet east and 85 feet north of the southwest corner of the SE¼SW¼ sec. 9, T. 18 N., R. 2 E.):

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

B21tg—7 to 12 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, brown (10YR 5/3) mottles; moderate, fine, angular blocky structure; firm; thick light brownish-gray (10YR 6/2) silt and clay films on faces of peds; medium acid; gradual, wavy boundary.

B22tg—12 to 19 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, brown (10YR 5/3) mottles; weak, coarse, prismatic structure that parts into moderate, medium, subangular blocky; firm; thick light brownish-gray (10YR 6/2) silt coatings and dark grayish-brown (10YR 4/2) clay films on faces of peds; many very dark brown (10YR 2/2) concretions of manganese and iron oxide; medium acid; clear, wavy boundary.

B23t—19 to 25 inches, brown (10YR 5/3) clay loam; common, fine, faint, grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure; firm; thick dark grayish-brown (10YR 4/2) clay films on faces of peds and as linings in voids; few black (10YR 2/1) concretions of manganese and iron oxide; few small pebbles; slightly acid; clear, wavy boundary.

B3tg—25 to 29 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, brown (10YR 5/3) and yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; firm; thick dark grayish-brown (10YR 4/2) clay films on faces of peds and as linings in some voids; many small pebbles; neutral; gradual, wavy boundary.

C—29 to 60 inches, yellowish-brown (10YR 5/4) loam; many, coarse, distinct, light-gray (10YR 6/1) and yellowish-brown (10YR 5/8) mottles; massive; firm; moderately alkaline; calcareous.

The Ap horizon ranges from 7 to 11 inches in thickness and is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). An A2 horizon of silt loam that is less than 9 inches thick occurs in some areas. It is commonly grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). In the B horizon the color is 10YR in hue and ranges from 4 through 6 in value and from 2 through 6 in chroma. The color of the mottles in the B horizon is 10YR or 2.5Y in hue and ranges from 4 through 6 in value and from 1 through 6 in chroma. The upper part of the B horizon is generally clay loam but in some areas it is silty clay loam. The C horizon ranges from silt loam to sandy loam and is firm or friable. The solum is 24 to 40 inches thick, and the loess deposit ranges from 0 to 20 inches in thickness.

Crosby soils are similar to Fincastle, Reesville, Sleeth, and Whitaker soils. Crosby soils have more sand in the upper part of the subsoil and have a thinner subsoil than Fincastle soils. They have more sand in the subsoil than Reesville soils. They are not stratified in the substratum as are Whitaker soils, and they have less sand and gravel in the subsoil and in the substratum than Sleeth soils.

Crosby silt loam, 0 to 3 percent slopes (CrA).—Some of this soil occupies large continuous areas within which are areas of very poorly drained soils (fig. 8), and some occupies small to large areas surrounded by very poorly drained soils. This soil has the profile described as representative of the series. All areas of this soil are irregular in shape, and most are between 10 and 30 acres in size.

Included with this soil in mapping were areas of a soil similar to Fincastle soils except that the depth to calcareous till is less than 36 inches. Also included, mainly in the western and southeastern parts of the county where this Crosby soil is associated with Miami soils, were a few small areas of eroded soils that have a grayish-brown cultivated surface layer, a few small areas of well-drained Miami soils, and a few areas in which the subsoil is less clayey than that in the representative profile. Where the topography is mostly nearly level, there are small included areas in which thin layers of stratified sand and silt lie above the calcareous till. Small narrow areas of steeper Miami and Hennepin soils that break abruptly to lower elevations are shown on the soil map by the symbol for escarpments.

Runoff is slow in this soil, and wetness is the main limitation that affects use and management.

If this Crosby soil is artificially drained, it is suited to all crops commonly grown in the county and is also

Figure 8.—**Crosby soils (lighter colored areas) intermingled with very poorly drained Brookston soils (darker colored areas).**

suited to tomatoes. Under proper management this soil can be used intensively for row crops. Capability unit IIw–2; tree and shrub suitability group 2.

Crosby-Miami silt loams, 2 to 6 percent slopes, eroded (CsB2).—This complex is on knolls. The areas are irregular in shape, and most are between 10 and 30 acres in size. About 65 percent of the acreage is Crosby silt loam, and about 35 percent is Miami silt loam. Miami silt loam is gently sloping and occurs on slight knolls surrounded by Crosby soils. Crosby silt loam occupies more level areas between slopes and the lower part of some slopes where water has seeped from the higher part. The Crosby and Miami soils in this complex have profiles similar to those described as representative of the respective series. Moderate amounts of brownish subsoil have been mixed with the original surface layer in most cultivated areas.

Included in mapping were areas of slightly eroded soils, a few small areas of Brookston soils, and a few areas of Crosby silt loam in which the subsoil is less clayey than that in the representative profile. Also included were small narrow areas of steeper Miami and Hennepin soils that abruptly break to lower elevations. These soils are shown on the soil map by the symbol for escarpments.

Permeability is slow in Crosby silt loam and moderate in Miami silt loam. Runoff is medium. The hazard of erosion affects use and management of both soils in this complex. Use of the Crosby soil is affected by wetness also.

The soils in this complex are suited to all crops commonly grown in the county. Careful management for control of erosion is needed if the soils are row cropped intensively. Capability unit IIe–12; tree and shrub suitability group 2.

Fincastle Series

The Fincastle series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils formed in 20 to 40 inches of loess and underlying material weathered from loamy glacial till. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 6 inches of dark grayish-brown silt loam. The subsurface layer, about 7 inches thick, consists of light brownish-gray, mottled silt loam. The subsoil is about 30 inches thick. The uppermost 11 inches is brown, mottled silty clay loam; the next 7 inches is grayish-brown, mottled silty clay loam; and the lowermost 12 inches is grayish-brown, mottled clay loam. The substratum, at a depth of 43 inches, is yellowish-brown, mottled, calcareous loam.

Available water capacity is high, permeability is slow, and content of organic matter is moderate. The water table is seasonally high.

Representative profile of Fincastle silt loam, 0 to 3 percent slopes (in a cultivated field 210 feet east and 700 feet south of the northwest corner of the NE¼ sec. 1, T. 18 N., R. 2 W.):

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

A2—6 to 13 inches, light brownish-gray (10YR 6/2) silt loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; weak, coarse, platy structure that parts into weak, medium, granular; friable; few very dark grayish-brown (10YR 3/2) concretions of iron and manganese oxide; medium acid; clear, wavy boundary.

B21t—13 to 24 inches, brown (10YR 5/3) silty clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium and fine, angular blocky structure; firm; thick light brownish-gray (10YR 6/2) silt and clay films on faces of peds; medium acid; gradual, wavy boundary.

B22tg—24 to 31 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; weak, coarse, prismatic structure that parts into moderate, medium and coarse, subangular blocky; firm; thick light brownish-gray (10YR 6/2) silt and clay films on faces of peds; few black (10YR 2/1) concretions of manganese and iron oxide; slightly acid; clear, wavy boundary.

IIB23tg—31 to 43 inches, grayish-brown (10YR 5/2) clay loam; many, common, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; weak, coarse, subangular blocky structure; firm; thin dark-gray (10YR 4/1) clay films on faces of peds and as linings in voids; neutral; gradual, wavy boundary.

IIC—43 to 60 inches, yellowish-brown (10YR 5/4) loam; common, coarse, distinct, light-gray (10YR 7/1) mottles; massive; firm; moderately alkaline; calcareous.

The A horizon ranges from 8 to 15 inches in thickness. In the B horizon the color is 10YR in hue and ranges from 4 through 6 in value and from 1 through 4 in chroma. The color of the mottles is 10YR in hue and ranges from 4 through 6 in value and from 1 through 8 in chroma. The IIC horizon is either firm or friable. The solum ranges from 36 to 70 inches in thickness and the loess deposit ranges from 20 to 40 inches.

Fincastle soils are similar to Crosby, Reesville, Sleeth, and Whitaker soils. Fincastle soils have less sand in the upper part of the subsoil and are deeper than Crosby soils. They have more sand in the subsoil than Reesville soils. They are not stratified in the substratum as are Whitaker soils, and they have less sand and gravel in the subsoil and in the substratum than Sleeth soils.

Fincastle silt loam, 0 to 3 percent slopes (FcA).—Some of this soil is in large continuous areas within which are areas of very poorly drained soils, and some occupies small to large areas surrounded by very poorly drained soils. These areas are commonly 10 to 30 acres in size and are irregular in shape.

Included with this soil in mapping were areas of soils where the depth to calcareous loam is less than 36 inches and areas of soils where the loess deposit is less than 20 inches thick. Also included were small areas of soils that are eroded and a few small areas of eroded soils that have a grayish-brown cultivated surface layer. Also included were a few areas of soils near Sugar Creek in the northwestern part of the county that are similar to Fincastle soils but are more poorly drained and have a surface layer and subsoil that are grayer. Areas of Reesville soils and a few small areas of well-drained Miami soils were also included. Small narrow areas of steeper Miami or Hennepin soils that abruptly break to a lower elevation were also included. These soils are shown on the soil map by an escarpment symbol.

Runoff is slow on this soil. Wetness is the main limitation that affects use and management.

If this Fincastle soil is artificially drained, it is suited to all crops commonly grown in the county and is also suited to tomatoes. Under proper management this soil can be used intensively for row crops. Capability unit IIw-2; tree and shrub suitability group 2.

Fox Series

The Fox series consists of well-drained, nearly level to moderately sloping soils on outwash plains. These soils formed in glacial outwash material and are moderately deep over sand and gravel. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 8 inches of dark grayish-brown silt loam. The subsoil is about 30 inches thick. The upper 10 inches is brown silty clay loam, the next 13 inches is dark-brown clay loam, and the lower 7 inches is dark yellowish-brown gravelly clay loam. The substratum, at a depth of 38 inches, is yellowish-brown, calcareous sand and gravel.

Available water capacity, permeability, and content of organic matter are moderate. The effective rooting depth is about 3 feet.

Representative profile of Fox silt loam, 2 to 6 percent slopes, eroded (in a cultivated field 1,825 feet south and 1,225 feet west of the northeast corner of sec. 34, T. 20 N., R. 2 W.):

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

B21t—8 to 18 inches, brown (10YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; firm; few small pebbles; thin dark-brown (10YR 4/3) clay films on faces of peds; neutral; clear, wavy boundary.

B22t—18 to 31 inches, dark-brown (7.5YR 4/4) clay loam; weak, medium, subangular blocky structure; firm; thick dark-brown (10YR 4/3) clay films on faces of peds; many small pebbles; medium acid; clear, wavy boundary.

B3t—31 to 38 inches, dark yellowish-brown (10YR 3/4) gravelly clay loam; weak, medium, subangular blocky structure; friable; medium acid; irregular, wavy boundary.

IIC—38 to 60 inches, yellowish-brown (10YR 5/4) sand and gravel; single grained; loose; moderately alkaline; calcareous.

The A horizon ranges from 5 to 15 inches in thickness. It is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 4/3). In the B horizon, the color ranges from 10YR through 5YR in hue, from 2 through 5 in chroma, and is 3 or 4 in value. The B21t horizon is generally silty clay loam, but in some areas it is clay loam. In some places a gravelly clay loam subhorizon is between the B horizon and the C horizon. In most areas, tongues of the B horizon extend into the C horizon. The solum is 30 to 40 inches thick.

Fox soils are similar to Miami and Ockley soils. Fox soils are shallower to sand and gravel than Ockley soils. They have more sand and gravel in the subsoil and in the substratum than Miami soils.

Fox silt loam, 0 to 2 percent slopes (FsA).—Some areas of this soil are adjacent to and slightly higher than bottom land soils. Other areas are on the crowns of small hills or knolls. The profile is similar to the one described as representative of the Fox series, except that the surface layer is slightly thicker.

Included with this soil in mapping were small areas of Ockley soils and a few small areas of soils that have a surface layer of loam or fine sandy loam. Small narrow areas of steeper soils that abruptly break to a lower elevation were also included. These soils are generally shallower to sand and gravel than this soil and are shown on the soil map by the symbol for escarpments.

Runoff is slow on this soil. The moderate depth to sand and gravel and insufficient moisture cause this soil to be droughty, a limitation that affects its use and management. This soil is favorable to root growth to a depth of about 3 feet.

This Fox soil is suited to all crops commonly grown in the county, but it is well suited to small grains and to alfalfa-grass hay. Capability unit IIs-1; tree and shrub suitability group 3.

Fox silt loam, 2 to 6 percent slopes, eroded (FsB2).—This soil occupies areas between bottom lands and higher elevated, nearly level Fox, Ockley, or Sleeth soils. It also occupies small knolls or kames that are surrounded by upland soils. This soil has the profile described as representative of the series. In most cultivated areas, moderate amounts of brownish subsoil are mixed with the material originally in the surface layer.

Included with this soil in mapping were small areas that are severely eroded, a few small areas that have a surface layer of fine sandy loam or gravelly loam, and small areas of Ockley soils. Small narrow areas of steeper soils that abruptly break to a lower elevation were also included. These soils are generally shallower to sand and gravel than this soil, and they are shown on the soil map by an escarpment symbol.

Runoff is medium on this soil. The hazard of erosion affects use and management. The moderate depth to sand and gravel and insufficient moisture cause this soil to be droughty and limit its use. This soil is favorable to root growth to a depth of about 3 feet.

This Fox soil is suited to crops commonly grown in the county but is well suited to small grains and alfalfa-grass hay. Capability unit IIe-9; tree and shrub suitability group 3.

Fox silt loam, 6 to 12 percent slopes, eroded (FsC2).—This soil occupies narrow bands between bottom land and higher elevated outwash soils. It also is on the sides of natural drainageways. This soil has a profile similar to that described as representative of the series, but the surface layer and subsoil are thinner. In most cultivated areas, moderate amounts of brownish subsoil are mixed with the material originally in the surface layer.

Included with this soil in mapping were small areas that are severely eroded, small areas of Ockley soils, areas where the slope is more than 12 percent, and a few small areas that have a fine sandy loam or gravelly loam surface layer. Small narrow areas of steeper soils that abruptly break to a lower elevation were also included. These soils are generally shallower to sand and gravel than this soil. They are shown on the soil map by an escarpment symbol.

Runoff is medium on this soil. The hazard of erosion affects use and management. Moderate depth to sand and gravel and insufficient moisture cause this soil to be droughty and limit its use. Root growth is favorable to a depth of about 3 feet.

This Fox soil is better suited to alfalfa-grass hay and small grains than to row crops. Capability unit IIIe-9; tree and shrub suitability group 3.

Genesee Series

The Genesee series consists of deep, well-drained, nearly level soils on bottom lands. These soils formed in loamy sediment deposited by floods. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 9 inches of dark-brown silt loam. The subsoil is about 26 inches thick and is brown silt loam in the upper 16 inches and brown loam in the lower 10 inches. The substratum, at a depth of 35 inches, is dark yellowish-brown, calcareous stratified loam and sandy loam.

Available water capacity is high, and permeability is moderate. Content of organic matter is moderate, and runoff is slow.

Representative profile of Genesee silt loam (in a cultivated field 200 feet west and 400 feet south of the northeast corner of the NW¼SE¼ sec. 25, T. 20 N., R. 2 W.):

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

B2—9 to 25 inches, brown (10YR 4/3) silt loam; weak, fine to medium, subangular blocky structure; friable; neutral; clear, smooth boundary.

B3—25 to 35 inches, brown (10YR 4/3) loam; weak, medium to coarse, subangular blocky structure; friable; moderately alkaline; calcareous; gradual, wavy boundary.

C—35 to 60 inches, dark yellowish-brown (10YR 3/4) stratified loam and sandy loam; massive; friable; moderately alkaline; calcareous.

The A horizon ranges from 7 to 10 inches in thickness and from dark grayish brown (10YR 4/2) to brown (10YR 5/3) or dark brown (10YR 3/3) in color. In the B horizon, the color is 10YR in hue, 4 or 5 in value, and 3 or 4 in chroma. The B horizon is silt loam or loam in the upper part and ranges from silt loam to sandy loam in the lower part. Free carbonates are in the B horizon at a depth of 24 to 40 inches. The C horizon ranges from silt loam to loamy sand and commonly becomes coarser as depth increases. The solum ranges from 30 to 40 inches in thickness.

Genesee soils are similar to somewhat poorly drained Shoals soils and to very poorly drained Sloan soils. Genesee soils have a lighter colored surface layer than Sloan soils. They have a browner subsoil and are not mottled as are Shoals and Sloan soils.

Genesee silt loam (0 to 2 percent slopes) (Gn).—This soil is in large areas on bottom lands. Most of these areas are 2 or 3 times longer than they are wide and are dissected by streams.

Included with this soil in mapping were small areas of soils that have a surface layer of loam or sandy loam; these soils are mainly on the large bottom lands. Also included were areas of soils that have a very dark grayish-brown surface layer, areas of soils that have a surface layer that is calcareous, and some small areas of soils in which the subsoil contains more sand than that in the representative profile. Some areas of soils in which the surface layer contains more sand than in the representative profile are included; these areas are less than 2 acres in size and are indicated on the soil map by the symbol for sand spots. Also included are a few areas of soils where sand and gravel are at a depth of more than 35 inches.

The hazard of flooding affects use and management, and crops are damaged at times by spring floods.

This Genesee soil is suited to most crops commonly grown in the county. Under proper management it can be used intensively for row crops. It is also suited to permanent pasture, woodland, and wildlife habitat. Walnut and tulip-poplar trees are well suited to this soil. Limitations of this soil for uses commonly associated with residential development are severe. Capability unit I-2; tree and shrub suitability group 3.

Hennepin Series

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

In a representative profile the surface layer is about 4 inches of very dark grayish-brown loam. The subsoil is about 10 inches thick and is brown loam. The substratum, at a depth of 14 inches, is brown, calcareous loam.

Available water capacity is high, and runoff is very rapid. Permeability and content of organic matter are moderate.

Representative profile of Hennepin loam, 25 to 50 percent slopes (in a wooded area 400 feet east and 225 feet north of the center of the NW¼ sec. 22, T. 18 N., R. 2 E.):

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; neutral; clear, wavy boundary.

B—4 to 14 inches, brown (10YR 4/3) loam; weak, fine, subangular blocky structure; friable; few, thin, very dark grayish-brown (10YR 3/2) organic coatings on faces of peds; mildly alkaline; clear, wavy boundary.

C—14 to 60 inches, brown (10YR 5/3) loam; massive; friable; many pebbles; moderately alkaline; calcareous.

The A horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). It is commonly loam, but some areas are silt loam. In the B horizon, color is 10YR in hue, ranges from 4 through 6 in value, and is 3 or 4 in chroma. The C horizon ranges from silt loam to sandy loam. The solum is 12 to 20 inches thick.

Hennepin soils are similar to Miami soils. Hennepin soils have less clay in the subsoil and have a thinner subsoil than Miami soils.

Hennepin loam, 25 to 50 percent slopes (HeF).—Some areas of this soil are on long, narrow, steep breaks between bottom lands and uplands; and some are on sides of drainageways.

Included with this soil in mapping were areas of soils that have a surface layer of silt loam and areas of soils that have a surface layer that is as much as 6 inches thick. Also included were small areas of Miami soils and areas of soils that are eroded.

The hazard of erosion affects use and management.

This Hennepin soil is mostly wooded and is suited to this use. Its limitations for uses associated with residential development are severe. Capability unit VIIe-2; tree and shrub suitability group 4.

Mahalasville Series

The Mahalasville series consists of deep, very poorly drained, nearly level soils in depressions on outwash plains and in glacial sluiceways. These soils formed in silty outwash materials. Thin layers of stratified silt, sand, and clay occur at a depth of about 3 feet. The native vegetation consisted of water-tolerant hardwoods and grasses.

In a representative profile the surface layer is about 13 inches of black silty clay loam. The subsoil, about 28 inches thick, is gray and mottled. The upper 21 inches is silty clay loam and the lower 7 inches is loam. The substratum, at a depth of 41 inches, is gray, mottled, stratified, calcareous loam, silty clay loam, and loamy sand.

Available water capacity is high, and permeability is slow. Runoff is very slow on nearly level areas, and water is ponded in depressions. The content of organic matter is high, and the water table is seasonally high.

Representative profile of Mahalasville silty clay loam (in a cultivated field 195 feet north and 450 feet west of the southeast corner of the SW¼SE¼ sec. 31, T. 20 N., R. 2 W.):

Ap—0 to 8 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A1—8 to 13 inches, black (10YR 2/1) silty clay loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; firm; neutral; gradual, wavy boundary.

B21tg—13 to 20 inches, gray (10YR 5/1) silty clay loam; common, fine, faint, yellowish-brown (10YR 5/6) mottles; moderate, fine and medium, angular blocky structure; firm; thin dark-gray (10YR 4/1) clay films on faces of peds; neutral; clear, wavy boundary.

B22tg—20 to 34 inches, gray (5Y 6/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; thin dark-gray (10YR 4/1) clay films on faces of peds; dark-gray (10YR 4/1) silty clay loam material in old crayfish channels; neutral; clear, wavy boundary.

IIB3g—34 to 41 inches, gray (5Y 5/1) loam; many, coarse, distinct, yellowish-brown (10YR 5/8) mottles; medium, subangular blocky structure; friable; mildly alkaline; gradual, wavy boundary.

IIICg—41 to 60 inches, gray (10YR 5/1) stratified loam, silty clay loam, and loamy sand; many, coarse, distinct, yellowish-brown (10YR 5/8) and light-gray (5Y 6/1) mottles; massive; friable; moderately alkaline; calcareous.

The A horizon ranges from 10 to 18 inches in thickness. It ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). In the B horizon color is 10YR, 2.5Y, or 5Y in hue, ranges from 4 through 6 in value and is 1 or 2 in chroma. Color of the mottles is 10YR, 7.5YR, or 2.5Y in hue and ranges from 4 through 6 in value and from 1 through 8 in chroma. The IIIB3g horizon is loam, silty clay loam, clay loam, or silt loam containing more than 15 percent sand that is coarser than very fine sand. The C horizon is stratified, ranges from silt to sand, and has thin layers of clay loam or silty clay loam. Reaction in the C horizon is commonly moderately alkaline, but in some areas the upper part is neutral. The solum ranges from 36 to 60 inches in thickness.

Mahalasville soils are similar to Brookston, Ragsdale, and Westland soils. Mahalasville soils have less sand in the subsoil than Brookston and Westland soils. They are stratified in the lower part of the subsoil and in the substratum, but Ragsdale soils formed in uniform silt.

Mahalasville silty clay loam (0 to 2 percent slopes) (Ma).—Some large areas of this soil are on old lake beds, and some areas are adjacent to drainage ditches in natural sluiceways.

Included with this soil in mapping were areas of Ragsdale soils, areas of soils in which the subsoil contains more sand than that in the representative profile, and small areas of soils that are underlain by pockets of sand and gravel. Wet depressions less than two acres in size were also included and are noted on the soil map by a wet spot symbol.

Wetness is the main limitation that affects use and management.

If this Mahalasville soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management it can be used intensively for row crops. Its limitations for uses commonly associated with residential development are severe. Capability unit IIw-1; tree and shrub suitability group 1.

Miami Series

The Miami series consists of deep, well-drained, nearly level to moderately steep soils on uplands. These soils formed in loamy glacial till covered in places with a layer of loess as much as 18 inches thick. Large areas of Miami soils are close to natural streams. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 8 inches of dark grayish-brown silt loam. The subsoil is about 25 inches thick. The upper 6 inches is brown to dark-brown light clay loam, the next 12 inches is dark yellowish-brown clay loam, and the lower 7 inches is dark grayish-brown and brown loam. The substratum, at a depth of 33 inches, is brown, calcareous loam.

Available water capacity is high, and permeability is moderate.

Representative profile of Miami silt loam, 6 to 12 percent slopes, eroded (in a cultivated field 450 feet east and 440 feet south of the northwest corner of the NE¼ sec. 26, T. 18 N., R. 2 E.):

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

B1—8 to 10 inches, brown to dark-brown (10YR 4/3) light clay loam; weak, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B21t—10 to 14 inches, brown to dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; thin dark-brown (10YR 4/3) clay films on faces of peds; strongly acid; clear, wavy boundary.

B22t—14 to 22 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, medium, angular blocky structure; firm; thin dark-brown (10YR 4/3) clay films on faces of peds; strongly acid; clear, wavy boundary.

B23t—22 to 26 inches, dark yellowish-brown (10YR 4/4) clay loam; weak, coarse, prismatic structure that parts into moderate, medium, subangular blocky structure; firm; thin dark-brown (10YR 4/3) clay films on faces of peds; few concretions of iron and manganese; medium acid; clear, wavy boundary.

B3t—26 to 33 inches, dark grayish-brown (10YR 4/2) and brown (10YR 5/3) loam; weak, coarse, prismatic structure; friable; thin dark-brown (10YR 4/3) clay films on faces of peds; mildly alkaline; clear, irregular boundary.

C—33 to 60 inches, brown (10YR 5/3) loam till; massive; firm; moderately alkaline; calcareous.

In the A1 horizon, color ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). Where the soil has been plowed, the Ap horizon ranges from 6 to 10 inches in thickness and is dark grayish brown (10YR 4/2), brown (10YR 5/3), or yellowish brown (10YR 5/4). A silt loam A2 horizon less than 7 inches thick occurs in some areas. It is commonly dark grayish brown (10YR 4/2), yellowish brown (10YR 5/4), or brown (10YR 5/3). In the B horizon, color is 10YR or 7.5YR in hue and ranges from 4 through 6 in value and from 3 through 6 in chroma. The B horizon is commonly clay loam, but the upper horizon in some areas is silty clay loam. The B3t horizon is lacking in some areas and in some areas is calcareous. The C horizon ranges from silt loam to sandy loam in texture and from firm to friable in consistence. The solum ranges from 24 to 42 inches in thickness, and the loess deposit ranges from 0 to 18 inches.

Miami soils are similar to Fox and Ockley soils. They have less sand and gravel in the lower part of the subsoil and in the substratum than Fox and Ockley soils.

Miami silt loam, 0 to 2 percent slopes (MmA).—Some areas of this soil are in broad areas adjacent to steeper soils. Other areas are on small crowns on larger areas of more sloping Miami soils. This soil has a profile similar to that described as representative of the series, but the surface layer and subsoil are thicker.

Included with this soil in mapping were a few small areas of Crosby soils, a few areas of soils in the west-central part of the county where the loess deposit is more than 18 inches thick, and areas of soils that have thin lenses of sand between the subsoil and substratum. Small narrow areas of Miami or Hennepin soils that abruptly break to a lower elevation were also included, and these soils are shown on the soil map by the symbol for escarpments. Also included were some areas of soils where sand and gravel underlie the till at a depth of more than 8 feet.

Runoff is slow on this soil, and content of organic matter is moderate. This soil has no more than slight limitations to use and management.

This Miami soil is suited to all crops commonly grown in the county. Under proper management this soil can be used intensively for row crops. Capability unit I-1; tree and shrub suitability group 3.

Miami silt loam, 2 to 6 percent slopes, eroded (MmB2).—Some areas of this soil are between nearly level soils on uplands and steeper soils adjacent to outwash plains and bottom lands. This soil also is on sides of natural drainageways and in slightly elevated areas that are surrounded by somewhat poorly drained soils. This soil has a profile similar to that described as representative of the series; but the subsoil is slightly thicker, and in places the lower part of the subsoil has a few mottles. In most cultivated areas moderate amounts of brownish subsoil are mixed with the surface layer.

Included with this soil in mapping were a few small areas of soils where the substratum is sandy loam and a few areas of soils in the west-central part of the county where the loess deposit is more than 18 inches thick. Small narrow areas of Miami or Hennepin soils that abruptly break to a lower elevation were also included, and these soils are shown on the soil map by the symbol for escarpments. Severely eroded areas of soils that are less than 2 acres in size were also included, and they are shown on the soil map by a severely eroded spot symbol.

Runoff is medium on this soil, and content of organic matter is moderate. The hazard of erosion affects use and management.

This Miami soil is suited to all crops commonly grown in the county. Capability unit IIe–1; tree and shrub suitability group 3.

Miami silt loam, 6 to 12 percent slopes, eroded (MmC2).—Some of this soil is in areas between soils on uplands and soils on bottom lands. Some areas of this soil are parallel to steeper soils that are adjacent to the soils on bottom lands, and some are on sides of natural drainageways. This soil has the profile described as representative of the series. In most cultivated areas moderate amounts of brownish subsoil are mixed with the surface layer.

Included with this soil in mapping were a few small areas of soils where the substratum is sandy loam. Small narrow areas of steeper Miami or Hennepin soil that abruptly break to a lower elevation were also included, and these soils are shown on the soil map by the symbol for escarpments. Severely eroded areas that are less than 2 acres in size were also included, and they are shown on the soil map by the symbol for severely eroded spots.

Runoff is medium on this soil, and content of organic matter is moderate. The hazard of erosion affects use and management.

This Miami soil is suited to all crops commonly grown in the county. Capability unit IIIe–1; tree and shrub suitability group 3.

Miami silt loam, 12 to 18 percent slopes, eroded (MmD2).—Some of this soil is in areas between soils on uplands and soils on bottom lands. Other areas of this soil are on sides of natural drainageways. This soil has a profile similar to that described as representative of the series, but the surface layer and subsoil are thinner. In most cultivated areas moderate amounts of brownish subsoil are mixed with the surface layer.

Included with this soil in mapping were a few small areas of soils where the substratum is sandy loam and some areas where the depth to calcareous till is less than 24 inches. Small narrow areas of steeper Miami or Hennepin soils that abruptly break to a lower elevation were also included, and these soils are shown on the soil map by the symbol for escarpments. Severely eroded areas that are less than 2 acres in size were included and are shown on the soil map by the symbol for severely eroded spots.

Runoff is rapid on this soil, and content of organic matter is moderate. The hazard of erosion affects use and management.

This Miami soil is better suited to small grain, alfalfa-grass hay, or clover-grass hay than to row crops. Capability unit IVe–1; tree and shrub suitability group 3.

Miami silt loam, 18 to 25 percent slopes, eroded (MmE2).—This soil is in areas between soils on uplands and soils on bottom lands (fig. 9). In places it is dissected by short steep waterways. It is commonly covered by trees or brush. This soil has a profile similar to that described as representative of the series, but the surface layer and subsoil are thinner. In most cultivated areas moderate amounts of brownish subsoil are mixed with the surface layer.

Included with this soil in mapping were a few small areas of soils where the substratum is sandy loam, some areas where the depth to calcareous till is less than 24 inches, and a few small areas that are severely eroded. Small areas of Hennepin soils were also included, and they are shown on the soil map by the symbol for escarpments.

Runoff is rapid on this soil, and content of organic matter is moderate. The hazard of erosion affects use and management.

This Miami soil is suited to permanent pasture or woodland. Capability unit VIe–1; tree and shrub suitability group 4.

Miami clay loam, 2 to 6 percent slopes, severely eroded (MsB3).—Some of this soil is in areas between nearly level soils on uplands and steeper soils that are adjacent to outwash plains and bottom lands. This soil also occupies sides of natural drainageways. This soil has a profile similar to that described as representative of the series, but more than three-fourths of the surface layer is missing because of erosion. In most areas some of the subsoil is eroded, and in places the lower part of the subsoil has a few mottles. The surface layer is brown or dark brown and consists mostly of material originally in the subsoil. In many places the subsoil is exposed at the surface. In most areas of this soil, pebbles and small stones are on the surface.

Included with this soil in mapping were a few small areas of soils where the substratum is sandy loam and some small areas of Miami silt loam, eroded, soils. Also included were some narrow areas of steeper Miami or Hennepin soils that abruptly break to a lower elevation, and these soils are shown on the soil map by the symbol for escarpments.

Runoff is rapid on this soil, and content of organic matter is low. The hazard of erosion affects use and management.

This Miami soil is suited to all crops commonly grown in the county. Capability unit IIIe–1; tree and shrub suitability group 3.

Miami clay loam, 6 to 12 percent slopes, severely eroded (MsC3).—Some of this soil is in areas between soils on uplands and soils on bottom lands. Some areas of this soil are parallel to steeper soils that are adjacent to the soils on bottom lands, and some are on sides of natural drainageways. This soil has a profile similar to that described as representative of the series, but more than three-fourths of the surface layer is missing because of erosion. Also in most areas some of the subsoil is missing. The surface layer is brown or dark brown and consists mostly of material originally in the subsoil. In many places the subsoil is exposed at the surface. In most areas of this soil, pebbles and small stones are on the surface.

Included with this soil in mapping were a few small areas of soils where the substratum is sandy loam, some areas where the depth to calcareous till is less than 24 inches, and some small areas of Miami silt loam, eroded, soils. Small narrow areas of steeper Miami or Hennepin soils that abruptly break to a lower elevation were also included, and these soils are shown on the soil map by the symbol for escarpments.

Runoff is rapid on this soil, and content of organic matter is low. The hazard of erosion affects use and management.

Figure 9.—**Moderately steep Miami silt loam in background; nearly level Genesee silt loam on bottom land in foreground.**

This Miami soil is better suited to small grain, alfalfa-grass hay, or clover-grass hay than to row crops. Capability unit IVe–1; tree and shrub suitability group 3.

Miami clay loam, 12 to 18 percent slopes, severely eroded (MsD3).—Some of this soil is in areas between soils on uplands and soils on bottom lands. Other areas of this soil are on sides of natural drainageways. This soil has a profile similar to that described as representative of the series; but more than three-fourths of the surface layer is missing because of erosion, and in most areas some of the subsoil also is missing. The surface layer is brown or dark brown and consists mostly of material originally in the subsoil. In many places the subsoil is exposed at the surface. In most areas of this soil, pebbles and small stones are on the surface.

Included with this soil in mapping were a few small areas of soils where the substratum is sandy loam, some areas where the depth to calcareous till is less than 24 inches, and some small areas of Miami silt loam, eroded, soils. Small narrow areas of steeper Miami or Hennepin soils that abruptly break to a lower elevation were also included. These soils are shown on the soil map by the symbol for escarpments.

Runoff is very rapid, and content of organic matter is low. The hazard of erosion affects use and management.

This Miami soil is poorly suited to row crops but can be used for pasture, for hay crops, or for trees. Capability unit VIe–1; tree and shrub suitability group 3.

Ockley Series

The Ockley series consists of well-drained, nearly level and gently sloping soils on outwash plains. These soils formed in glacial outwash material and are deep over sand and gravel. In places a layer of loess as much as 24 inches thick covers the outwash material. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 8 inches of dark-brown silt loam. The subsurface layer is about 3 inches of brown silt loam. The subsoil is about 44 inches thick and is dark brown in the upper part, reddish brown in the middle, and dark brown in the lower part. The subsoil is stratified silt loam, silty clay loam, clay loam, gravelly clay loam, gravelly sandy loam, and loamy sand. The substratum, at a depth of 55 inches, is yellowish-brown, calcareous sand and gravel.

Available water capacity is high. Permeability and content of organic matter are moderate.

Representative profile of Ockley silt loam, 0 to 2 percent slopes (in a cultivated field 1,500 feet south and 400 feet west of the northeast corner of sec. 34, T. 20 N., R. 2 W.):

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

A2—8 to 11 inches, brown (10YR 5/3) silt loam; moderate, medium and thick, platy structure that parts into moderate, medium, granular; friable; neutral; clear, wavy boundary.

B1—11 to 14 inches, dark-brown (10YR 4/3) heavy silt loam; moderate, medium, subangular blocky structure; friable; neutral; clear, wavy boundary.

B21t—14 to 21 inches, dark-brown (10YR 4/3) light silty clay loam; moderate, medium, subangular blocky structure; firm; thin dark-brown (7.5YR 4/4) clay films on faces of peds; common fine sand grains; slightly acid; clear, wavy boundary.

IIB22t—21 to 28 inches, dark-brown (7.5YR 4/4) gravelly clay loam; moderate, medium, subangular blocky structure; firm; thin reddish-brown (5YR 4/4) clay films on faces of peds; 15 to 20 percent gravel, ⅛ to 1 inch in size; strongly acid; clear, wavy boundary.

IIB23t—28 to 39 inches, reddish-brown (5YR 4/4) light clay loam; weak, medium and coarse, subangular blocky structure; friable; thin reddish-brown (5YR 4/3) clay films on faces of peds; 5 to 10 percent gravel, ⅛ to 1 inch in size; strongly acid; gradual, wavy boundary.

IIB24t—39 to 45 inches, reddish-brown (5YR 4/4) gravelly sandy loam; weak, coarse, subangular blocky structure; very friable; patchy reddish-brown (5YR 4/3) clay films on faces of peds; 10 to 15 percent fine gravel; medium acid; abrupt, wavy boundary.

IIB25t—45 to 47 inches, dark reddish-brown (5YR 3/2) gravelly clay loam; weak, coarse, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIB3—47 to 55 inches, dark-brown (7.5YR 4/4) loamy sand to sandy loam; weak, coarse, subangular blocky structure; very friable; 5 percent gravel; neutral; abrupt, irregular boundary.

IIIC—55 to 72 inches, yellowish-brown (10YR 5/4) sand and gravel; single grained; loose; moderately alkaline; calcareous.

The A horizon ranges from 8 to 13 inches in thickness. It is dark brown (10YR 4/3), dark grayish brown (10YR 4/2), or brown (10YR 5/3). In the B horizon color is 10YR, 7.5YR, or 5YR in hue, ranges from 3 through 5 in value, and is 3 or 4 in chroma. The B21t horizon is silty clay loam or clay loam. In some places a gravelly clay loam subhorizon is between the B horizon and the C horizon. In most areas tongues of the B horizon extend into the C horizon. The solum ranges from 42 to 60 inches in thickness, and the loess deposit ranges from 0 to 24 inches.

Ockley soils are similar to Fox and Miami soils. Ockley soils are deeper to sand and gravel than Fox soils. They contain more gravel in the subsoil and in the substratum than Miami soils.

Ockley silt loam, 0 to 2 percent slopes (OcA).—Some of this soil is in areas adjacent to and at slightly higher elevations than the bottom lands. Other small areas that are irregularly shaped are surrounded by somewhat poorly drained and very poorly drained soils. This soil has the profile described as representative of the series.

Included with this soil in mapping were areas where the loess deposit is more than 24 inches thick. Also included were areas where the substratum has small amounts of gravel. These areas of Ockley soils are associated with Mahalasville and Whitaker soils and are poor or unsuitable sources of sand and gravel. Small narrow areas of steeper soils that abruptly break to a lower elevation were also included, and these soils are shown on the soil map by the symbol for escarpments.

Runoff is slow on this soil.

This Ockley soil is suited to all crops commonly grown in the county. Under proper management this soil can be used intensively for row crops. Capability unit I–1; tree and shrub suitability group 3.

Ockley silt loam, 2 to 6 percent slopes, eroded (OcB2).—Some of this soil is in areas adjacent to soils on bottom lands and to nearly level Ockley and Sleeth soils. Other areas of this soil are on sides of natural drainageways. In some areas this soil is on small knolls surrounded by somewhat poorly drained and very poorly drained soils. This soil has a profile similar to that described as representative of the series, but the surface layer and subsoil are thinner. In most cultivated areas moderate amounts of brownish subsoil are mixed with the surface layer.

Included with this soil in mapping were a few small areas where the surface layer is loam. Also included were areas where the substratum has small amounts of sand and gravel. These areas of Ockley soils are associated with Mahalasville and Whitaker soils and are poor or unsuitable sources of sand and gravel. Small narrow areas of steeper soils that abruptly break to a lower elevation were also included. These soils are generally shallower to sand and gravel than this soil, and they are shown on the soil map by the symbol for escarpments. Severely eroded areas that are less than 2 acres in size were also included and are shown on the soil map by the symbol for severely eroded spots.

Runoff is medium on this soil. The hazard of erosion affects use and management.

This Ockley soil is suited to all crops commonly grown in the county. Capability unit IIe–3; tree and shrub suitability group 3.

Ragsdale Series

The Ragsdale series consists of deep, very poorly drained, nearly level soils in depressions on uplands. These soils formed in silty material. The native vegetation consisted of water-tolerant trees and grasses.

In a representative profile the surface layer is about 13 inches of black silty clay loam. The subsoil is about 30 inches thick. The upper 8 inches is dark-gray, mottled silty clay loam; the next 11 inches is light olive gray, mottled silty clay loam; and the lower 11 inches is light brownish-gray, mottled silt loam. The substratum, at a depth of 43 inches, is gray and yellowish-brown, mottled, calcareous silt loam.

Available water capacity is high, permeability is slow, and content of organic matter is high. Runoff is very slow on nearly level areas and is ponded in depressions. The water table is seasonally high.

Representative profile of Ragsdale silty clay loam (in a cultivated field 275 feet west and 500 feet north of the center of sec. 27, T. 19 N., R. 1 W.):

Ap—0 to 8 inches, black (10YR 2/1) light silty clay loam; moderate, medium and fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A1—8 to 13 inches, black (10YR 2/1) silty clay loam; moderate, fine, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B21tg—13 to 21 inches, dark-gray (5Y 4/1) silty clay loam; common, fine, distinct, light olive-brown (2.5Y 5/4) mottles; moderate, medium, angular blocky structure; firm; thin very dark gray (10YR 3/1) organic and clay films on faces of peds; neutral; gradual, wavy boundary.

B22tg—21 to 32 inches, light olive-gray (5Y 6/2) silty clay loam; many, medium, distinct, brownish-yellow (10YR 6/6) mottles; moderate, coarse, prismatic structure that parts to moderate, medium and coarse, angular blocky; firm; thin dark-gray (10YR 4/1) organic and clay films on prismatic faces and as linings in few voids; neutral; gradual, irregular boundary.

B3g—32 to 43 inches, light brownish-gray (10YR 6/2) silt loam; many, coarse, yellowish-brown (10YR 5/8) and brownish-yellow (10YR 6/6) mottles; weak, coarse, prismatic structure; friable; thin grayish-brown (10YR 5/2) silt and organic coatings on prismatic faces and as linings in few voids; few pockets of carbonate in soft round masses; moderately alkaline; calcareous; diffused, wavy boundary.

Cg—43 to 60 inches, mottled gray (10YR 6/1) and yellowish-brown (10YR 5/6) silt loam; massive; friable; few, fine voids from old root channels or worm burrows lined with gray (10YR 5/1) organic and silt coatings; moderately alkaline; calcareous.

The A horizon ranges from 10 to 20 inches in thickness. It ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). In the B horizon color is 10YR or 5Y in hue, ranges from 4 through 6 in value, and is 1 or 2 in chroma. In some areas the color is neutral (N 4/0 or N 5/0). Color of the mottles is 10YR or 2.5Y in hue and ranges from 4 through 6 in value and from 1 through 8 in chroma. The C horizon is silt loam or silt. The solum ranges from 30 to 52 inches in thickness.

Ragsdale soils are similar to Brookston, Mahalasville, and Westland soils. Ragsdale soils are not stratified in the subsoil and in the substratum as are Mahalasville soils. They have less sand in the subsoil than Brookston and Westland soils.

Ragsdale silty clay loam (0 to 2 percent slopes) (Ra).—Some of this soil is in large areas on uplands, and some of this soil is in large areas within which are irregularly shaped islands of lighter colored soils. The lowest areas in some large tracts of this soil have a thicker surface layer and a grayer subsoil. In some areas of this soil the substratum has as little as 3 inches of calcareous silt over loam till, and in some areas the calcareous silt is underlain by stratified silt and sand.

Included with this soil in mapping were areas adjacent to Crosby and Fincastle soils where the lower part of the subsoil was formed in glacial till. Also included were areas of soils where the surface layer is silt loam. Also included was an area of approximately 25 acres in the SE¼SE¼ sec. 26, T. 19 N., R. 1 E. that has 10 to 20 inches of muck mixed with silt that overlies a subsoil of silty clay loam.

Wetness limits use and management.

If this Ragsdale soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management this soil can be used intensively for row crops. Its limitation for uses generally associated with residential development is severe. Capability unit IIw–1; tree and shrub suitability group 1.

Reesville Series

The Reesville series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils formed in silty material. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 8 inches of brown silt loam. The subsurface layer is about 3 inches of light-gray, mottled silt loam. The subsoil is about 26 inches thick. The upper 7 inches is yellowish-brown, mottled silty clay loam; the next 11 inches is grayish-brown, mottled silty clay loam; and the lower 8 inches is yellowish-brown and gray, mottled silt loam. The substratum, at a depth of 37 inches, is yellowish-brown and light-gray, mottled, calcareous silt loam.

Available water capacity is high, permeability and runoff are slow, and content of organic matter is moderate. The water table is seasonally high.

Representative profile of Reesville silt loam (in a cultivated field 400 feet west and 800 feet south of the northeast corner of the SE¼ sec. 2, T. 18 N., R. 2 W.):

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

A2g—8 to 11 inches, light-gray (10YR 7/1) silt loam; common, medium, distinct yellowish-brown (10YR 5/6) and gray (10YR 5/1) mottles; moderate, medium, platy structure that parts to moderate, medium, granular; friable; vertical wormholes average about 1 per square inch; dark grayish-brown (10YR 4/2) worm castings in pockets, old castings appear as splotches; medium acid; clear, wavy boundary.

B21t—11 to 18 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, faint, gray (10YR 5/1) mottles; moderate, fine, angular blocky structure; firm; thick light-gray (10YR 7/1) silt and clay films on faces of peds; medium acid; clear, wavy boundary.

B22tg—18 to 29 inches, grayish-brown (10YR 5/2) silty clay loam; many, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure that parts to fine and medium, subangular blocky; firm; common, fine, distinct, very dusky red (2.5YR 2/2) firm concretions of manganese and iron oxide; thin gray (10YR 5/1) clay films on faces of peds; slightly acid; gradual, wavy boundary.

B3tg—29 to 37 inches, mottled yellowish-brown (10YR 5/6) and gray (10YR 6/1) silt loam; weak, coarse, subangular blocky structure; friable; thick gray (10YR 5/1) clay films as linings in voids; few, soft, dark reddish-brown (5YR 2/2) accumulations of manganese and iron oxide; neutral; abrupt, wavy boundary.

C—37 to 60 inches, mottled yellowish-brown (10YR 5/4 and 5/8) and light-gray (10YR 6/1) silt loam; massive; friable; few accumulations of lime in fine, soft, rounded masses; moderately alkaline; calcareous.

The Ap horizon ranges from 6 to 10 inches in thickness. It ranges from dark grayish brown (10YR 4/2) to light brownish gray (10YR 6/2). In the B horizon color is 10YR in hue and ranges from 4 through 6 in value and from 1 through 6 in chroma. Color of the mottles is 10YR in hue and ranges from 4 through 6 in value and from 1 through 8 in chroma. The dominant colors of the B horizon are grayish brown (10YR 5/2) and yellowish brown (10YR 5/4). The C horizon is silt loam or silt. The solum ranges from 24 to 42 inches in thickness.

Reesville soils are similar to Crosby, Fincastle, Sleeth, and Whitaker soils. Reesville soils have less sand in the subsoil than Crosby and Fincastle soils. They do not have sand and gravel in the subsoil like Sleeth soils and are not stratified like Whitaker soils.

Reesville silt loam (0 to 2 percent slopes) (Re).—Some of this soil is in large continuous areas within which are very poorly drained soils, and some of this soil is in small to large areas surrounded by very poorly drained soils.

Included with this soil in mapping were small areas of Fincastle soils and areas where the calcareous silt is underlain by stratified silt and sand.

Wetness limits use and management.

If this Reesville soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management this soil can be used intensively for crops. Capability unit IIw–2; tree and shrub suitability group 2.

Shoals Series

The Shoals series consists of deep, somewhat poorly drained, nearly level soils on bottom lands. These soils formed in loamy sediment deposited by floods. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 9 inches of dark grayish-brown, mottled silt loam and about 5 inches of brown, mottled silt loam. The subsoil is about 22 inches thick. It is light brownish-gray silt loam in the upper 14 inches and grayish-brown, mottled silt loam in the lower 8 inches. The substratum, at a depth of 36 inches, is yellowish-brown, mottled loam.

Available water capacity is high, permeability and content of organic matter are moderate, and runoff is slow. The water table is seasonally high.

Representative profile of Shoals silt loam (in a cultivated field 100 feet south and 425 feet east of the northwest corner of the NE¼ sec. 15, T. 18 N., R. 2 E.):

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, fine and medium granular structure; friable; neutral; abrupt, smooth boundary.

A1—9 to 14 inches, brown (10YR 5/3) silt loam; common, medium, faint, light-brownish gray (10YR 6/2) mottles; moderate, medium, granular structure; friable; neutral; clear, smooth boundary.

B21g—14 to 28 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, distinct, brown (7.5YR 4/4) and yellowish-brown (10YR 5/6) mottles; moderate, medium, granular structure; friable; common fine sand grains; few dark-brown (7.5YR 3/2) concretions of iron and manganese oxide; neutral; gradual, smooth boundary.

B22g—28 to 36 inches, grayish-brown (10YR 5/2) silt loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, granular structure; friable; many, small dark yellowish-brown (10YR 3/4) concretions of iron and manganese oxide; common fine sand grains; neutral; gradual, smooth boundary.

C—36 to 60 inches, yellowish-brown (10YR 5/4) loam; many, coarse, distinct, yellowish-brown (10YR 5/6) and gray (10YR 6/1) mottles; massive; friable; neutral.

The Ap horizon ranges from 7 to 10 inches in thickness. It is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). In the B horizon, color is 10YR in hue and ranges from 4 through 6 in value and from 1 through 4 in chroma. The color of the mottles is 7.5YR or 10YR in hue and ranges from 4 through 6 in value and 1 through 8 in chroma. The B horizon is commonly silt loam or loam in the upper part and ranges from silt loam to sandy loam in the lower part. The C horizon ranges from silt loam to sandy loam and commonly is coarser as depth increases. The C horizon ranges from neutral to mildly alkaline. The solum ranges from 30 to 40 inches in thickness.

Shoals soils are similar to well-drained Genesee soils and very poorly drained Sloan soils. Shoals soils have mottles in the subsoil, but Genesee soils are not mottled. Shoals soils have a lighter colored surface layer and a browner subsoil than Sloan soils.

Shoals silt loam (0 to 2 percent slopes) (Sh).—Areas of this soil are on narrow or wide bottom lands. On many areas on the narrow bottom lands, meandering streams dissect this soil into small tracts. On the wide bottom lands, this soil is away from the streams and is adjacent to sloping soils on uplands or to sloping soils on outwash plains.

Included with this soil in mapping were small areas where the surface layer is loam. These areas are mainly on the wide bottom lands. Also included were areas where the surface layer is very dark gray, areas where the surface layer is calcareous, and some areas where the subsoil has a high sand content. Also included were small tracts of Sloan soils. Wet depressions that are less than 2 acres in size are shown on the soil map by the symbol for wet spots, and areas of muck that are less than 2 acres in size are shown on the soil map by the symbol for muck. A few included areas where pockets of sand and gravel are at depths of more than 36 inches are on the large bottom lands.

The hazard of flooding and wetness limit use and management. Sometimes crops are damaged by spring floods.

If this Shoals soil is artificially drained, it is suited to most crops grown in the county. It also is suited to permanent pasture, trees, and wildlife habitat. Under proper management this soil can be used intensively for row crops. Its limitations for uses associated with residential development are severe. Capability unit IIw-7; tree and shrub suitability group 2.

Sleeth Series

The Sleeth series consists of somewhat poorly drained, nearly level soils on outwash plains. These soils formed in glacial outwash material and are deep over sand and gravel. In places a layer of loess as much as 20 inches thick covers the outwash material. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 10 inches of dark grayish-brown silt loam. The subsurface layer is about 3 inches of grayish-brown silt loam. The subsoil is about 35 inches thick. The upper 4 inches is brown, mottled heavy loam; the next 7 inches is grayish-brown, mottled clay loam; and the lower 24 inches is grayish-brown and dark grayish-brown, mottled gravelly clay loam. The substratum, at a depth of 48 inches, is gray, calcareous sand and gravel.

Available water capacity is high, permeability and content of organic matter are moderate, and runoff is slow. The water table is seasonally high.

Representative profile of Sleeth silt loam (in a cultivated field 200 feet east and 15 feet north of the southwest corner of the SE¼ sec. 25, T. 20 N., R. 2 W.):

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

A2—10 to 13 inches, grayish-brown (10YR 5/2) silt loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, fine and medium, granular structure; friable; slightly acid; clear, wavy boundary.

IIB1tg—13 to 17 inches, brown (10YR 5/3) heavy loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; thick gray (10YR 6/1) silt and clay films on faces of peds; slightly acid; clear, wavy boundary.

IIB21tg—17 to 24 inches, grayish-brown (10YR 5/2) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure that parts to weak, medium, subangular blocky; firm; thin gray (10YR 5/1) clay films on faces of peds and as linings in voids; medium acid; clear, wavy boundary.

IIB22tg—24 to 39 inches, grayish-brown (10YR 5/2) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; firm; thin gray (10YR 5/1) clay films on faces of peds; many small pebbles and some gravel; slightly acid; gradual, wavy boundary.

IIB3t—39 to 48 inches, dark grayish-brown (2.5Y 4/2) gravelly clay loam; few, medium, distinct, yellowish-red (5YR 4/8) and olive-yellow (5Y 6/8) mottles; weak, coarse, subangular blocky structure; friable; thick dark-gray (10YR 4/1) clay films on the faces of most pebbles; moderately alkaline; calcareous; abrupt, irregular boundary.

IIIC—48 to 60 inches, gray (10YR 5/1) sand and gravel; single grained; loose; moderately alkaline; calcareous.

The Ap horizon ranges from 6 to 10 inches in thickness. It is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The A2 horizon ranges from 2 to 6 inches in thickness. It is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). In the B2 horizon, color is 10YR in hue and ranges from 4 through 6 in value and from 1 through 4 in chroma. In some areas the upper part of the B horizon is silty clay loam. Color of the mottles in the B2 horizon is 10YR in hue and ranges from 4 through 6 in value and from 1 through 8 in chroma. The solum ranges from 40 to 60 inches in thickness, and the loess deposit ranges from 0 to 20 inches.

Sleeth soils are similar to Crosby, Fincastle, Reesville, and Whitaker soils. They have more gravel in the subsoil and in the substratum than Crosby, Fincastle, Reesville, and Whitaker soils.

Sleeth silt loam (0 to 2 percent slopes) (St).—Some of this soil is in large continuous areas. Within these areas or surrounding these areas are well-drained or very poorly drained soils. Other areas of this soil are in slight depressions in small narrow areas surrounded by well-drained soils.

Included with this soil in mapping were small areas where the depth to sand and gravel is less than 40 inches and areas where the loess deposit is more than 20 inches thick. Small narrow areas of steeper soils that abruptly break to a lower elevation were also included. Steeper soils are generally shallower to sand and gravel than this soil, and they are shown on the soil map by the symbol for escarpments.

Wetness limits use and management of this soil.

If this Sleeth soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management this soil can be used intensively for row crops. Capability unit IIw-2; tree and shrub suitability group 2.

Sloan Series

The Sloan series consists of deep, very poorly drained, nearly level soils. These soils are in depressions on bottom lands. These soils developed in loamy sediment deposited by floods. The native vegetation consisted of water-tolerant trees and grasses.

In a representative profile the surface layer is about 13 inches thick. It is very dark gray silt loam in the upper 8 inches and is clay loam in the lower 5 inches. The subsoil is about 20 inches of dark-gray and gray, mottled clay loam. The substratum, at a depth of 33 inches, is gray, mottled, calcareous loam.

Available water capacity is high, permeability is moderate, and content of organic matter is high. Runoff is very slow on nearly level areas and is ponded in depressions. The water table is seasonally high.

Representative profile of Sloan silt loam (in a cultivated field 175 feet west and 125 feet south of the northeast corner of the SE¼NE¼ sec. 16, T. 19 N., R. 1 W.):

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

A1—8 to 13 inches, very dark gray (10YR 3/1) clay loam; few, fine, faint, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; neutral; clear, wavy boundary.

B21g—13 to 19 inches, dark-gray (10YR 4/1) clay loam; common, medium, distinct, pale-brown (10YR 6/3) and yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; neutral; gradual, wavy boundary.

B22g—19 to 26 inches, gray (10YR 5/1) clay loam; many, coarse, faint, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; neutral; clear, wavy boundary.

B3g—26 to 33 inches, gray (10YR 5/1) clay loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, angular blocky structure; friable; mildly alkaline; clear, wavy boundary.

Cg—33 to 60 inches, gray (10YR 6/1) loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; moderately alkaline; calcareous.

The A horizon ranges from 10 to 20 inches in thickness. It is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). In the B horizon, color is 10YR or 5YR in hue. 4 or 5 in value, and 1 or 2 in chroma. Color of the mottles is 10YR or 5YR in hue and ranges from 3 through 6 in value and chroma. The B horizon is commonly clay loam; but in some areas it is silty clay loam, silt loam, or loam. The C horizon ranges from silt loam to sandy loam and commonly becomes coarser as depth increases. The C horizon ranges from neutral to moderately alkaline. The solum ranges from 30 to 60 inches in thickness.

Sloan soils are similar to well-drained Genesee soils and somewhat poorly drained Shoals soils. Sloan soils have a darker colored surface layer and a grayer subsoil than Genesee and Shoals soils.

Sloan silt loam (0 to 2 percent slopes) (Sx).—Some areas of this soil are in slight depressions within broad areas of better drained soils on bottom lands. Other areas are adjacent to the base of steep slopes where seepage occurs.

Included with this soil in mapping were small areas of soils that have a surface layer of silty clay loam. Wet depressions less than 2 acres in size are shown on the soil map by the symbol for wet spots. A muck symbol denotes areas of muck less than 2 acres in size. On the large bottom lands there are a few included areas where pockets of sand and gravel are at depths of more than 33 inches.

Wetness and the flood hazard limit use and management of this soil. Crops are sometimes damaged by spring floods.

If this Sloan soil is artificially drained, it is suited to most crops commonly grown in the county. It is also suited to permanent pasture, trees, and wildlife habitat. Under proper management this soil can be used intensively for row crops. Its limitations for uses commonly associated with residential development are severe. Capability unit IIIw-9; tree and shrub suitability group 1.

Westland Series

The Westland series consists of very poorly drained, nearly level soils that are in depressions on outwash plains. These soils formed in glacial outwash material and are deep over sand and gravel. The native vegetation consisted of water-tolerant trees and grasses.

In a representative profile the surface layer is about 13 inches of black light silty clay loam in the upper 8 inches and black, mottled light clay loam in the lower 5 inches. The subsoil is about 40 inches thick. The upper 32 inches is dark-gray, grayish-brown, and gray, mottled clay loam; and the lower 8 inches is dark-gray, mottled gravelly clay loam. The substratum, at a depth of 53 inches, is gray, calcareous sand and gravel.

Available water capacity is high, permeability is slow, and content of organic matter is high. Runoff is very slow on nearly level areas and is ponded in depressions. The water table is seasonally high.

Representative profile of Westland silty clay loam (in a cultivated field 675 feet west and 120 feet north of the center of sec. 35, T. 20 N., R. 2 W.):

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

A1—8 to 13 inches, black (10YR 2/1) light clay loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, medium, granular structure; friable; neutral; clear, wavy boundary.

B21tg—13 to 29 inches, dark-gray (10YR 4/1) clay loam; many, fine, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) mottles; weak, coarse, prismatic structure that parts to moderate, fine, angular blocky; firm; thick very dark gray (10YR 3/1) organic and clay films on faces of peds and as linings in voids; neutral; clear, wavy boundary.

B22tg—29 to 37 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, yellowish-brown (10YR 5/6–5/8) mottles; weak, coarse, prismatic structure that parts to weak, medium, subangular blocky; firm; thick black (10YR 2/1) organic and clay films on prismatic faces and as linings in voids; few fine pebbles; neutral; clear, wavy boundary.

B23tg—37 to 45 inches, gray (10YR 5/1) clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure that parts to weak, medium and coarse, subangular blocky; firm; thick dark-gray (10YR 4/1) organic and clay films on prismatic faces and as linings in voids; 10 to 15 percent gravel, 1/4 inch to 1 inch in diameter; neutral; clear, wavy boundary.

B24tg—45 to 53 inches, dark-gray (10YR 4/1) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; thick very dark gray (10YR 3/1) organic and clay films as linings in voids; pebbles 1/4 inch to 1 inch in diameter; neutral; abrupt, irregular boundary.

IICg—53 to 62 inches, gray (10YR 6/1) sand and gravel; single grained; loose; moderately alkaline; calcareous.

The A horizon ranges from 10 to 18 inches in thickness. It ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). In the B horizon, color is 10YR or 5Y in hue, ranges from 4 through 6 in value, and is 1 or 2 in chroma. Color of the mottles is 10YR or 2.5Y in hue and ranges from 4 through 6 in value and from 2 through 8 in chroma or 7.5YR 5/6 in the B24 horizon. In some areas the A1 and the B21tg horizons are silty clay loam. The solum ranges from 40 to 60 inches in thickness.

Westland soils are similar to Brookston, Mahalasville, and Ragsdale soils. Westland soils have more sand and gravel in the subsoil and in the substratum than Mahalasville and Ragsdale soils. They have more gravel in the lower part of the subsoil and in the substratum than Brookston soils.

Westland silty clay loam (We).—Some of this soil is on flats or is in depressions adjacent to well-drained and somewhat poorly drained soils. Other areas of this soil are low and level and are dissected by streams or ditches.

Included with this soil in mapping were areas of soils that have a surface layer of silt loam, and areas that have a thin layer of loess. Also included were small areas of soils that are underlain by fine sand and silt and a few areas of soils where the depth to sand and gravel is less than 40 inches.

Wetness limits use and management of this soil.

If this Westland soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management this soil can be used intensively for row crops. Its limitations for uses commonly associated with residential development are severe. Capability unit IIw–1; tree and shrub suitability group 1.

Whitaker Series

The Whitaker series consists of deep, somewhat poorly drained, nearly level soils on outwash plains and in glacial sluiceways. These soils formed in loamy outwash material. Thin layers of stratified silt, sand, and clay occur at a depth of about 3 feet. In places a layer of loess up to 20 inches thick covers the outwash material. The native vegetation consisted of hardwoods.

In a representative profile the surface layer is about 9 inches of dark grayish-brown silt loam. The subsoil is about 37 inches thick. The upper 18 inches is light olive-brown, mottled clay loam, the next 13 inches is grayish-brown, mottled sandy clay loam and sandy loam, and the lower 6 inches is grayish-brown, mottled loamy sand. The substratum, at a depth of 46 inches, is yellowish-brown, stratified, mottled, calcareous sand, sandy loam, loam, and silt loam.

Available water capacity is high, permeability and content of organic matter are moderate, and runoff is slow. The water table is seasonally high.

Representative profile of Whitaker silt loam (in a cultivated field 50 feet west and 325 feet south of the northeast corner of the NW1/4SW1/4 sec. 4, T. 18 N., R. 1 E.):

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

B21t—9 to 18 inches, light olive-brown (2.5Y 5/4) clay loam; common, medium, faint, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; firm; few black (10YR 2/1) concretions of manganese and iron oxide; thick dark grayish-brown (10YR 4/2) clay films on faces of peds; medium acid; clear, smooth boundary.

B22t—18 to 27 inches, light olive-brown (2.5Y 5/4) clay loam; many, fine, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; few black (10YR 2/1) concretions of manganese and iron oxide; thick dark grayish-brown (10YR 4/2) clay films on faces of peds and as linings in voids; slightly acid; clear, smooth boundary.

B23tg—27 to 37 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure; firm; thick dark grayish-brown (10YR 4/2) clay films on faces of peds and as linings in voids; neutral; abrupt, smooth boundary.

IIB24tg—37 to 40 inches, grayish-brown (10YR 5/2) sandy loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; few, thin, dark grayish-brown (10YR 4/2) clay films as linings in some voids; neutral; abrupt, wavy boundary.

IIB3g—40 to 46 inches, grayish-brown (10YR 5/2) loamy sand; coarse, faint, yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure; friable; few pebbles 1/4 inch to 1/2 inch in size; neutral; abrupt, wavy boundary.

IIIC—46 to 60 inches, yellowish-brown (10YR 5/4) stratified sand, sandy loam, loam, and silt loam; many, coarse, distinct, light-gray (10YR 6/1) and light brownish-gray (10YR 6/2) mottles; massive; friable; moderately alkaline; calcareous.

The A horizon ranges from 8 to 16 inches in thickness. It ranges from dark grayish brown (10YR 4/2) to light brownish gray (10YR 6/2). In the B horizon, color is 10YR or 2.5Y in hue and ranges from 4 through 6 in value and from 1 through 4 in chroma. Color of the mottles is 10YR or 2.5Y in hue and ranges from 4 through 6 in value and from 1 through 8 in chroma. In some areas the B21tg horizon is silty clay loam. The C horizon is stratified. It ranges from silt to sand and has thin layers of clay loam or silty clay loam. The solum ranges from 36 to 60 inches in thickness, and the loess deposit ranges from 0 to 20 inches.

Whitaker soils are similar to Crosby, Fincastle, Reesville, and Sleeth soils. Whitaker soils are stratified in the lower part of the subsoil and in the substratum; and Crosby, Fincastle, and Reesville soils are not. They have less sand and gravel in the lower part of the subsoil and in the substratum than Sleeth soils.

Whitaker silt loam (0 to 2 percent slopes) (Wh).—This soil is in areas surrounded by very poorly drained soils. Areas of this soil are predominantly 5 to 15 acres in size and are irregularly shaped. This soil is very level in some areas where it is associated with Mahalasville soils.

Included with this soil in mapping were areas of soils that are similar to Whitaker soils except that the upper part of the subsoil is less sandy. Also included were small areas of Fincastle soils. Small narrow areas of steeper soils that abruptly break to a lower elevation were also included; these soils are shown on the soil map by the symbol for escarpments.

Wetness limits use and management of this soil.

If this Whitaker soil is artificially drained, it is suited to all crops commonly grown in the county. Under proper management this soil can be used intensively for row crops. Capability unit IIw–2; tree and shrub suitability group 2.

Use and Management of the Soils

This section contains information about the use and management of the soils of Boone County for crops, trees and shrubs, wildlife, recreation, and engineering.

Use of the Soils for Crops

About four-fifths of the acreage of Boone County is used for crops and permanent pasture. The main cultivated crops are corn, soybeans, wheat, and oats. The principal forage crops are clover-grass hay and alfalfa-grass hay. A small acreage is used for tomatoes.

Winter cover crops, green-manure crops, and crop residues can be utilized to help maintain or increase the organic-matter content of the soils. Along with minimum tillage, they also help to preserve or improve soil tilth.

Sloping soils, such as those of the Miami series, erode when cultivated unless protective measures are used. Minimum tillage, contour cultivation, grassed waterways, diversions, proper use of crop residue, and the inclusion of grass and legumes in the rotation are effective in controlling erosion and also help to conserve moisture.

Wet soils, such as those of the Ragsdale series, have to be drained artificially, by tile systems or by surface ditches, before they can be used profitably to grow crops. Most tile and surface drains outlet into open ditches that have been dug to help speed the drainage of excess water.

Soil tests should be made to determine the amounts of lime and fertilizer needed for cultivated crops and pasture. Crops respond well to the proper amounts of lime and fertilizer.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are 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 tomatoes, 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, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat. (None of the soils in this county is in class V.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and restrict their use mainly to pasture, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and restrict their use mainly to pasture, woodland, or wildlife habitat.

Class VIII soils and land types have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife habitat, water supply, or to esthetic purposes. (None of the soils in this county is in class VIII.)

CAPABILITY SUBCLASSES are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water on or in 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, although they have other limitations that restrict their use mainly to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIw–2 or IIIe–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

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

CAPABILITY UNIT I–1

This unit consists of deep, well-drained, nearly level soils of the Miami and Ockley series. These soils are on uplands and outwash plains. The surface layer is silt loam. Permeability is moderate, and available water capacity is high.

These soils are suited to all crops commonly grown in the county. Corn and soybeans are the main crops, but small grain, alfalfa-grass hay, and clovergrass hay are also grown. Trees also grow well on these soils.

These soils are easy to cultivate and have few limitations for farming. If these soils are properly managed, they are suited to intensive use for row crops.

CAPABILITY UNIT I–2

This unit consists of Genesee silt loam, a deep, well-drained soil on bottom lands (fig. 10). Permeability is moderate, and available water capacity is high.

This soil is suited to most crops commonly grown in the county. Corn and soybeans are the main crops. Narrow or irregularly shaped areas of this soil that are difficult to cultivate are suited to permanent pasture, wildlife habitat, and woodland. Trees grow well on this soil, especially walnut and tulip-poplar.

This soil is easy to cultivate and has few limitations for farming. Stream flooding generally is a hazard in spring. Well-established sod in overflow channels and along bare embankments helps to reduce scouring. If this soil is properly managed, it is suited to intensive use for row crops.

CAPABILITY UNIT IIe–1

This unit consists of Miami silt loam, 2 to 6 percent slopes, eroded. This soil is deep and well drained. It is on uplands. Permeability is moderate, and available water capacity is high.

This soil is suited to all crops commonly grown in the county. Corn, soybeans, small grain, clover-grass hay, and alfalfa-grass hay are the main crops. Trees also grow well on this soil.

This soil is easy to cultivate. Erosion is a hazard, and management practices are needed to minimize soil loss.

CAPABILITY UNIT IIe–3

This unit consists of Ockley silt loam, 2 to 6 percent slopes, eroded. This soil is deep and well drained. It is on outwash plains. Permeability is moderate, and available water capacity is high.

This soil is suited to all crops commonly grown in the county. Corn, soybeans, small grain, clover-grass hay, and alfalfa-grass hay are the main crops. Trees also grow well on this soil.

This soil is easy to cultivate. This soil erodes easily and management practices are needed to minimize soil loss. This soil dries quickly after rain, and it can be plowed earlier in spring than most soils in the county.

CAPABILITY UNIT IIe–9

This unit consists of Fox silt loam, 2 to 6 percent slopes, eroded. This soil is well drained and is on outwash plains. It is moderately deep over sand and gravel. The effective rooting depth is about 3 feet. Permeability is moderate above the sand and gravel, and available water capacity is also moderate.

This soil is suited to all crops commonly grown in the county. It is well suited to small grain, alfalfa-grass hay, and clover-grass hay; and these are the main crops grown. Insufficient moisture often limits plant growth.

This soil is easy to cultivate. Erosion is the main hazard. Droughtiness caused by the moderate depth to sand and gravel and insufficient moisture is a limitation. Erosion-control practices are needed that will minimize soil loss, and irrigation is needed to insure an adequate supply of water for crops.

CAPABILITY UNIT IIe–12

This unit consists of Crosby-Miami silt loams, 2 to 6 percent slopes, eroded. These are deep soils on uplands. The surface layer is silt loam. Permeability is slow in the somewhat poorly drained Crosby soil. Permeability is moderate in the well-drained Miami soil. Available water capacity is high in both these soils.

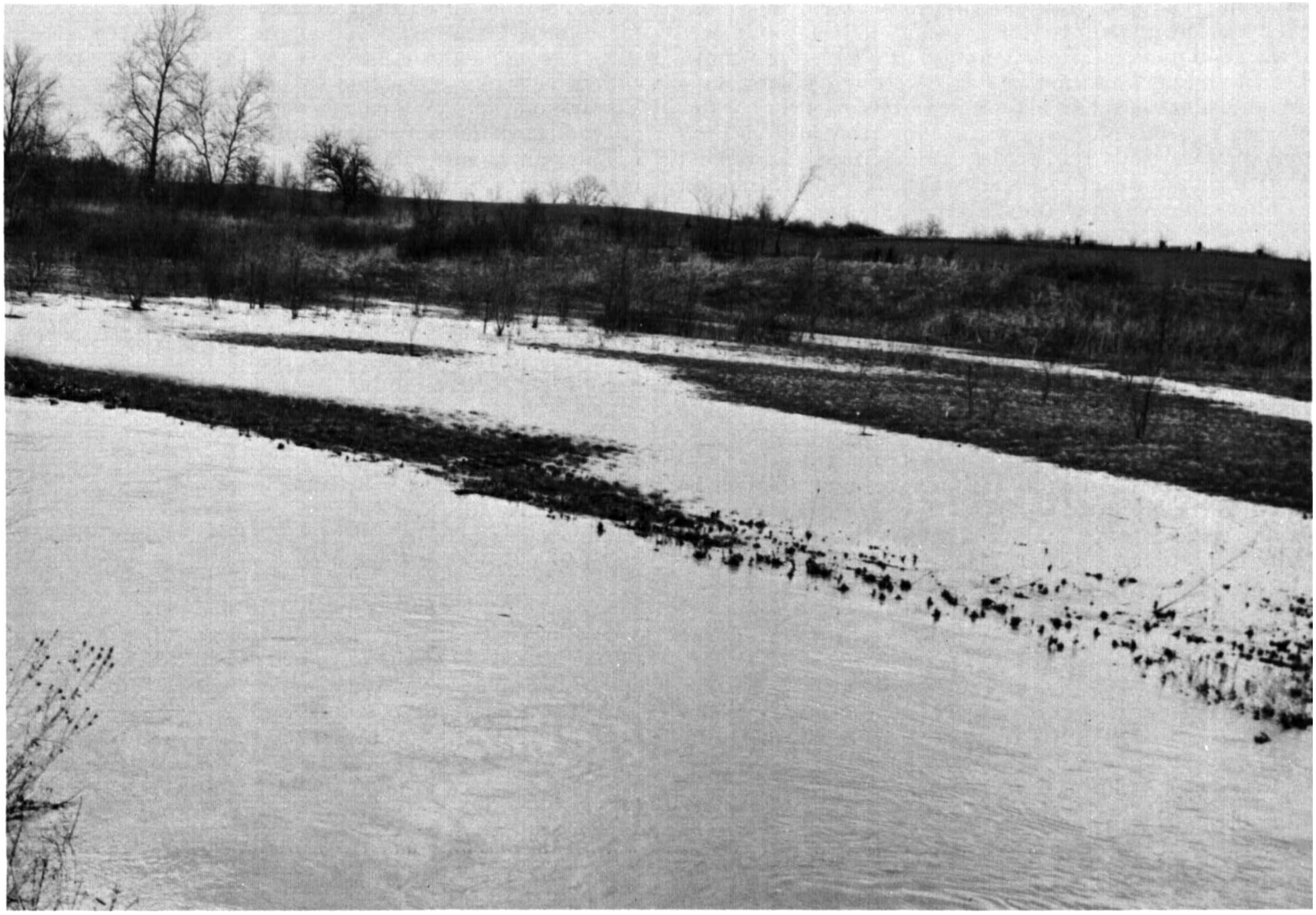

Figure 10.—**Genesee silt loam, flooded after a spring rain.**

These soils are suited to all crops commonly grown in the county. Corn, soybeans, small grain, clover-grass hay, and alfalfa-grass hay are the main crops. Trees also grow well on these soils.

Erosion is a hazard. Wetness resulting from a seasonal high water table is a limitation in the Crosby soil but not in the Miami soil. Management practices are needed to minimize soil loss. Constructing shallow surface drains and installing drainage tiles are practices that help to reduce wetness. Careful management to control the hazard of erosion is needed if these soils are used intensively for row crops.

CAPABILITY UNIT IIw-1

This unit consists of deep, very poorly drained Brookston, Mahalasville, Ragsdale, and Westland soils. These soils are on nearly level outwash plains and in depressions on uplands. The surface layer is silty clay loam or silt loam. Permeability is slow, and available water capacity is high.

If these soils are artificially drained, they are suited to all crops commonly grown in the county. Corn (fig. 11) and soybeans are the main crops.

These soils are easy to cultivate. If these soils are plowed when they are too wet, large clods form and become very firm when dry. These clods make it difficult to prepare a seedbed. Dry, very firm clods generally do not occur in Brookston silt loam, overwash. Wetness caused by a seasonal high water table and surface ponding (fig. 12) are limitations. Constructing shallow surface drains and installing drainage tiles are practices that help to reduce wetness. If these soils are properly managed, they are suited to intensive use for row crops.

CAPABILITY UNIT IIw-2

This unit consists of deep, somewhat poorly drained, nearly level soils of the Crosby, Fincastle, Reesville, Sleeth, and Whitaker series. These soils are on uplands and outwash plains. The surface layer is silt loam.

Permeability is slow in the Crosby, Fincastle, and Reesville soils and moderate in the Sleeth and Whitaker soils. Available water capacity is high in all the soils in this unit.

These soils are suited to all crops commonly grown in the county. Corn and soybeans are the main crops.

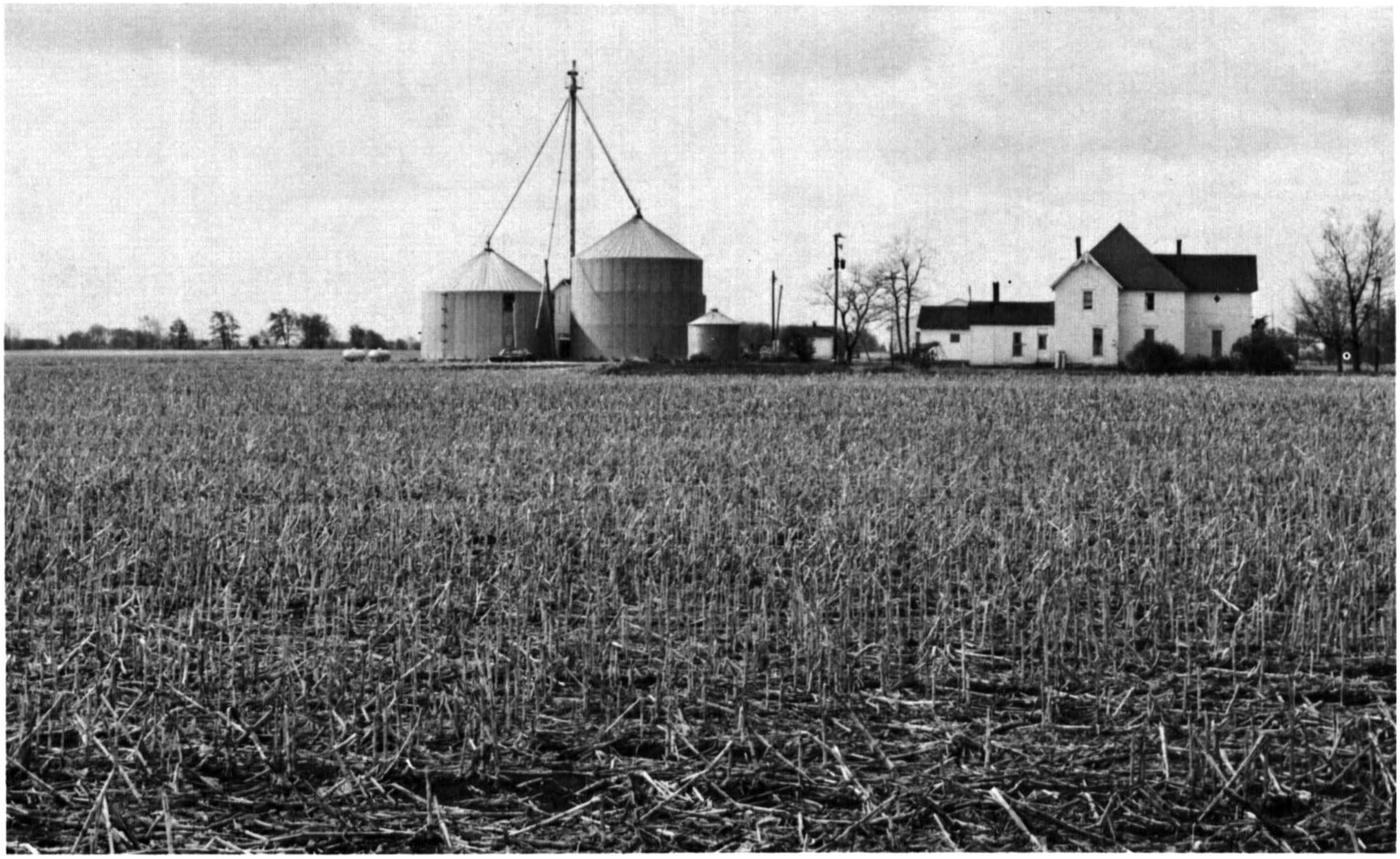

Figure 11.—Corn stubble on nearly level Brookston silty clay loam, which is in capability unit IIw-1. Drying and storage silos for grain are in the background.

These soils are easy to cultivate. If the surface of these soils is not protected, rain generally loosens and rearranges the exposed soil particles and causes them to seal. This sealing causes a thin crust to form when the surface soil dries. This crust can retard the emergence of plant seedlings, increase surface runoff, and reduce infiltration. Wetness resulting from a seasonal high water table is a limitation. Constructing shallow surface drains and installing tile drains are methods that help to reduce wetness. If these soils are properly managed, they are suited to intensive use for row crops.

CAPABILITY UNIT IIw-7

This unit consists of Shoals silt loam. This soil is deep and somewhat poorly drained. It is on bottom lands and is subject to flooding. Permeability is moderate, and available water capacity is high.

If this soil is artificially drained, it is suited to most crops commonly grown in the county. Corn and soybeans are the main crops. Narrow or irregularly shaped areas of this soil that are difficult to cultivate are suited to permanent pasture, wildlife habitat, and woodland.

This soil is easy to cultivate. Wetness caused by a seasonal high water table is a limitation. Stream flooding generally is a hazard in spring. Constructing surface drainage ditches and installing drainage tiles are practices that help to reduce wetness. Well-established sod in overflow channels and along bare embankments helps to reduce scouring. Diversion of runoff from uplands helps to reduce flooding in some areas. If this soil is properly managed, it is suited to intensive use for row crops.

CAPABILITY UNIT IIs-1

This unit consists of Fox silt loam, 0 to 2 percent slopes. This soil is well drained and is on outwash plains. It is moderately deep over sand and gravel. The effective rooting depth is about 3 feet. Permeability is moderate above the sand and gravel, and available water capacity is also moderate.

This soil is suited to all crops commonly grown in the county. It is well suited to small grain, alfalfa-grass hay, and clover-grass hay. These crops and corn and soybeans are the main crops grown. Insufficient moisture often limits plant growth.

This soil is easy to cultivate. Droughtiness caused by the moderate depth to sand and gravel and insufficient moisture is a limitation. Irrigation is needed to insure an adequate supply of water for crops.

CAPABILITY UNIT IIIe-1

This unit consists of deep, well-drained soils of the Miami series. These soils are on uplands. The gently slop-

Figure 12.—**Water ponded on Ragsdale silty clay loam, which is in capability unit IIw-1.**

ing soils are severely eroded, and the moderately sloping soils are eroded. The surface layer is clay loam or silt loam. Permeability is moderate, and available water capacity is high.

These soils are suited to all crops commonly grown in the county. Corn, soybeans, small grain, clover-grass hay, and alfalfa-grass hay are the main crops grown. Trees also grow well on these soils.

Erosion and runoff are hazards. Management practices that help to reduce runoff and soil loss are needed. Improvement of tilth and an increase in content of organic matter are needed on the severely eroded soil.

CAPABILITY UNIT IIIe-9

This unit consists of Fox silt loam, 6 to 12 percent slopes, eroded. This soil is well drained and is on outwash plains. It is moderately deep over sand and gravel. The effective rooting depth is about 3 feet. Permeability is moderate above the sand and gravel, and available water capacity is also moderate.

This soil is better suited to alfalfa-grass hay, clover-grass hay, and small grain than to corn and soybeans. Insufficient moisture often limits plant growth.

Erosion and runoff are hazards. Management practices that help to reduce runoff and soil loss are needed. Droughtiness caused by the moderate depth to sand and gravel and insufficient moisture are limitations.

CAPABILITY UNIT IIIw-9

This unit consists of Sloan silt loam. This soil is deep, very poorly drained, and nearly level. It is in depressions on bottom lands and is subject to occasional flooding. Permeability is moderate, and available water capacity is high.

If this soil is artificially drained, it is suited to most crops commonly grown in the county. Corn and soybeans are the main crops. Narrow or irregularly shaped areas of this soil that are difficult to cultivate are suited to water-tolerant grasses, to trees, and to wildlife.

This soil is easy to cultivate. Wetness caused by a seasonal high water table and surface ponding are limitations. Stream flooding generally is a hazard in spring. Constructing ditches and installing drainage tiles are practices that help to reduce wetness. Intercepting water that seeps from higher soils also helps to reduce wetness in some areas. If this soil is properly managed, it is suited to intensive use for row crops.

CAPABILITY UNIT IVe-1

This unit consists of deep, well-drained soils of the Miami series. These soils are on uplands. The moderately sloping soils are severely eroded, and strongly sloping soils are eroded. The surface layer is clay loam or silt loam. Permeability is moderate, and available water capacity is high.

These soils are better suited to small grain, alfalfa-grass hay, or clover-grass hay than to row crops. On the moderately sloping soil, the main crops grown are corn, soybeans, small grain, alfalfa-grass hay, and clover-grass hay. On the strongly sloping soil, the main crops are grasses and legumes. Trees also grow well on these soils.

Runoff and erosion are hazards. Management practices that help to reduce runoff and soil loss are needed. Improvement of tilth and an increase in content of organic matter are needed on the severely eroded soil. Grasses and legumes and minimum tillage help to improve tilth, conserve moisture, reduce runoff, and limit soil loss. The operation of some equipment is limited on the strongly sloping soils.

CAPABILITY UNIT VIe-1

This unit consists of deep, well-drained soils of the Miami series. These soils are on uplands. The strongly sloping soils are severely eroded, and moderately steep soils are eroded. The surface layer is clay loam or silt loam. Permeability is moderate, and available water capacity is high.

These soils are suited to pasture, hay crops, and woodland. Legumes, grasses, and small grain are the main crops grown. Trees also grow well on these soils.

Erosion and runoff are hazards. Management practices that help to reduce runoff and soil loss are needed. Improvement of tilth and an increase in content of organic matter are needed on the severely eroded soil. Grasses and legumes and minimum tillage help to improve tilth, conserve moisture, reduce runoff, and limit soil loss. The operation of some equipment is severely limited on these soils.

CAPABILITY UNIT VIIe-2

This unit consists of Hennepin loam, 25 to 50 percent slopes. This soil is deep, well drained, and on uplands. Permeability is moderate, and available water capacity is high.

This soil is suited to many species of trees. Some areas are grazed, but most areas are in woodland.

Erosion and very rapid runoff are hazards, and steepness of the slopes is a limitation. Management practices that help to reduce runoff and soil loss are needed.

Estimated yields

Estimated yields of the principal crops grown in Boone County are shown in table 2. These yields are averages for a period of 5 to 10 years. They are based on farm records, on interviews with farmers and with members of the staff of the Purdue University Agricultural Experiment Station, and on direct observations by soil scientists and soil conservationists. Factors considered in making the estimated yields were the prevailing climate, the characteristics of the soils, and the influence of different kinds of management on the soils.

These figures are not intended to apply directly to specific tracts of land for any particular year, because soils vary somewhat from place to place, management practices differ from farm to farm, and weather conditions vary from year to year. Nevertheless, the estimated yields are useful in showing relative productivity of the soils.

The following are assumed to be part of a management system needed to obtain the yields in table 2.

1. Using cropping systems that maintain tilth and organic-matter content.
2. Controlling erosion to the maximum extent possible so that qualities of the soil will be maintained or improved rather than impaired.
3. Maintaining a high level of fertility by means of frequent soil tests and use of fertilizer in accordance with recommendations of the Purdue University Agricultural Experiment Station.
4. Liming soils in accordance with the results of soil tests.
5. Using crop residue to the fullest extent to protect and improve the soil.
6. Following minimum tillage practices.
7. Planting only the crop varieties that are best adapted to the soils and climate.
8. Controlling weeds and insects thoroughly by tillage and the use of pesticides and herbicides.
9. Draining wet areas well enough that wetness does not restrict yields.

Trees and Shrubs [2]

Table 3 provides information about the characteristics and suitable uses of trees and shrubs. The table includes only a partial list of the trees and shrubs suited to the soils of Boone County. The tree and shrub suitability group of each individual soil is given in the "Guide to Mapping Units" and at the end of the soil description.

Among the soil characteristics that most affect the growth of trees and shrubs are available water capacity, natural drainage, and thickness of the root zone. Other important characteristics are aeration, thickness of the surface layer, natural supply of nutrients, texture and consistence of soil material, and depth to the water table. The tree and shrub suitability groups are based mainly on natural drainage and available water capacity of the soils.

Trees and shrubs are very useful for shade, screen plantings, windbreaks, cover for wildlife, cover for road cuts, and erosion control. In addition they have esthetic values if planted in parks and other recreation areas; around homes in the country and built-up residential areas; for beautification along highways, streets, and roads; and for overall community beautification. Many plants serve more than one purpose. Shelterbelts and windbreaks to the north and west of buildings give year-round protection from wind, as well as adding to the attractiveness of the landscape and providing cover for wildlife. Some plants that provide food and cover for wildlife also make good hedges.

[2] By JOHN O. HOLWAGER, woodland conservationist, Soil Conservation Service.

TABLE 2.—*Estimated average yields per acre of principal crops grown in county*

[Dashed lines indicate that the crop either is not grown or is not suited to the soil specified]

Soil	Corn	Soybeans	Wheat	Oats	Clover-grass hay	Alfalfa-grass hay
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Brookston silt loam, overwash	130	45	50	90	4.0	5.5
Brookston silty clay loam	130	45	50	90	4.0	5.5
Crosby silt loam, 0 to 3 percent slopes	120	40	50	85	4.0	5.5
Crosby-Miami silt loams, 2 to 6 percent slopes, eroded	115	35	50	85	4.0	5.0
Fincastle silt loam, 0 to 3 percent slopes	120	40	50	85	4.0	5.5
Fox silt loam, 0 to 2 percent slopes	85	30	50	60	3.5	4.5
Fox silt loam, 2 to 6 percent slopes, eroded	85	30	45	60	3.5	4.5
Fox silt loam, 6 to 12 percent slopes, eroded	80	25	40	55	3.2	4.0
Genesee silt loam	115	40	----	----	----	----
Hennepin loam, 25 to 50 percent slopes	----	----	----	----	----	----
Mahalasville silty clay loam	130	45	50	90	4.0	5.5
Miami silt loam, 0 to 2 percent slopes	120	40	50	90	4.5	5.5
Miami silt loam, 2 to 6 percent slopes, eroded	110	35	50	85	4.0	5.0
Miami silt loam, 6 to 12 percent slopes, eroded	100	30	45	70	4.0	5.0
Miami silt loam, 12 to 18 percent slopes, eroded	75	25	40	70	3.5	4.5
Miami silt loam, 18 to 25 percent slopes, eroded	----	----	35	55	3.5	4.0
Miami clay loam, 2 to 6 percent slopes, severely eroded	100	30	45	70	3.8	5.0
Miami clay loam, 6 to 12 percent slopes, severely eroded	75	25	40	70	3.5	4.5
Miami clay loam, 12 to 18 percent slopes, severely eroded	----	----	30	55	3.0	4.0
Ockley silt loam, 0 to 2 percent slopes	120	40	50	90	4.5	5.5
Ockley silt loam, 2 to 6 percent slopes, eroded	105	35	45	70	4.0	4.5
Ragsdale silty clay loam	130	45	50	90	4.0	5.5
Reesville silt loam	120	40	50	85	4.0	5.5
Shoals silt loam	115	40	----	----	----	----
Sleeth silt loam	115	40	50	85	4.0	5.0
Sloan silt loam	110	45	----	----	----	----
Westland silty clay loam	130	45	50	90	4.0	5.5
Whitaker silt loam	115	40	50	85	4.0	5.5

TABLE 3.—*Tree and shrub planting guide*

[Dashes indicate that, on the soils of the particular group, the plant is not suitable for any of the specified uses]

Plant	Characteristics of the plant	Suitable uses, by tree and shrub suitability groups			
		Group 1	Group 2	Group 3	Group 4
Arborvitae, American.	Height of 20 to 30 feet at maturity; evergreen.	Screen planting and windbreak; ornamental.	----	----	----
Arrowwood	Height of 6 to 10 feet at maturity; attractive flower and fruit; shade tolerant.	----	Screen planting; wildlife food and cover; road cuts.	----	----
Ash, mountain	Height of 40 to 50 feet at maturity; white flowers, reddish-orange fruit.	----	----	Ornamental and shade; wildlife food and cover.	----
Autumn-olive	Height of 6 to 12 feet at maturity; yellow flowers, red berries; leaves are green on top and silver on bottom.	----	Screen planting and windbreak; ornamental; wildlife food and cover; road cuts.	Screen planting and windbreak; ornamental; wildlife food and cover; road cuts and eroded areas.	Screen planting and windbreak; ornamental; wildlife food and cover; road cuts and eroded areas.
Basswood	Height of 80 to 100 feet at maturity; flowers attract honeybees; winged seeds.	----	Shade; wildlife food and cover.	----	----

TABLE 3.—*Tree and shrub planting guide*—Continued

Plant	Characteristics of the plant	Suitable uses, by tree and shrub suitability groups			
		Group 1	Group 2	Group 3	Group 4
Birch:					
Red River	Height of 50 to 60 feet at maturity; red to pink bark, peels around trunk; shade tolerant.	Ornamental and shade; road cuts.			
White	Height of 30 to 40 feet at maturity; white bark; usually planted in clumps of 3 or 4 trees; shade tolerant.			Ornamental	
Blackhaw	Height of 12 to 16 feet at maturity; white clustered flowers; blue-black fruit; shade tolerant.		Screen planting and windbreak; wildlife food and cover; road cuts.	Screen planting and windbreak; wildlife food and cover; road cuts and eroded areas.	Screen planting and windbreak; wildlife food and cover; road cuts and eroded areas.
Burningbush, winged.	Height of 8 to 10 feet at maturity; red fruit; winged twigs.			Screen planting; wildlife food and cover; road cuts and eroded areas.	
Cherry, cornelian	Height of 8 to 10 feet at maturity; yellow blossoms; large red fruit; shade tolerant.		Screen planting; ornamental; wildlife food and cover.		
Cranberry, highbush.	Height of 6 to 10 feet at maturity; white flowers; red berries; red fall foliage.		Screen planting and windbreak; ornamental; wildlife food and cover.	Screen planting and windbreak; ornamental; wildlife food and cover.	
Dogwood:					
Flowering	Height of 12 to 20 feet at maturity; white flowers; red fruit; shade tolerant.			Ornamental and shade; wildlife food and cover.	Ornamental and shade; wildlife food and cover; road cuts and eroded areas.
Gray	Height of 6 to 8 feet at maturity; white fruit; gray branches; shade tolerant.	Screen planting and windbreak; wildlife food and cover; road cuts.			
Red-osier	Height of 8 to 10 feet at maturity; green-white flower; white fruit; purplish-red to red branches; shade tolerant.	Screen planting and windbreak; wildlife food and cover; road cuts.	Screen planting and windbreak; wildlife food and cover; road cuts.	Screen planting and windbreak; wildlife food and cover; road cuts and eroded areas.	
Silky	Height of 8 to 10 feet at maturity; white flowers; blue fruit; shade tolerant.	Screen planting and windbreak; wildlife food and cover; road cuts.			
Elderberry, American.	Height of 6 to 8 feet at maturity; white flower; blue-black fruit.	Wildlife food and cover.			
Forsythia	Height of 8 to 10 feet at maturity; yellow flowers; shade tolerant.			Screen planting and windbreak; road cuts and eroded areas.	Screen planting and windbreak; road cuts and eroded areas.
Gum:					
Black	Height of 50 to 60 feet at maturity; scarlet fall color; shade tolerant.	Ornamental and shade; wildlife food and cover.	Ornamental and shade; wildlife food and cover.	Ornamental and shade; wildlife food and cover.	
Red	Height of 50 to 60 feet at maturity; red to scarlet fall color; winged bark on limbs.	Ornamental and shade; road cuts.			

TABLE 3.—*Tree and shrub planting guide*—Continued

Plant	Characteristics of the plant	Suitable uses, by tree and shrub suitability groups			
		Group 1	Group 2	Group 3	Group 4
Hazelnut (filbert)	Height of 6 to 8 feet at maturity; edible nuts.			Screen planting and windbreak; wildlife food and cover; road cuts and eroded areas.	Screen planting and windbreak; wildlife food and cover; road cuts and eroded areas.
Honeysuckle, amur	Height of 10 to 15 feet at maturity; white flowers; red fruit; fruit attracts songbirds.	Screen planting and windbreak; wildlife food and cover; road cuts.	Screen planting and windbreak; wildlife food and cover; road cuts.	Screen planting and windbreak; wildlife food and cover; road cuts and eroded areas.	
Larch, European	Height of more than 50 feet at maturity; sheds needles in fall; shallow roots.	Ornamental and shade.			
Lilac, varieties	Height of 10 to 12 feet at maturity; white to purple flowers.			Screen planting and windbreak; ornamental; wildlife food and cover; road cuts and eroded areas.	Screen planting and windbreak; ornamental; wildlife food and cover; road cuts and eroded areas.
Locust:					
Black	Height of 60 to 80 feet at maturity; white flowers; short thorns.			Shade; wildlife food and cover; road cuts and eroded areas.	
Honey (thornless).	Height of 50 to 60 feet at maturity; thin foliage; yellow fall color.			Shade	Shade; road cuts and eroded areas.
Maple, red	Height of 50 to 60 feet at maturity; yellow to red fall foliage; rapid growth; shade tolerant.	Ornamental and shade; road cuts.			
Oak:					
Pin	Height of 60 to 80 feet at maturity; red fall color; horizontal limbs.	Ornamental and shade; wildlife food and cover.	Ornamental and shade; wildlife food and cover.		
Scarlet	Height of 60 to 70 feet at maturity; scarlet fall foliage.				Ornamental and shade.
Pine:					
Austrian	Height of 50 to 60 feet at maturity; two stiff needles in a clump.				Screen planting and windbreak; ornamental and shade.
Jack	Height of 50 to 60 feet at maturity; two short, dark-green needles in a clump; crooked growth.				Screen planting and windbreak; road cuts and eroded areas.
Red	Height of 70 to 80 feet at maturity; two long, dark-green needles in a clump.			Screen planting and windbreak; ornamental and shade.	Screen planting and windbreak; ornamental and shade.
White	Height of more than 100 feet at maturity; five soft, blue-green needles in a clump; long lived.		Screen planting and windbreak; ornamental and shade.	Screen planting and windbreak; ornamental and shade.	

TABLE 3.—*Tree and shrub planting guide*—Continued

Plant	Characteristics of the plant	Suitable uses, by tree and shrub suitability groups			
		Group 1	Group 2	Group 3	Group 4
Plum, wild	Height of 8 to 10 feet at maturity; red fall color; thicket forming; shade tolerant.				Wildlife food and cover; road cuts and eroded areas.
Poplar:					
Lombardy	Height of 40 to 50 feet at maturity; slender columnar growth; short lived.	Screen planting; ornamental and shade; road cuts.			
Tulip	Height of over 100 feet at maturity; tulip like flowers.		Ornamental and shade; wildlife food and cover.	Ornamental and shade; wildlife food and cover.	
Russian olive	Height of 15 to 20 feet at maturity; silver-colored leaves and fruit.				Screen planting; wildlife food and cover; road cuts and eroded areas.
Serviceberry	Height of 8 to 15 feet at maturity; white flower; edible fruit; shade tolerant.		Ornamental; wildlife food and cover.	Screen planting; ornamental; wildlife food and cover.	
Spicebush	Height of 8 to 10 feet at maturity; yellow flowers; red fruit; shade tolerant.	Wildlife food and cover.	Wildlife food and cover.		
Spruce:					
Norway	Height of 60 to 80 feet at maturity; short, dark-green needles; shade tolerant.		Screen planting and windbreak; ornamental and shade.	Screen planting and windbreak; ornamental and shade.	
White	Height of 60 to 80 feet at maturity; light-green needles; slow growth; shade tolerant.		Screen planting and windbreak; ornamental and shade.		
Sumac:					
Cutleaf	Height of 8 to 15 feet at maturity.		Screen planting; wildlife food and cover; road cuts.		
Fragrant	Height of 6 to 8 feet at maturity; red fall color.				Screen planting; wildlife food and cover; road cuts and eroded areas.
Staghorn	Height of 10 to 15 feet at maturity; red fruit held into winter.				Screen planting; wildlife food and cover; road cuts and eroded areas.
Sycamore	Height of 90 to 100 feet at maturity; attractive white patches of bark.		Ornamental and shade; road cuts.		
Viburnum, mapleleaf.	Height of 4 to 8 feet at maturity; white flowers; blue-black fruit; shade tolerant.		Wildlife food and cover; road cuts.	Wildlife food and cover; road cuts and eroded areas.	Wildlife food and cover; road cuts and eroded areas.
Willow:					
Blue Arctic	Height of 5 to 7 feet at maturity; trims well into bluish-green hedge.	Screen planting; road cuts.			
Medium purple	Height of 15 to 20 feet at maturity; well suited to very wet areas.	Screen planting and windbreak; road cuts.			

Wildlife

A well-planned and well-managed system of farming that maintains the productivity of the soils will provide food and cover for wildlife. Farming that depletes the soils reduces the supply of food and the amount of cover. The resulting reduction in the population of desirable animals leads to an increase in the number of destructive insects and rodents and other undesirable animals.

On most farms, the wildlife habitat can be improved by increasing and diversifying the supply of food and the areas of food and cover (*2*) and by providing travel lanes.

Only a few farms in Boone County have an ideal balance between cover and food for wildlife. Some farms are used almost entirely for row crops. On these farms, food for wildlife is abundant but cover is scarce. Other farms are largely in pasture and woodland, which furnish ample cover but little food.

Cropland, pasture, and woodland can all be managed so that both food and cover are made available. On cropland, cover can be provided by establishing fence rows, windbreaks, and perennial field borders and by planting vegetation in waterways and on the banks of drainage ditches and streams. In addition to these places of cover, odd areas in fields and areas around ponds and in very wet spots can be used for both food and cover. In pasture or woodland, food can be provided by border plantings of grasses, conifers, grains, and suitable shrubs (see table 3 in the section "Trees and Shrubs").

The kinds of wildlife that live in an area are related to the kinds of soils and to other environmental factors. For that reason, the kinds of wildlife in Boone County are discussed according to their relationship to the six soil associations, which are described in the section "General Soil Map." Food in the form of farm crops is abundant in much of the county, but cover for small animals is lacking in most places.

Bobwhite quail are in all six soil associations. Quail prefer the edges of fields and woods where they can obtain food and cover. Compared with other counties in the state, Boone County has a small number of these birds. A few migrating waterfowl, mainly ducks, pass through the county in fall and in spring. Mallards and black ducks are the most numerous. These birds stop for short periods of time at many of the ponds and streams in the county.

The number of deer in Boone County is small because of the high percentage of cultivated land and the expanding cities and towns. Most of the desirable habitat for deer is in soil associations 3, 4, and 5.

Rabbits and squirrels are the most abundant small game animals in all six associations but are less numerous in associations 1, 2, and 6 than in the other associations. Rabbits prefer cropland or the edges of fields, where they can obtain food and cover. Squirrels are plentiful in small woodlots and on wooded streambanks that are adjacent to cultivated areas.

Recreation

The Outdoor Recreation Resources Review Commission predicts that the need for outdoor recreational facilities will greatly increase during the latter half of the twentieth century (*4*). The Commission recommends that land-use planning include planning for outdoor recreation.

The landscape and resources of Boone County and the location of the county in relation to centers of population make it possible to develop some recreational enterprises that could produce income. The most likely enterprises include parks, improved picnic areas, golf courses, hunting areas, and fishing waters. Several private recreational facilities have been established and are in use.

In table 4 the soils in Boone County are rated according to their limitations for developing five kinds of recreation facilities. The ratings are guides for preliminary planning and selection of sites; they do not eliminate the need for onsite investigation. The column headings in table 4 and the factors considered in deriving the limitations are explained here.

TABLE 4.—*Limitations of soils for recreational uses*

[The soils are rated on the basis of three classes of soil limitations: *slight* means the soil is relatively free of limitations or the limitations are easily overcome; *moderate* indicates that overcoming the limitations is generally feasible; and *severe* indicates that the use of the soil for this purpose is questionable]

Soil series and map symbols	Picnic areas, parks, and extensive play areas	Tent and trailer campsites	Golf fairways	Bridle paths, nature trails, and hiking trails	Playgrounds, athletic fields, and other intensive play areas
Brookston: Br, Bs	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: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding.
Crosby: CrA, CsB2. For Miami part of CsB2, see Miami series, unit MmB2.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; soft when wet.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; muddy when wet.	Moderate: somewhat poorly drained; seasonal high water table.

TABLE 4.—*Limitations of soils for recreational uses*—Continued

Soil series and map symbols	Picnic areas, parks, and extensive play areas	Tent and trailer campsites	Golf fairways	Bridle paths, nature trails, and hiking trails	Playgrounds, athletic fields, and other intensive play areas
Fincastle: FcA	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; soft when wet.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; muddy when wet.	Moderate: somewhat poorly drained; seasonal high water table.
Fox:					
FsA	Slight	Slight	Slight	Slight	Slight.
FsB2	Slight	Slight	Slight	Slight	Moderate: slope hinders development of site.
FsC2	Moderate: subject to erosion.	Moderate: subject to erosion.	Moderate: subject to erosion; droughty.	Moderate: subject to erosion.	Severe: slope severely hinders development of site.
Genesee: Gn	Moderate: subject to flooding during season of use.	Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding; muddy when wet.	Severe: subject to flooding.
Hennepin: HeF	Severe: subject to erosion; slope hinders development of site.	Severe: subject to erosion; slope hinders development of site.	Severe: subject to erosion.	Severe: subject to erosion.	Severe: slope severely hinders development of site.
Mahalasville: Ma	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: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding.
Miami:					
MmA	Slight	Slight	Slight	Slight	Slight.
MmB2, MsB3	Slight	Slight	Slight	Slight	Moderate: slope hinders development of site.
MmC2, MsC3	Moderate: subject to erosion.	Moderate: subject to erosion.	Moderate: subject to erosion.	Moderate: subject to erosion.	Severe: slope severely hinders development of site.
MmD2, MmE2, MsD3.	Severe: subject to erosion; slope hinders development of site.	Severe: subject to erosion; slope hinders development of site.	Severe: subject to erosion.	Severe: subject to severe erosion; slippery when wet.	Severe: slope severely hinders development of site.
Ockley:					
OcA	Slight	Slight	Slight	Slight	Slight.
OcB2	Slight	Slight	Slight	Slight	Moderate: slope hinders development of site.
Ragsdale: Ra	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: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding.
Reesville: Re	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; soft when wet.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; muddy when wet.	Moderate: somewhat poorly drained; seasonal high water table.
Shoals: Sh	Severe: subject to flooding; somewhat poorly drained; seasonal high water table.	Severe: subject to flooding; somewhat poorly drained; seasonal high water table.	Moderate: subject to flooding; somewhat poorly drained; seasonal high water table.	Moderate: subject to flooding; somewhat poorly drained; seasonal high water table; muddy when wet.	Severe: subject to flooding; somewhat poorly drained; seasonal high water table.

TABLE 4.—*Limitations of soils for recreational uses*—Continued

Soil series and map symbols	Picnic areas, parks, and extensive play areas	Tent and trailer campsites	Golf fairways	Bridle paths, nature trails, and hiking trails	Playgrounds, athletic fields, and other intensive play areas
Sleeth: St	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; soft when wet.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; muddy when wet.	Moderate: somewhat poorly drained; seasonal high water table.
Sloan: Sx	Severe: subject to flooding; very poorly drained; seasonal high water table; subject to ponding.	Severe: subject to flooding; very poorly drained; seasonal high water table; subject to ponding.	Severe: subject to flooding; very poorly drained; seasonal high water table; subject to ponding.	Severe: subject to flooding; very poorly drained; seasonal high water table; subject to ponding.	Severe: subject to flooding; very poorly drained; seasonal high water table; subject to ponding.
Westland: We	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: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding.
Whitaker: Wh	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; soft when wet.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; muddy when wet.	Moderate: somewhat poorly drained; seasonal high water table.

Picnic areas, parks, and extensive play areas.—These are areas used for picnicking in a natural outdoor environment. They are subjected to heavy foot traffic. Factors evaluated are wetness, flood hazard, slope, surface texture, stoniness, and rockiness. Such features as presence of trees or ponds, which may affect the desirability of a site, were not considered.

Tent and trailer campsites.—These are areas for tent and trailer camping and the accompanying activities of outdoor living. Factors evaluated are wetness, flood hazard, permeability, slope, surface texture, stoniness, and rockiness.

Golf fairways.—Factors evaluated are wetness, flood hazard, slope, droughtiness, surface texture, stoniness, and rockiness.

Bridle paths, nature trails, and hiking trails.—These are areas for riding, cross-country hiking, and other intensive uses that involve movement of people. Factors considered are wetness, flood hazard, slope, surface texture, stability, stoniness, and rockiness.

Playgrounds, athletic fields, and intensive play areas.—These are areas for play and for organized games such as baseball, football, tennis, badminton, and the like. Factors evaluated are wetness, flood hazard, slope, surface texture, stoniness, and rockiness.

Engineering Uses of the Soils[3]

This section of the soil survey is useful to those who need information about soils used as structural material or as foundations upon which structures are built. Among those who can benefit from this section are planning commissioners, town and city managers, land developers, engineers, contractors, and farmers.

Among the soil properties important in engineering are permeability, shear strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds, small dams, and systems for disposal of sewage and refuse.

Information in this section can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate 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 the performance of structures on the same or similar kinds of soil in other locations.
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 5, 6, and 7, which show, respectively, the results of engineering laboratory tests on soil samples, estimates of several soil properties significant in engineering, and

[3] MAX L. EVANS, area engineer, Soil Conservation Service, assisted in the preparation of this section.

interpretations of soil properties as they affect various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations besides those in table 7 and also can be used to make other useful maps. It does not, however, eliminate need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those generally shown in the tables. Also, inspection of sites, especially of small ones, is needed because a delineated area of a given soil may contain small areas of other soils that have strongly contrasting properties and different suitabilities or limitations for engineering.

Some of the terms used in this soil survey have different meanings in soil science than in engineering. The Glossary defines many of these terms as they are commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying soils for engineering are the Unified system (*8*), used by SCS engineers, the Department of Defense, and others, and the AASHO system (*1*), developed by the American Association of State Highway Officials and generally used by highway engineers.

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. 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. Table 5 gives the Unified classification of each soil for which laboratory test data are available, and table 6 gives the estimated Unified classification of each soil in the county.

In the AASHO 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, 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 mineral soils for subgrade. If 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 an additional refinement, the relative engineering value of soils within any group can be indicated by group index numbers. Group index numbers range from 0 for the best material within a group to 20 for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, are given in table 5; the estimated AASHO classification, for each soil, without a group index number, is given in table 6.

Engineering test data

Table 5 presents test data on samples of five soil series in the county. These samples were tested by standard procedures in the laboratories of the Joint Highway Research Project at Purdue University. The samples do not represent all the soils in Boone County, nor do they include the entire range of characteristics of any series sampled. Not all layers of each profile were sampled. The test results, however, have been used as a general guide in estimating the engineering properties of the soils of the county. Tests were made for moisture-density relationships, liquid limit, and plastic limit. Texture was determined by mechanical analysis.

Moisture-density relationships indicate the moisture content at which soil material can be compacted to maximum dry density. If a soil is compacted at successively higher moisture content, assuming that the compactive effort remains the same, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The ovendry weight, in pounds per cubic foot, of soil material that was compacted with standard compactive effort at optimum moisture content is termed the maximum dry density. Data on the relationship of moisture to density are important in planning earthwork, for generally a soil is most stable if compacted to about its maximum dry density when it is at approximately the optimum moisture content.

The tests for liquid limit and plastic limit indicate the effect of water on the consistence of soil material. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic. 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.

Mechanical analysis to determine the particle-size distribution of the soil material was made by a combination of the sieve and hydrometer methods.

Estimated engineering properties

Table 6 gives estimates of soil properties that affect engineering significantly. Since actual tests were made only for the five soils listed in table 5, it was necessary to estimate the engineering properties for the rest of the soils. Estimates were based upon a comparison of these soils with those that were sampled and tested and upon experiences gained from working with and observing similarly classified soils in other areas. These estimates provide information that an engineer would otherwise have to obtain for himself, but the estimates are not a substitute for the detailed tests needed at a specific site selected for construction purposes. The information in this table applies, in general, to a depth of 5 feet or less. The depth at which bedrock occurs is not given, because in this county all soils are more than 5 feet deep to bedrock.

A brief explanation of each column in table 6 follows:

Depth to seasonal high water table.—This column lists the depth to the highest level of free water in the soil at the wettest time during the year.

Depth from surface.—Normally, only the major horizons and their depths are listed. Special horizons are listed when they have engineering properties significantly different from those of the adjacent horizons.

TABLE 5.—*Engineering*

[Tests performed by Soils and Pavement Design Laboratory, Joint Highway Research Project, School of Civil Engineering, Purdue of State Highway

Soil name and location of sample	Parent material	Report No.	Depth	Moisture-density data [1]		Mechanical analysis [2]		
						Percentage passing sieve—		
				Maximum dry density	Optimum moisture	1 in.	¾ in.	⅜ in.
			In.	*Lb./cu. ft.*	*Pct.*			
Fincastle silt loam: SE¼NW¼ sec. 2, T. 19 N., R. 2 W. (Modal).	Loess over glacial till of Wisconsin age.	5–1	0–8	104	19	--------	--------	100
		5–6	26–41	98	22	--------	--------	--------
		5–8	60–72	132	8	100	96	93
Miami silt loam: NE¼SE¼ sec. 13, T. 19 N., R. 2 W. (Coarse textured).	Glacial till of Wisconsin age.	7–1	0–8	108	17	100	96	96
		7–2	8–20	108	17	100	99	97
		7–5	46–55	127	10	--------	100	96
Ockley silt loam: SE¼NE¼ sec. 34, T. 20 N., R. 2 W. (Modal).	Loamy outwash over sand and gravel.	6–1	0–8	98	22	--------	--------	100
		6–5	21–28	104	19	100	99	91
		6–10	55–72	119	12	100	96	88
Ragsdale silty clay loam: SE¼NW¼ sec. 27, T. 19 N., R. 1 W. (Modal).	Silty material.	4–1	0–8	94	25	--------	--------	--------
		4–4	21–32	97	23	--------	--------	--------
		4–6	43–53	126	21	--------	100	97
Whitaker silt loam: SW¼NW¼ sec. 10, T. 18 N., R. 1 E. (Coarse-textured substratum).	Loamy outwash over stratified silt and sand.	8–1	0–9	105	18	--------	--------	100
		8–5	23–32	129	14	--------	--------	100
		8–8	51–60	114	14	--------	--------	100

[1] Based on AASHO Designation T 99–57, Method A (*1*).
[2] Mechanical analyses according to AASHO Designation T 88–57 (*1*). Results obtained by this procedure may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming the textural class of a soil.

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The different tions for referring to other series. The sign>

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Classification		
			USDA texture	Unified	AASHO
Brookston:	*Ft.*	*In.*			
Br	[1] 0–1	0–18	Silt loam	ML or CL	A–4 or A–6
		18–50	Clay loam	CL	A–6
		50–60	Loam	ML or CL	A–4
Bs	[1] 0–1	0–28	Silty clay loam	OL or CL	A–7
		28–39	Clay loam	CL	A–6
		39–60	Loam	ML or CL	A–4
*Crosby: CrA, CsB2. For Miami part of CsB2, see Miami series, unit MmB2.	1–3	0–7	Silt loam	ML or CL	A–4 or A–6
		7–29	Clay loam	CL or CH	A–7
		29–60	Loam	CL or SC	A–4
Fincastle: FcA	1–3	0–13	Silt loam	ML or CL	A–4 or A–6
		13–31	Silty clay loam	CH	A–7
		31–43	Clay loam	CL or CH	A–6 or A–7
		43–60	Loam	CL or SC	A–4

See footnotes at end of table.

test data

University, West Lafayette, Indiana, in accordance with standard methods of testing of the American Association Officials (AASHO) (*1*)]

Mechanical analysis [2] —Continued								Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Continued				Percentage [3] smaller than—							
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO [4]	Unified [5]
								Pct.			
99	98	90	75	68	50	22	13	29	9	A-4(8)	CL
100	99	97	83	80	65	39	25	58	38	A-7-6(20)	CH
88	82	70	39	33	24	14	9	20	8	A-4(1)	SC
94	93	92	80	68	50	25	18	33	11	A-6(9)	CL
96	94	89	65	54	43	28	20	39	21	A-6(11)	CL
90	84	74	37	28	18	12	8	17	2	A-4(1)	SM
99	99	95	82	77	57	24	16	32	9	A-4(8)	ML-CL
87	82	74	45	42	35	25	18	59	36	A-7-6(9)	SC
76	59	29	11	8	5	3	2	[6] NP	NP	A-1-b(0)	SW-SM
----------	100	98	95	92	72	33	19	55	24	A-7-5-(17)	CH
----------	----------	100	99	94	74	40	31	64	41	A-7-6(20)	CH
96	95	95	91	75	47	19	15	30	9	A-4(8)	CL
99	98	92	65	60	43	19	14	26	8	A-4(6)	CL
99	97	89	38	33	25	20	18	31	13	A-6(2)	SC
99	97	74	14	11	8	5	3	NP	NP	A-2-4(0)	SM

[3] Clay percentage was determined by the hydrometer method and varies several percent from field determinations.
[4] Based on AASHO Designation M 145-49 (*1*).
[5] Based on MIL-STD-619B (*8*).
[6] Nonplastic.

significant to engineering

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instruc- means more than; the sign < means less than]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Frost-heave potential	Shrink-swell potential
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
			In/hr.	*In./in of soil*	*pH*		
90-100	90-100	75-85	0. 63-2. 00	0. 17-0. 20	5. 5-6. 5	Moderate to high	Low.
95-100	85-95	70-90	0. 06-0. 20	0. 19-0. 21	6. 0-7. 3	Moderate	Moderate.
90-100	75-90	60-75	0. 20-0. 63	0. 17-0. 20	(2)	Moderate	Low.
100	90-100	85-95	0. 20-0. 63	0. 19-0. 21	6. 5-7. 3	Moderate	Moderate.
95-100	85-95	70-90	0. 06-0. 20	0. 19-0. 21	6. 5-7. 3	Moderate	Moderate.
90-100	75-90	60-75	0. 20-0. 63	0. 17-0. 20	(2)	Moderate	Low.
95-100	90-100	75-90	0. 63-2. 00	0. 17-0. 20	6. 5-7. 3	Moderate to high	Low.
95-100	85-95	65-85	0. 06-0. 20	0. 19-0. 21	5. 5-7. 3	Moderate	Moderate.
85-95	70-85	35-65	0. 06-0. 20	0. 17-0. 20	(2)	Moderate	Low.
95-100	90-100	75-95	0. 63-2. 00	0. 17-0. 20	5. 5-6. 5	Moderate to high	Low.
95-100	90-100	85-100	0. 06-0. 20	0. 19-0. 21	5. 5-6. 5	Moderate	Moderate.
95-100	85-100	65-85	0. 06-0. 20	0. 19-0. 21	6. 5-7. 3	Moderate	Moderate.
80-95	70-90	35-70	0. 06-0. 20	0. 17-0. 20	(2)	Moderate	Low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Ft.	*in.*			
Fox: FsA, FsB2, FsC2	>6	0–8	Silt loam	ML or CL	A–4 or A–6
		8–18	Silty clay loam	CL	A–7
		18–38	Clay loam or gravelly clay loam.	SC or CL	A–6
		38–60	Sand and gravel	SW–SM	A–1
Genessee: Gn	>6	0–25	Silt loam	ML	A–4
		25–60	Loam	CL or SC	A–6
Hennepin: HeF	>6	0–14	Loam	CL or SC	A–4
		14–60	Loam	CL or SC	A–4
Mahalasville: Ma	[1] 0–1	0–34	Silty clay loam	OL or CL	A–7
		34–41	Loam	CL or SC	A–4
		41–60	Silty clay loam and loamy sand	CL or SC	A–2 or A–4
Miami:					
MmA, MmB2, MmC2, MmD2, MmE2	>6	0–8	Silt loam	ML or CL	A–4 or A–6
		8–26	Clay loam	CL or CH	A–6 or A–7
		26–60	Loam	CL or SC or SM	A–4
MsB3, MsC3, MsD3	>6	0–24	Clay loam	CL or CH	A–6 or A–7
		24–60	Loam	CL or SC or SM	A–4
Ockley: OcA, OcB2	>6	0–14	Silt loam	ML or CL	A–4 or A–6
		14–39	Silty clay loam, gravelly clay loam, and clay loam.	CL or SC	A–6 or A–7
		39–55	Loamy sand and sandy loam	SM or ML	A–4
		55–72	Sand and gravel	SW–SM	A–1
Ragsdale: Ra	[1] 0–1	0–32	Silty clay loam	OH or CH	A–7
		32–60	Silt loam	ML or CL	A–4
Reesville: Re	1–3	0–11	Silt loam	ML or CL	A–4 or A–6
		11–29	Silty clay loam	CH	A–7
		29–60	Silt loam	ML or CL	A–4
Shoals: Sh	1–3	0–36	Silt loam	ML	A–4
		36–60	Loam	CL or SC	A–6
Sleeth: St	1–3	0–13	Silt loam	ML or CL	A–4 or A–6
		13–24	Clay loam	CL	A–6
		24–48	Gravelly clay loam	SC or CL	A–6
		48–60	Sand and gravel	SW–SM	A–1
Sloan: Sx	[1] 0–1	0–8	Silt loam	ML or CL	A–4
		8–33	Clay loam	CL	A–6
		33–60	Loam	CL	A–4
Westland: We	[1] 0–1	0–8	Silty clay loam	OL or CL	A–7
		8–45	Clay loam	CL or CH	A–7
		45–53	Gravelly clay loam	SC or CL	A–6
		53–60	Sand and gravel	SW–SM	A–1
Whitaker: Wh	1–3	0–9	Silt loam	ML or CL	A–4 or A–6
		9–27	Clay loam	CL	A–6
		27–46	Sandy clay loam, loamy sand, and sandy loam.	SC or SM	A–2 or A–4
		46–60	Stratified sand, sandy loam, loam, and silt loam.	SC or SM	A–2 or A–4

[1] Ponded.
[2] Calcareous.

significant to engineering—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Frost-heave potential	Shrink-swell potential
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
			In/hr.	*In./in. of soil*	*pH*		
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
95–100	90–100	85–95	0. 63–2. 00	0. 19–0. 21	6. 5–7. 3	Moderate	Moderate.
90–100	75–90	35–70	0. 63–2. 00	0. 17–0. 20	5. 5–6. 3	Moderate	Moderate.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
90–100	75–100	75–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
85–95	70–85	45–65	0. 63–2. 00	0. 17–0. 20	6. 5–7. 8	Moderate	Low.
85–95	70–85	35–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
100	90–100	85–95	0. 06. 0. 20	0. 19–0. 21	6. 0–7. 3	Moderate	Moderate.
90–100	70–85	45–65	0. 20–0. 63	0. 17–0. 20	7. 3–7. 8	Moderate	Low.
95–100	90–100	30–70	0. 63–2. 00	0. 17–0. 20	(2)	Moderate to high	Low.
90–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	5. 5–6. 0	Moderate to high	Low.
90–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 0–6. 0	Moderate	Moderate.
80–95	70–85	35–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
90–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 0–6. 0	Moderate	Moderate.
80–95	70–85	35–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	5. 5–7. 3	Moderate to high	Low.
80–100	65–90	40–75	0. 63–2. 00	0. 19–0. 21	5. 0–6. 5	Moderate	Moderate.
90–100	70–80	45–55	2. 00–6. 30	0. 12–0. 17	5. 5–7. 3	Moderate	Low.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
100	95–100	95–100	0. 06–0. 20	0. 19–0. 21	6. 0–7. 3	Moderate to high	Moderate.
95–100	90–100	85–95	0. 20–0. 63	0. 17–0. 20	(2)	High	Low.
100	90–100	85–95	0. 63–2. 00	0. 17–0. 20	5. 5–6. 0	Moderate to high	Low.
100	95–100	90–100	0. 06–0. 20	0. 19–0. 21	5. 5–6. 5	Moderate to high	Moderate.
95–100	90–100	85–95	0. 20–0. 63	0. 17–0. 20	(2)	High	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
90–100	75–100	45–65	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 0–7. 3	Moderate to high	Low.
95–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 5–6. 5	Moderate	Moderate.
90–100	75–90	35–70	0. 63–2. 00	0. 19–0. 21	6. 0–7. 8	Moderate	Moderate.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low to moderate.
95–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	6. 5–7. 8	Moderate	Moderate.
90–100	75–100	45–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
100	90–100	85–95	0. 20–0. 63	0. 17–0. 20	6. 5–7. 3	Moderate	Moderate.
95–100	85–95	65–85	0. 06–0. 20	0. 19–0. 21	6. 5–7. 3	Moderate	Moderate.
90–100	75–90	35–70	0. 06–0. 20	0. 19–0. 21	6. 5–7. 3	Moderate	Moderate.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
95–100	90–100	65–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
95–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 5–6. 5	Moderate	Moderate.
90–100	70–90	10–50	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate	Low.
95–100	70–90	10–50	0. 63–2. 00	0. 12–0. 20	(2)	Moderate to high	Low.

TABLE 7.—*Interpretations of engineering*

[An asterisk in first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The different tions for referring

Soil series and map symbols	Suitability of soils as a source of— Topsoil	Sand and gravel	Road subgrade material	Soil features affecting— Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Brookston: Br	Good in surface layer. Poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
Bs	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
*Crosby: CrA, CsB2. For Miami part of CsB2 see Miami series, unit MmB2.	Good in surface layer. Fair to poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
Fincastle: FcA	Good in surface layer. Fair to poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.

See footnote at end of table.

properties of the soils

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instruc-
to other series]

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Severe: very poor drainage; seasonal high water table; subject to ponding.	Severe: very poor drainage; seasonal high water table; subject to ponding.
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Severe: very poor drainage; seasonal high water table; subject to ponding.	Severe: very poor drainage; seasonal high water table; subject to ponding.
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; use limited to periods when the water table is at a depth of more than 48 inches.
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; use limited to periods when the water table is at a depth of more than 48 inches.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of— Topsoil	Sand and gravel	Road subgrade material	Soil features affecting— Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Fox: FsA, FsB2, FsC2.	Fair to good in surface layer. Poor to fair in subsoil: moderately fine to coarse texture.	Good: About 36 inches of overburden on well-graded mixture of sand and gravel.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; low susceptibility to frost heave; fair to to poor stability.	Loose sand and gravel can be easy to excavate but sometimes hinders hauling; cuts and fills often needed in places; difficult to vegetate exposed gravel in road cuts; subsoil is subject to frost heave.	Natural drainage is adequate; not needed.	Rapid seepage rate in substratum.
Genessee: Gn	Good in surface layer. Good to fair in subsoil: subject to stream flooding.	Poor to unsuitable: location of sand and gravel spotty; deep overburden; dipper equipment necessary.	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability.	Subject to flooding and frost heave.	Natural drainage is adequate; subject to flooding; not needed.	Moderate to slow seepage rate; subject to flooding.
Hennepin: HeF	Fair in surface layer: thin; steep slopes. Fair to poor in subsoil.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability.	Cuts and fills needed; difficult to vegetate road cuts; subject to frost heave.	Natural drainage is adequate; not needed.	Moderate to slow seepage rate.
Mahalasville: Ma	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Fair to poor in substratum: fair to poor shear strength; poor compaction; medium compressibility; low shrink-swell potential; subject to frost heave; poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability; stratified silt and sand below depth of 36 inches.	Moderate to slow seepage rate; seasonal high water table.

See footnote at end of table.

properties of the soils—Continued

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Difficult to vegetate; erosion hazard during construction.	Good to fair shear strength; moderate to low shrink-swell potential; medium compressibility in subsoil; slight compressibility in substratum.	Slight where slopes are 0 to 6 percent; possible contamination of ground water. Moderate where slopes are 6 to 12 percent; downslope seepage; possible contamination of ground water.	Severe: porous sand and gravel at depth of 30 to 40 inches; very rapid permeability in sand and gravel.	Severe: porous sand and gravel at depth of 30 to 40 inches; hazard of free-leachate flow to ground water.
In subsoil and substratum, fair stability; fair to poor compaction characteristics; moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Subject to flooding; fair to poor shear strength; low shrink-swell potential; medium to high compressibility.	Severe: subject to flooding; moderate permeability.	Severe: subject to flooding.	Severe: subject to flooding.
In subsoil and substratum, fair stability; fair to poor shear strength; fair to poor compaction characteristics; moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential.	Difficult to vegetate; erosion hazard during construction.	Fair to poor shear strength; low shrink-swell potential; medium to high compressibility.	Severe: steep and very steep slopes; downslope seepage.	Severe: steep and very steep slopes severely hinder development of site.	Severe: steep and very steep slopes severely hinder development of site.
In subsoil, fair stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate shrink-swell potential; fair to poor shear strength. In substratum, poor stability and compaction; moderate permeability when compacted; medium compressibility; poor resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Severe: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of— Topsoil	Sand and gravel	Road subgrade material	Soil features affecting— Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Miami: MmA, MmB2, MmC2, MmD2, MmE2.	Fair to good in surface layer. Fair to poor in subsoil: moderately fine texture.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability.	Cuts and fills needed; subject to frost heave.	Natural drainage is adequate; not needed.	Moderate to slow seepage rate.
MsB3, MsC3, MsD3.	Fair to poor in surface layer and subsoil: moderately fine texture.	Not suitable	Fair to poor in subsoil and substratum; fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability.	Cuts and fills needed; subject to frost heave.	Natural drainage is adequate; not needed.	Moderate to slow seepage rate.
Ockley: OcA, OcB2.	Good in surface layer. Fair in subsoil: moderately fine to coarse texture.	Good: at least 42 inches of overburden over well-graded mixture of sand and gravel.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; low frost heave; fair to poor stability.	Loose sand and gravel easy to excavate but hinders hauling at times; cuts and fills needed in places; difficult to vegetate exposed gravel in road cuts; subsoil subject to frost heave.	Natural drainage is adequate; not needed.	Rapid seepage rate in substratum.
Ragsdale: Ra	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair compaction characteristics; medium compressibility; moderate to low shrink-swell potential; subject to frost heave; fair stability; seasonal high water table.	Seasonal high water table; moderately high susceptibility to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.

See footnote at end of table.

properties of the soils—Continued

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Moderate where slopes are 0 to 12 percent; moderate permeability. Severe where slopes are 12 to 25 percent; moderate permeability; downslope seepage.	Moderate where slopes are 0 to 6 percent; moderate permeability. Severe where slopes are 6 to 25 percent; slope severely hinders development of site.	Slight where slopes are 0 to 12 percent; moderate where slopes are 12 to 25 percent; slope moderately hinders development of site.
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Moderate where slopes are 2 to 12 percent; moderate permeability; downslope seepage. Severe where slopes are 12 to 18 percent; moderate permeability; downslope seepage.	Moderate where slopes are 2 to 6 percent; moderate permeability. Severe where slopes are 6 to 18 percent; slope severely hinders development of site.	Slight where slopes are 2 to 12 percent; moderate where slopes are 12 to 18 percent; slope moderately hinders development of site.
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Soil features favorable.	Good to fair shear strength; moderate to low shrink-swell potential; medium compressibility in subsoil; slight compressibility in substratum.	Slight: moderate permeability; possible contamination of ground water.	Severe: porous sand and gravel at depth of 42 to 60 inches; very rapid permeability in sand and gravel.	Severe: porous sand and gravel at depth of 42 to 60 inches; hazard of free leachate flow to ground water.
In subsoil and substratum, fair stability; fair compaction characteristics; moderate to low permeability when compacted; medium compressibility; fair resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium compressibility; moderate to high susceptibility to frost heave.	Severe: slow permeability; seasonal high water table.	Severe: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding; silty clay loam and silt loam materials hinder trafficability.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of— Topsoil	Sand and gravel	Road subgrade material	Soil features affecting— Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Reesville: Re	Good in surface layer. Fair to poor in subsoil; moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; high compressibility; moderate shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table. Poor to fair in substratum: fair to poor shear strength; poor to fair compaction characteristics; medium compressibility; low shrink-swell potential; subject to frost heave; poor to fair stability.	Seasonal high water table; moderate to high susceptibility to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
Shoals: Sh	Good in surface layer. Good to fair in subsoil; subject to stream flooding; seasonal high water table.	Poor to unsuitable: location of sand and gravel spotty; deep overburden; dipper equipment necessary.	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability; seasonal high water table.	Subject to flooding and frost heave; seasonal high water table.	Seasonal high water table; moderate permeability; subject to flooding.	Moderate to slow seepage rate; subject to flooding; seasonal high water table.
Sleeth: St	Good in surface layer. Fair in subsoil: moderately fine to coarse texture; seasonal high water table.	Good: at least 42 inches of overburden on well-graded mixture of sand and gravel; dipper equipment necessary.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; fair to poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; moderate permeability; sand and gravel in substratum.	Rapid seepage rate in substratum; seasonal high water table.
Sloan: Sx	Good in surface layer. Good to fair in subsoil: subject to stream flooding; seasonal high water table.	Poor to unsuitable; location of sand and gravel spotty; deep overburden; dipper equipment necessary.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Fair to poor in substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability.	Subject to flooding and frost heave; seasonal high water table.	Seasonal high water table; moderate permeability; subject to flooding.	Moderate to slow seepage rate; subject to flooding; seasonal high water table.

See footnote at end of table.

properties of the soils—Continued

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; high compressibility; fair to good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, poor to fair stability; poor to fair compaction characteristics; moderate permeability when compacted; medium compressibility; fair resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility; moderate to high susceptibility to frost heave.	Severe: slow permeability; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; use limited to periods when the water table is at a depth of more than 48 inches; silt loam and silty clay loam materials hinder trafficability.
In subsoil and substratum, fair stability; fair to poor shear strength; fair to poor compaction characteristics; moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential.	Soil features favorable; generally not needed.	Seasonal high water table; subject to flooding, fair to poor shear strength; low shrink-swell potential; medium to high compressiblity.	Severe: seasonal high water table; subject to flooding: moderate permeability.	Severe: subject to flooding.	Severe: subject to flooding; somewhat poorly drained; seasonal high water table.
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Soil features favorable.	Seasonal high water table; good to fair shear strength; moderate to low shrink-swell potential; medium compressibility in subsoil; slight compressibility in substratum.	Severe: moderate permeability; seasonal high water table.	Severe: porous sand and gravel at depth of 40 to 60 inches; very rapid permeability in sand and gravel.	Severe: somewhat poorly drained; seasonal high water table; sand and gravel at depth of 40 to 60 inches; hazard of free leachate flow to ground water.
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair stability; fair to poor compaction characteristics; moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to flooding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility; subject to ponding.	Severe: seasonal high water table; subject to flooding; moderate permeability.	Severe: subject to flooding.	Severe: subject to flooding; very poorly drained; seasonal high water table.

TABLE 7.—*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of—			Soil features affecting		
	Topsoil	Sand and gravel	Road subgrade material	Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Westland: We	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture; seasonal high water table.	Good: at least 42 inches of overburden on well-graded mixture of sand and gravel; dipper equipment necessary.	Poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; fair to poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability; sand and gravel substratum.	Rapid seepage in substratum; seasonal high water table.
Whitaker: Wh	Good in surface layer. Fair to poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Fair to poor in substratum: fair to poor shear strength; poor compaction characteristics; medium compressibility; low shrink-swell potential; subject to frost heave, poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; moderate permeability; stratified silt and sand below depth of 36 inches.	Moderate seepage rate; seasonal high water table.

[1] *Slight* means that the soil is relatively free of limitations or that the limitations are easily overcome; *moderate* means that overcoming

USDA texture.—The United States Department of Agriculture textural classification is based on the relative amounts of sand, silt, and clay particles in a soil (*6*).

Unified and AASHO classifications.—These are explained under the heading "Engineering classification systems."

Percentage passing sieves 10, 40, and 200.—The values in these columns are estimates rounded off to the nearest 5 percent. Gravel-size material does not pass the No. 10 sieve. The material that passes the No. 200 sieve is mainly silt and clay, but the smaller grains of very fine sand also pass it.

Permeability.—This term refers to the downward movement of water through undisturbed soil material. Estimates are based mostly on texture, structure, and consistence.

Available water capacity.—This term refers to the capacity of a soil to hold water in a form available to plants and to the amount of water held in the soil that is wet to field capacity. The available water capacity is the measurement of the difference between the amount of water held in the soil at field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Reaction.—This column lists estimated ranges in field pH values for each major horizon.

Frost-heave potential.—Frost action includes heave caused by ice lenses forming in a soil and the subsequent loss of strength as a result of excess moisture during periods of thawing. Three conditions must exist for frost heave to become a major consideration: (1) a susceptible soil, (2) a source of water during the freezing period, and (3) freezing temperatures that persist long enough to penetrate the ground.

Shrink-swell potential.—This is the quality of the soil that determines its volume change in proportion to its moisture content. The shrink-swell potential of a soil is estimated primarily on the basis of the amount and kind of clay in a soil.

properties of the soils—Continued

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil, fair stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate shrink-swell potential; fair to poor shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding. In subsoil, fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential. In substratum, good to fair shear strength; slight compressibility; low shrink-swell potential.	Severe: slow permeability; seasonal high water table.	Severe: porous sand and gravel at depth of 40 to 60 inches; very rapid permeability in sand and gravel.	Severe: very poorly drained; seasonal high water table; subject to ponding; porous sand and gravel at depth of 40 to 60 inches; hazard of free leachate flow to ground water.
In subsoil, fair stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate shrink-swell potential; fair to poor shear strength. In substratum, poor stability; poor compaction characteristics; moderate permeability when compacted; medium compressibility; poor resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: moderate permeability; seasonal high water table.	Severe: stratified material at depth of less than 60 inches allows rapid seepage at times.	Severe: somewhat poorly drained; seasonal high water table; stratified loamy and sandy material at depth of less than 60 inches; hazard of free leachate flow to ground water.

the limitations is generally feasible; and *severe* means that the use of the soil for this purpose is questionable.

Interpretations of engineering properties

Table 7 gives interpretations of the suitability of the soils for specific engineering uses. The interpretations include: (1) the suitability of the soils as sources of topsoil, sand and gravel, and road subgrade; (2) soil features affecting use for highway location, agricultural drainage, ponds, grassed waterways, and foundations of buildings; and (3) soil limitations for sewage disposal fields, sewage lagoons, and sanitary landfills. These interpretations apply to the representative profile of each soil series, as described in the section "Descriptions of the Soils."

Some soil features may be helpful in one kind of engineering work and a hindrance in another kind. For example, a permeable substratum would make a soil unsuitable as a pond site but suitable for highway location. The column headings in table 7 are explained here.

Topsoil.—This refers to soil material, preferably high in organic-matter content, used to topdress back slopes, embankments, lawns, gardens, and other areas. The suitability ratings are based mainly on texture and organic-matter content.

Sand and gravel.—The suitability ratings apply to soil material within a depth of 5 to 7 feet. Sand or sand and gravel occur at variable depths within soils of the same series. Test pits are needed to determine the extent and availability of sand or sand and gravel.

Road subgrade material.—The suitability of the soil depends upon its performance when used as borrow for subgrade. Both the subsoil and the substratum are rated.

Highway location.—The entire soil profile is evaluated. Soil features considered are those that affect overall performances of the soil.

Drainage for crops and pasture.—Texture, permeability, topography, seasonal water table, and restricting layers are the main features considered.

Pond reservoir areas.—Permeability, which affects seepage, is the main feature considered.

Pond embankments, dikes, and levees.—The features considered are those that affect the use of disturbed soil material for construction of embankments to impound surface water.

Grassed waterways.—Suitability depends on soil features that affect establishment, growth, and maintenance of vegetation and the layout and construction of waterways.

Foundations of buildings.—The features considered are those of undisturbed soils that affect their suitability for supporting foundations of buildings up to three stories high. Such features include seasonal high water table, hazard of flooding, and limitations affecting foundations.

Sewage disposal fields.—Factors evaluated are permeability, seasonal high water table, hazard of flooding, topography, and depth to bedrock.

Sewage lagoons.—Factors evaluated are permeability, slope, depth to bedrock or sand and gravel, organic-matter content, hazard of flooding, and soil texture.

Sanitary landfills.—Factors evaluated are seasonal high water table, natural drainage, hazard of flooding, slope, depth to bedrock, degree of rockiness and stoniness, soil texture, and permeability.

Formation and Classification of the Soils

This section discusses the major factors of soil formation, the processes of soil formation that have affected the development of soils in Boone County, and the system of soil classification currently used.

Factors of Soil Formation

The characteristics of the soil are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plants and animals, but chiefly plants, are the active factors of soil formation. They act on parent material that has accumulated through the weathering of rocks and slowly bring about the formation of genetically related horizons. The effects of the climate and of 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. Some time is always required for differentiation of soil horizons, and generally 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 all five factors. Many of the processes of soil development are unknown.

Parent material

The soils of Boone County formed mainly from three kinds of parent material: glacial drift, or ice-laid material; loess, or windblown silt; and alluvium, or water-laid deposits.

Glaciation has been important in the formation of the soils in Boone County. Ice sheets hundreds of miles long and hundreds of feet thick covered this county during at least three different ice ages. From the oldest to the youngest, these glacial ice ages were the Kansan, the Illinoian, and the Wisconsin. The Wisconsin glacier completely covered Boone County.

As the ice moved southward, it destroyed old hills and made new ones. The unconsolidated material the ice carried buried old preglacial valleys. A mantle of rock, sand, silt, and clay was left when the ice sheets melted and receded. This material, collectively called glacial drift, is partly glacial till and partly outwash. Till is a heterogeneous deposit of sand, silt, clay, and gravel; and outwash is a water-laid deposit that consists mainly of sand and gravel.

As the glaciers receded, dry periods occurred on the glacial flood plains. These dry periods were in the winters when the melting of ice had diminished. During these periods, silt was blown from the west, probably the Wabash River Valley, and some of this silt was deposited in Boone County. This windblown silt, or loess, ranges in thickness from 0 to more than 60 inches; the thicker deposits are in the west-central part of the county. The till deposited by the glaciers was gently sloping or undulating in many areas. When the loess was deposited, it filled many depressions in the till plain. In most places the loess made a nearly level surface by covering the undulating till.

Soil-forming processes started to work after the glaciers receded northward. Most of the soils in the county developed from calcareous loam till. Miami soils developed on nearly level to moderately steep areas that are in close proximity to streams and creeks. Crosby soils formed on nearly level or gently sloping areas, and Brookston soils formed on nearly level or depressional areas. Hennepin soils developed on very steep areas. In places the till is covered with a layer of loess less than 2 feet thick.

The soils that formed in glacial outwash materials are variable. Some soils formed in outwash that contains a considerable amount of sand and gravel. The outwash was deposited by melt water when the glacier receded. Fox, Ockley, and Sleeth soils are a few soils that were derived partly from sand and gravel and partly from a finer textured loamy material over the sand and gravel.

When the melt water from the glacier decreased in velocity, it no longer carried coarse-textured sand and gravel but it did deposit silt and sand. Whitaker and Mahalasville soils are outwash soils that developed in this silt and sand. Most of these soils, especially Mahalasville soils, developed in glacial sluiceways in the south-central part of the county. A large level area of Mahalasville soils lies halfway between New Brunswick and Fayette. This area was at one time a glacial lake. Stratified sand which was the lake bottom occurs at a depth of 3 to 7 feet. Finer textured silt and clay were blown and washed into the water and settled over the sand. Eventually the lake filled and became a swamp until man cleared and drained it.

Development of the soils in the west-central part of the county was strongly influenced by loess. Silt in that part of the county is mainly from windblown loess although some is water laid. In some areas, loess has covered the water-laid silt. Ragsdale and Reesville soils developed completely in silt. Fincastle soils formed partly in loess and partly in the underlying till.

Genesee, Shoals, and Sloan soils are on flood plains. These young soils formed in water-laid material, or alluvium. They receive fresh deposits of alluvium from frequent flooding.

Climate

The climate of Boone County is midcontinental. The temperature varies widely from summer to winter. The climate is so uniform throughout the county that differences among the soils cannot be attributed to climate.

Climate, acting alone on parent material, would be largely destructive. Rain and melting snow would wash soluble materials out of the soil. The processes of climate become constructive only when combined with the activities of plants and animals. Plants draw nutrients from the lower part of the soil; then, when the plants die, the nutrients are restored in varying degrees to the soil by the accumulation of decaying vegetation in the upper part. In Boone County the climate is such that leaching of plant nutrients progresses faster than replacement. This accounts for the fact that most of the soils are leached and acid in the subsoil.

The average annual rainfall is 38.8 inches. It is well distributed throughout the year, but it is slightly heavier in spring and in summer than in fall and in winter.

Plant and animal life

In Boone County, most of the soils formed under a deciduous forest that consisted mainly of elm, maple, ash, oak, hickory, and poplar. In swampy areas the vegetation consisted of trees, swamp grasses, and sedges. These plants along with micro-organisms, earthworms, and other forms of life are important active forces in soil development.

The plants, especially trees, take moisture and plant nutrients from the lower part of the soil and return the nutrients to the upper part of the soil when the plants decay. In wooded areas a layer of forest litter and leaf mold covers the soil. This layer is acted on by micro-organisms, earthworms, and other forms of life and by direct chemical action. As the organic matter decays, it releases organic acids that make the slowly soluble mineral materials more soluble. The rate of decay depends on climate, especially temperature and amount of moisture. The organic matter in dry wooded areas is thin, but that in swampy areas is thick. The swampy areas were covered with water most of the year; consequently, the organic matter accumulated instead of decaying or oxidizing.

Relief

Relief has had an important effect on the drainage and formation of the soils in Boone County. Relief influences soil formation by affecting internal drainage, runoff, depth to the water table, leaching, and accumulation or decay of organic matter. The relief in this county is predominantly level to gently sloping and is steep only in a few small areas.

Because of differences in relief, mainly through its effect on drainage, different kinds of soil developed from the same kind of parent material. As an example, Miami, Crosby, and Brookston soils all developed in the same kind of parent material. Miami soils mostly formed in gently sloping or moderately sloping areas, are well drained, are moderately permeable, and have a brown or yellowish-brown subsoil. Crosby soils formed in nearly level areas, are somewhat poorly drained, are slowly permeable, and have a grayish-brown, mottled subsoil. Brookston soils formed in nearly level or depressional areas, are very poorly drained, are slowly permeable, and have a dark-colored surface layer and a gray mottled subsoil.

Relief also affects erosion. In Boone County erosion is mainly caused by the runoff of water which picks up soil particles and deposits them away from their original source. Water erosion of the nearly level areas of the county is slight because the water moves so slowly. Water erosion occurs more readily on the sloping areas because the water flow has greater velocity which can loosen and carry more soil particles. Although water erosion on the large level areas of the county is slight, fields that are not protected by cover can be affected by soil blowing.

Time

The length of time that soil material remains in place and is acted on by the soil-forming processes largely determines whether a soil is fully developed or mature, or is undeveloped or young. Alluvial soils are young and show little or no profile development because fresh material is deposited periodically. Soils of this kind in the county are Genesee, Shoals, and Sloan soils. The very steep Hennepin soils are also young because geologic erosion removes the soil material as fast as it forms, and because very rapid runoff leaves little water to percolate through the soil.

In Boone County there is little difference in the age of the mature soils and in the age of the parent material in which they formed. These soils started developing when the glaciers receded. Mature soils have well-developed A and B horizons that are a result of the natural processes of soil formation.

Processes of Soil Formation

Several processes have been involved in the formation of the soils of this county. These processes 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 formation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in horizon differentiation.

Some organic matter has accumulated in the surface layer of all the soils of this county. The organic-matter content of some soils is low, but that of others is high. Generally, the soils that have the most organic matter, like Ragsdale soils, have a thick, black surface horizon.

Carbonates and bases have been leached from the upper horizons of nearly all the soils of this county, but the leaching has had little effect on horizon differentiation. The effect has been indirect. The leaching is generally believed to precede the translocation of silicate clay minerals. Most of the well-drained soils have been completely leached of carbonates and bases. Even in the wettest soils some leaching is indicated by the absence of carbonates and by an acid reaction. Leaching of wet soils is slow because water moves slowly through the soil.

Clay particles accumulate in pores and form films on the surfaces along which water moves. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils of this county. Miami soils are examples of soils in which translocated silicate clays have accumulated in the B2t horizon in the form of clay films.

The reduction and transfer of iron, or gleying, has occurred in all of the very poorly drained and somewhat poorly drained soils of this county. In the naturally wet soils, this process has been significant in horizon differentiation. The gray color of the subsoil indicates the reduction of iron oxides. The reduction is commonly accompanied by some transfer of the iron, either from upper horizons to lower horizons or completely out of the profile. Mottles, which are in some horizons, indicate segregation of iron.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationships to each other and to the whole environment, and develop principles that will help us to understand their behavior and response to use. First through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The system currently used to classify soils in the United States was adopted for general use by the National Cooperative Soil Survey in 1965 and was supplemented in March 1967 (*7*). This system is under continual study. Readers interested in the development of the system should refer to the literature available (*5*).

The current system consists of six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are measurable or observable, but the properties are selected so that soils of similar genesis are grouped together. Placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of the soil series of Boone County according to the current system. The categories of the current system are defined briefly in the following paragraphs.

ORDER.—Soils are grouped into orders according to properties that seem to have resulted from the same processes acting to about the same degree on the parent material. Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Four of the ten soil orders are represented in Boone County: Entisols, Inceptisols, Mollisols, and Alfisols.

Entisols occur on recent land surfaces. Inceptisols occur mostly on young, but not recent, land surfaces. Mollisols have a thick, dark-colored surface layer, moderate to strong structure, and a base saturation of more than 50 percent. Alfisols have a clay-enriched B horizon and a base saturation of more than 35 percent.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that seem to produce classes having the greatest genetic similarity. The soil properties used are mainly those that reflect either the presence or absence of waterlogging, or differences in climate or vegetation. The climatic range of the suborders is narrower than that of the orders.

GREAT GROUP.—Each suborder is divided into great groups, on the basis of uniformity in the kinds and sequence of major horizons and soil features. The horizons

TABLE 8.—*Classification of soil series by higher categories*

Series	Family	Subgroup	Order
Brookston	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Crosby	Fine, mixed, mesic	Aeric Ochraqualfs	Alfisols.
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, mesic	Fluventic Eutrochrepts	Inceptisols.
Hennepin	Fine-loamy, mixed, mesic	Typic Eutrochrepts	Inceptisols.
Mahalasville	Fine-silty, mixed, mesic	Typic Argiaquolls	Mollisols.
Miami	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Ockley	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Ragsdale	Fine-silty, mixed, mesic	Typic Argiaquolls	Mollisols.
Reesville	Fine-silty, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Shoals	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Sleeth	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Sloan	Fine-loamy, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Westland	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Whitaker	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.

considered are those in which clay, iron, or humus has accumulated and those that have pans that interfere with the growth of roots or the movement of water. The features considered include soil temperature and chemical composition (mainly calcium, magnesium, sodium, and potassium).

SUBGROUP.—Each group is divided into subgroups, one representing the central (typic) segment of the group, and other groups, called intergrades, that have properties of one great 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 the range of any other great group, suborder, or order.

FAMILY.—Families are established within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils when used for engineering purposes. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

Climate [4]

Boone County has a climate with four well-defined seasons. It is located in the middle latitudes and in the interior of the continent away from the moderating effects of the oceans. Air of both tropical and polar origin plies the county resulting in periodic rainfall and frequent changes in temperature and humidity. Much of the rainfall in the county comes from low pressure centers that bring moisture from the west. Most of these low pressure centers move up the Ohio River Valley into the St. Lawrence River Valley and eventually to the Atlantic Ocean.

Table 9 provides information about temperatures and precipitation. The probabilities of the last freezing temperatures in spring and the first in fall are given in table 10.

Scattered thunderstorms occur on an average of about 44 days of each year, of which about 2 days are during the winter months. Scattered thunderstorms are the primary source of summer rainfall.

The greatest amount of precipitation in the county generally occurs late in spring and early in summer. Precipitation in winter averages about 2.5 inches per month, and in spring it averages about 4.0 inches per month. March, April, and May average 7 days per month having 0.10 inch or more of rain. Late in summer and early in fall, the average drops to 5 days per month that have 0.10 inch or more of rain. Droughts are infrequent, but they do affect farm production occasionally.

Rainfall of 1.7 inches in 1 hour occurs 1 year out of 5, 2.0 inches in 1 hour occurs about 1 year out of 10, and 2.3 inches in 1 hour occurs about 1 year out of 25. In a 6-hour period, rainfall of 3.1 inches occurs about 1 year out of 10 and a rainfall of 4.2 inches occurs about 1 year out of 25. Snowfall has occurred as early as October and as late as May. The total snowfall in the county averages 17

[4] By LAWRENCE A. SCHAAL, state climatologist, National Weather Service, U.S. Department of Commerce.

TABLE 9.—*Temperature and precipitation data*

[All data from Whitestown, Boone County. Elevation 829 feet. Period of record, 1896 to 1968]

Month	Temperature				Precipitation				
						One year in 10 will have—			
	Average daily maximum	Average daily minimum	Average monthly maximum	Average monthly minimum	Average total	Less than—	More than—	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover of 1 inch or more
	°F.	°F.	°F.	°F.	In.	In.	In.		In.
January	36	19	56	−5	2.9	1.0	5.3	10	3
February	38	20	59	−1	2.1	.8	4.0	6	3
March	49	29	71	10	3.9	1.7	7.0	2	3
April	62	39	81	23	3.8	1.9	6.3	(1)	2
May	73	50	88	34	4.2	1.8	7.4		
June	83	59	94	44	4.0	1.7	6.4		
July	87	62	96	49	3.4	1.3	5.9		
August	85	60	95	47	3.1	1.3	4.9		
September	77	53	91	36	3.2	.9	5.7		
October	66	42	82	26	2.8	.9	4.9	(1)	2
November	50	32	70	14	2.8	1.3	4.5	1	2
December	38	22	58	1	2.6	.9	5.3	7	3
Year	62	41	(2) 98	(3) −10	38.8	31.2	46.5	26	3

(1) Average less than half a day.
(2) Average annual highest temperature.
(3) Average annual lowest temperature.

TABLE 10.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Whitestown, Boone County]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	March 27	April 7	April 24	May 3	May 15.
2 years in 10 later than	March 22	April 2	April 13	April 27	May 11.
5 years in 10 later than	March 10	March 20	March 31	April 16	May 2.
Fall:					
1 year in 10 earlier than	November 9	October 31	October 22	October 9	September 26.
2 years in 10 earlier than	November 16	November 5	October 25	October 13	October 1.
5 years in 10 earlier than	November 28	November 17	November 4	October 25	October 10.

inches per year. In 1 day it has snowed as much as 10 inches. The greatest monthly snowfall has been 12 inches. Many winters, however, have very little snow.

Temperature in July, the warmest month of the year, reaches 90° F. or higher an average of 11 days a year. The winter season averages 6 days during which the temperature drops below 0° F. January generally is the coldest month of the year.

Relative humidity varies on an average summer day from slightly over 40 percent during a sunny summer afternoon to 90 percent or higher just before dawn. Relative humidity rises and falls during a 24-hour period with the highest percent generally occurring with the minimum temperature and the lowest percent with the maximum temperature. Southerly winds bring higher humidities than northerly winds.

The wind is from the southwest most of the time, but in some winters the prevailing wind is from the west or northwest. Wind velocities 20 feet above the ground average about 11 miles per hour in spring months and near 7 miles per hour late in summer. Winds are stronger during the daylight hours than at night. Tornadoes occurred on 11 days in a 54-year period.

The best weather for outdoor activities is in fall, when temperatures are regularly in the comfortable range, showers are infrequent, and sunshine averages about 72 percent of the daylight hours.

Additional Facts About the County

Boone County was established in 1830; and Lebanon, the county seat, was founded in 1832. The county was named after Daniel Boone, the Kentucky woodsman. The dense forests and swampy areas that covered the county were cleared and drained by the early settlers. As the land was being cleared, more settlers came and small towns started to dot the county. These towns served the surrounding farming communities with supplies, places of worship, and schools. As the population of the county increased, Lebanon became the largest town and Zionsville the second largest.

Farming, mainly on family farms, accounts for a relatively large proportion of the total income in the county. Row crops, small grains, and livestock are the main products that provide income. In 1969 there were 1,448 farms in the county.

Water for cities, rural areas, and areas of expanding industry and housing is obtained from municipal and private wells. Most of the water used in the county is ground water pumped from glacial drift. A few wells tap water from limestone formations below the glacial drift. The thick mantle of glacial drift in the county contains many deposits of sand and gravel that constitute a large underground reservoir in which many millions of gallons of water are stored (*3*). Advance, Jamestown, Lebanon, Thornton, Whitestown, and Zionsville have municipally owned and operated waterworks. Presently the only source of water for these communities is ground water.

Transportation is available by highways, railroads, and air. There are six federal highways and these include three interstate highways: Interstate 65, Interstate 74, and Interstate 465. There are seven state highways and approximately 825 miles of county roads. Several bus lines and many trucking firms serve the county. A number of communities have rail service. The commercial airport at Indianapolis is about 28 miles from Lebanon, and several small private airfields are located in the county.

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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.

Bottom land. The flood plain of a stream; frequently or occasionally flooded unless protected artificially.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Coarse-textured soil. Soil of the sand or loamy sand textural class.

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 moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Cover crop. A close-growing crop grown between periods of regular crops, primarily for the purpose of improving and protecting the soil; or a crop grown between trees and vines in orchards and vineyards.

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 layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

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.

Fine-textured soil. Soil of the sandy clay, silty clay, or clay textural class.

Forage crop. A plant that can be used as feed by domestic animals; it may be grazed or cut for hay.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial outwash (geology). Cross-bedded gravel, sand, and silt deposited by melt water as it flowed from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, and covered with grass for protection against erosion; used to conduct surface water away from cropland.

Gravel. 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.

Habitat. The natural abode of a plant or animal; it refers to the kind of environment in which a plant or animal normally lives as opposed to its range, or geographical distribution.

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.

Leaching. The removal of soluble materials from soils or other materials by percolating water.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Medium-textured soil. Soil of the very fine sandy loam, loam, silt loam, or silt textural class.

Moderately coarse textured soil. Soil of the sandy loam or fine sandy loam textural class.

Moderately fine textured soil. Soil of the clay loam, sandy clay loam, or silty clay loam textural class.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil, consisting of fairly well decomposed plant remains, that is relatively high in mineral content, finely divided, and dark in color. (Muck is not shown as a separate mapping unit on the soil map of Boone County, because the total acreage is small [less than 20 acres] and the individual areas are mostly less than 2 acres in size. Symbols on the soil map show where areas of muck are located within areas of other soils. Fibrous peat underlies the muck in most of these areas. The organic material is more than 40 inches thick. Drainage is very poor.)

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

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.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff (hydraulics). That part of precipitation upon a drainage area that is discharged from the area in stream channels. The part that flows off the surface without sinking in is called surface runoff; the part that enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments 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. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are 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 soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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.

Windbreak. Any shelter that protects from the wind. A vegetative windbreak is a strip of closely spaced trees or shrubs, planted primarily to deflect wind currents and thereby reduce soil blowing, control snow drifting, conserve moisture, and protect crops, orchards, livestock, and buildings.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, p. 9.
Predicted yields, table 2, p. 28.
Tree and shrub suitability, table 3, p. 28.
Limitations of soils for recreational uses, table 4, p. 32.
Engineering uses of the soils, tables 5, 6, and 7, pp. 36 through 49.

Map symbol	Mapping unit	Described on page	Capability unit		Tree and shrub suitability group
			Symbol	Page	Number
Br	Brookston silt loam, overwash	8	IIw-1	24	1
Bs	Brookston silty clay loam	8	IIw-1	24	1
CrA	Crosby silt loam, 0 to 3 percent slopes	9	IIw-2	24	2
CsB2	Crosby-Miami silt loams, 2 to 6 percent slopes, eroded	10	IIe-12	23	2
FcA	Fincastle silt loam, 0 to 3 percent slopes	11	IIw-2	24	2
FsA	Fox silt loam, 0 to 2 percent slopes	11	IIs-1	25	3
FsB2	Fox silt loam, 2 to 6 percent slopes, eroded	12	IIe-9	23	3
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	12	IIIe-9	26	3
Gn	Genesee silt loam	12	I-2	23	3
HeF	Hennepin loam, 25 to 50 percent slopes	13	VIIe-2	27	4
Ma	Mahalasville silty clay loam	14	IIw-1	24	1
MmA	Miami silt loam, 0 to 2 percent slopes	14	I-1	23	3
MmB2	Miami silt loam, 2 to 6 percent slopes, eroded	14	IIe-1	23	3
MmC2	Miami silt loam, 6 to 12 percent slopes, eroded	15	IIIe-1	25	3
MmD2	Miami silt loam, 12 to 18 percent slopes, eroded	15	IVe-1	27	3
MmE2	Miami silt loam, 18 to 25 percent slopes, eroded	15	VIe-1	27	4
MsB3	Miami clay loam, 2 to 6 percent slopes, severely eroded	15	IIIe-1	25	3
MsC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	15	IVe-1	27	3
MsD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	16	VIe-1	27	3
OcA	Ockley silt loam, 0 to 2 percent slopes	17	I-1	23	3
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	17	IIe-3	23	3
Ra	Ragsdale silty clay loam	18	IIw-1	24	1
Re	Reesville silt loam	18	IIw-2	24	2
Sh	Shoals silt loam	19	IIw-7	25	2
St	Sleeth silt loam	20	IIw-2	24	2
Sx	Sloan silt loam	20	IIIw-9	26	1
We	Westland silty clay loam	21	IIw-1	24	1
Wh	Whitaker silt loam	22	IIw-2	24	2

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