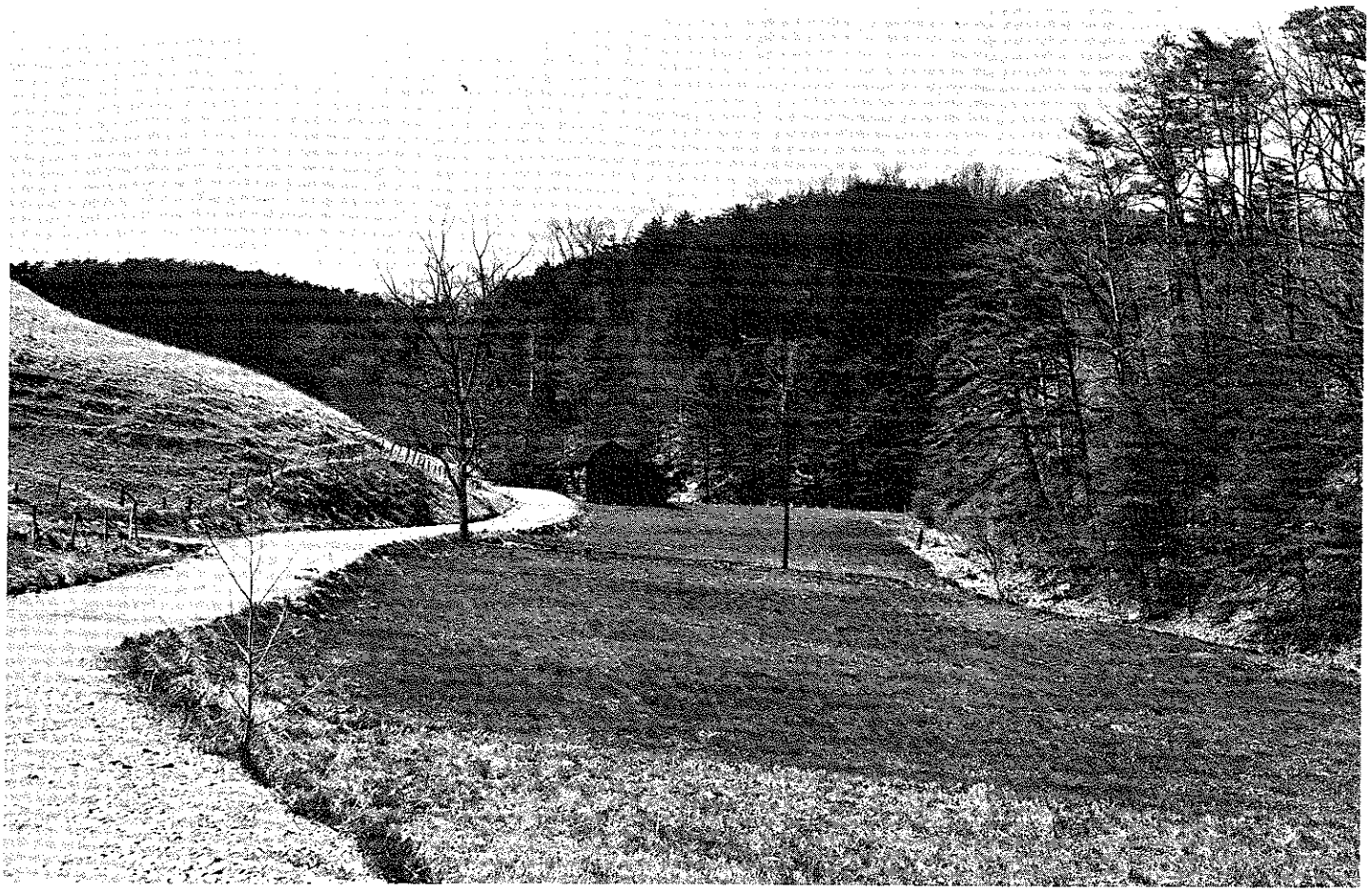
SOIL SURVEY OF

Washington County, Ohio



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service and Forest Service
in cooperation with the
OHIO DEPARTMENT OF NATURAL RESOURCES
Division of Lands and Soil
and the
OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

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

Major fieldwork for this soil survey was completed in the period 1966-71. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1971. This survey was made cooperatively by the Soil Conservation Service and Forest Service, the Ohio Department of National Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Washington Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

All the soils of Washington 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 and woodland classification of each. It also shows the page where each soil is described and the page for the capability unit to which the soil has been assigned.

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 descriptions of the capability units.

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

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

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and for recreation areas in the section "Town and Country Planning."

Engineers and builders can find, under "Engineering" 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 Washington County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication and in the section "General Nature of the County."

Contents

Issued---April 1977

Cover: Hartshorn silt loam, in narrow valleys throughout the county, is productive of hay and pasture.

Index to Mapping Units

1/ Mapping unit is referred to as "Strip mine spoil, calcareous" throughout the survey.

2/ Mapping unit is referred to as "Strip mine spoil, acidic (toxic)" throughout the survey.

Summary of Tables

Soil Survey of Washington County, Ohio

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

WASHINGTON COUNTY is in the southeastern part of Ohio (fig. 1). It is bordered on the south and the east by the Ohio River. It has an area of 410,240 acres, or 641 square miles. Its population in 1970 was 57,160. The county seat, Marietta, which was settled on April 7, 1788, as the first permanent settlement in Ohio and in the Northwest Territory, has a population of 16,861. Belpre, the other city in the county, has a population of 7,189. Smaller incorporated villages are Beverly, Lowell, Lower Salem, Macksburg, and New Matamoras.

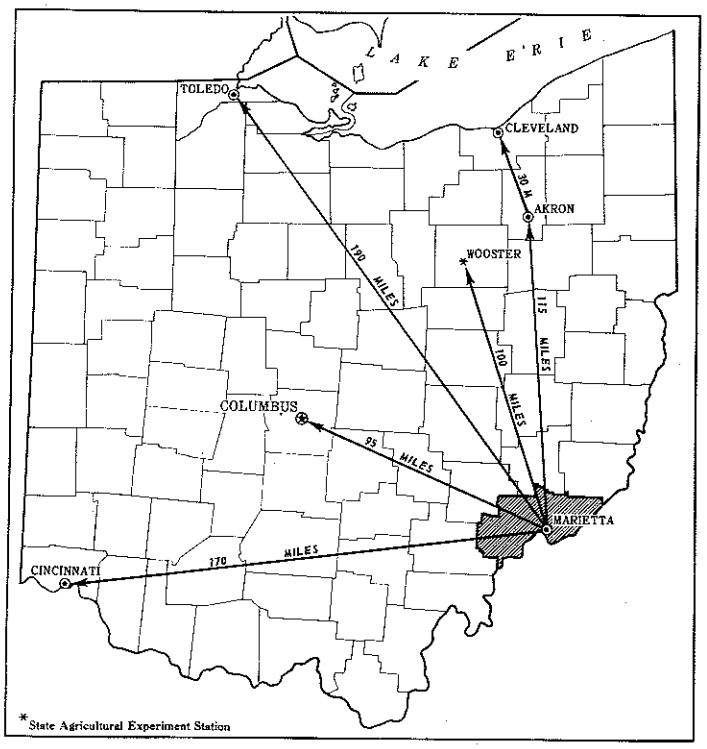

Figure 1.--Location of Washington County in Ohio.

The county is entirely within the unglaciated Allegheny Plateau physiographic region of Ohio. The landscape is strongly dissected, and many of the soils are steep to very steep.

Washington County is mainly rural. Most farms are general. The main source of farm income is from the sale of livestock and their products. Truck crops are important along the Ohio River.

Industry is mainly in or near Marietta or along the Ohio and the Muskingum Rivers. The principal industries are the manufacturing of ferroalloys, chemicals, and office equipment.

Forestry is another important enterprise. Part of the Wayne National Forest is in Washington County.

How This Survey Was Made

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

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

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Gilpin and Upshur, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Upshur silty clay loam, 12 to 18 percent slopes, is one of several phases within the Upshur series.

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

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

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

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Gilpin-Summitville-Upshur complex is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. An association is named for the dominant soil or soils. Upshur association, very stony, 25 to 70 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Dekalb and Gilpin stony soils, 25 to 70 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Fill land, clayey materials, is an example.

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

defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing medium 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 failure to slow permeability or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a given kind of soil, and they relate this failure to a high shrink-swell potential. Thus, they use observation and knowledge of soil properties, together with available research data, to predict the limitations or suitability of a soil for present and potential uses.

After data have been collected and tested for the key, or benchmark, 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 study 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 survey shows, in color, the soil associations in Washington County. A soil association is a landscape that has a distinctive pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, 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 soil associations in this survey have been grouped into four general kinds of landscapes for broad interpretative purposes. The broad groups and the 13 soil associations are described on the following pages.

Soils on Steep and Very Steep Side Slopes and Moderately Steep Ridgetops and Knobs

These associations are in very steep and hilly parts of the county along the Ohio and Muskingum Rivers and some of the larger creeks. The ridgetops are very narrow or rolling and lack the smooth even surfaces suitable for farming. The soils formed mainly in material weathered from the underlying bedrock. The associations are mostly forested. They make up about 53 percent of the county.

1. Upshur-Vandalia Association

Reddish clayey soils formed in residuum from shale on side slopes and ridgetops and reddish clayey soils formed in colluvium on foot slopes

This association is on steep and very steep side slopes and sloping and rolling ridgetops. The soils are predominantly reddish and clayey. The side slopes are typically broken by benches. The foot slopes are uneven and subject to landslips. The streams that dissect the association are small and have narrow flood plains.

This association makes up about 22 percent of the county. It is about 40 percent Upshur soils, 10 percent Vandalia soils, and 50 percent less extensive Gilpin, Summitville, Dekalb, Woodsfield, Zanesville, Hackers, and Moshannon soils.

Upshur and Vandalia are reddish, clayey, well-drained soils. The Upshur soil, on side slopes, formed in residuum from shale. Vandalia, a deep soil on colluvial benches and foot slopes, formed in thick colluvium. The less extensive Gilpin, Summitville, and Dekalb soils are on side slopes; Woodsfield and Zanesville soils are on ridgetops; Hackers soils are on low terraces; and Moshannon soils are on flood plains.

Most farms on this association are small livestock farms in narrow stream valleys and in the wider valleys of East and Mill Branches in Dunham and Belpre Townships. Hay and pasture are the main crops on uplands. Only a small acreage is in vegetable crops, mostly tomatoes and peppers. A severe erosion hazard is a limitation in the steep areas. Much of

the very steep area was cleared, but has since reverted to brush and woodland. White oak and Virginia pine are the dominant kinds of trees. In steep parts bordering the rivers are large tracts of continuous hardwood forest. Much of this association is near Marietta and the Ohio River Valley. The slope, the hazard of landslips, and the very slow or slow permeability are limitations for most nonfarm uses.

2. Gilpin-Upshur-Vandalia Association

Brownish loamy soils formed in residuum from siltstone and reddish clayey soils formed in residuum from shale on side slopes and ridgetops and reddish clayey soils formed in colluvium on foot slopes

This association is on mostly very steep side slopes and rolling ridgetops that are typically a series of knobs. The side slopes are rough and channery or stony and are broken by narrow benches. The foot slopes have uneven colluvial benches. Except along the Little Muskingum River, the flood plains along the streams are narrow.

This association makes up about 20 percent of the county. It is about 25 percent Gilpin soils, 25 percent Upshur soils, 10 percent Vandalia soils, and 40 percent less extensive Summitville, Dekalb, Hayter, Brookside, Hartshorn, and Chagrin soils.

Gilpin and Upshur are moderately deep and deep, well-drained soils on side slopes. Gilpin is a brown loamy soil formed in residuum from siltstone, and Upshur is a reddish clayey soil formed in residuum from shale. Vandalia is a deep, reddish clayey soil formed in thick colluvium along foot slopes. Summitville and Dekalb soils are on side slopes, Brookside and Hayter soils are on colluvial benches, and Hartshorn and Chagrin soils are on flood plains.

Very steep, rugged slopes and a very severe erosion hazard are major limitations for most land uses. Crops are limited largely to a few wider valleys and several ridgetops. Most of the remaining cleared land is in hay and pasture. Beef cattle is the main farm enterprise. There are a few dairy farms. Scattered homesites are limited to the valleys and ridgetops.

This association is in the Wayne National Forest purchase tract. About 15 percent is Government owned. More than 75 percent supports the best stands of hardwoods in the county. Many of the ridgetops and upper slopes that were formerly cleared have reseeded naturally to Virginia pine and yellow-poplar.

This association has potential for recreational development. The Little Muskingum River is clean and provides good fishing and attractive scenery. Local relief is typically 400 to 500 feet.

3. Upshur-Gilpin-Lowell Association

Reddish clayey soils formed in residuum from shale, brownish loamy soils formed in residuum from siltstone, and brownish clayey soils formed in residuum from limestone, siltstone, and shale on side slopes and ridgetops

This association is on steep and very steep side slopes and rolling and sloping ridgetops. The ridgetops are generally narrow and uneven and have many knolls and low saddles. The streams are small and the valleys narrow.

This association makes up about 8 percent of the county. It is about 35 percent Upshur soils, 25 percent Gilpin soils, 10 percent Lowell soils, and 30 percent less extensive Summitville, Dekalb, Westmore, Vandalia, Hayter, Brookside, and Chagrin soils.

Upshur and Gilpin are deep and moderately deep, well-drained soils on side slopes. Upshur is a reddish clayey soil formed in residuum from shale. Gilpin is a brownish loamy soil formed in residuum from siltstone. Lowell is a deep, brownish clayey soil, on side slopes, formed in residuum from layers of limestone, shale, and siltstone. Summitville, Dekalb, and Westmore soils are on side slopes; Vandalia, Hayter, and Brookside soils are on colluvial benches; and Chagrin soils are on flood plains.

Most of the association was cleared and farmed at one time, but much of it is now idle or in brush and woodland. Beef cattle is the main farm enterprise. There are also a few dairy farms. Most farms are on ridgetops and in valleys. About 65 percent of the association is wooded. Lowell soils are higher in natural nutrient supply than most associated soils on uplands and are well suited to pasture. The slope, the hazard of landslips, and the slow or very slow permeability of some soils are limitations for most nonfarm uses.

4. Elba-Belpre Association

Brownish clayey soils formed in residuum from limestone and reddish clayey soils formed in residuum from calcareous shale on side slopes and ridgetops

This association is on steep and very steep side slopes and on rolling ridgetops that are generally narrow and have many knolls and low saddles. Many side slopes are benched, and many have been strip mined for coal. The stream valleys are narrow.

This association makes up about 3 percent of the county. It is about 20 percent Elba soils, 20 percent Belpre soils, 15 percent Strip mine spoil, and 45 percent less extensive Gilpin, Upshur, Brookside, and Nolin soils.

Elba and Belpre are well-drained, deep, non-acid clayey soils on side slopes. They have a high natural nutrient supply. Elba is a brownish soil formed in residuum from limestone, and Belpre is a reddish soil formed in residuum from calcareous shale. Upshur and Gilpin soils are on side slopes, Brookside soils are on low colluvial benches, and Nolin soils are on flood plains.

Much of the association was once cleared and farmed, but about three-fourths of it is now idle or wooded. Most of the present farming is in the valley of the West Fork of Duck Creek and on a few ridgetops that are used for pasture. The major soils of this association are well suited to pasture. Many of the side slopes have been strip mined for coal and the resulting spoils are too rough, too stony, or too acid for farming. Many ridgetops are surrounded by strip mine spoil and high walls and thus have poor accessibility and a limited water supply for livestock. Most of the streams have been polluted by acid drainage from the mines and thus can no longer support aquatic life or provide water for livestock.

Landslides and sedimentation of stream channels and roadside ditches are major limitations. The slope and the hazard of landslips are limitations for many nonfarm uses.

Soils on Moderately Steep to Very Steep Side Slopes and Wide Gently Sloping and Sloping Ridgetops

These associations are on hills and wide ridgetops mostly in the western part of the county. Most of the soils formed in residuum from the underlying bedrock. Those on ridgetops are deep and gently sloping or sloping and are used for farming. The side slopes are mostly grassland and woodland. The associations make up about 21 percent of the county.

5. Gilpin-Dekalb-Woodsfield Association

Brownish loamy soils formed in residuum from siltstone and sandstone on side slopes and reddish clayey soils formed in residuum from shale on ridgetops

This association is on steep and very steep side slopes and wide, gently sloping and sloping ridgetops. Brownish loamy soils predominate.

This association makes up about 11 percent of the county. It is about 25 percent Gilpin soils, 15 percent Dekalb soils, 15 percent Woodsfield soils, and 45 percent less extensive Upshur, Zanesville, Summitville, Clymer, Keene, Hayter, and Hartshorn soils.

Gilpin and Dekalb are moderately deep, well-drained soils on side slopes. Woodsfield are deep, well-drained soils on ridgetops. Gilpin are brownish loamy soils formed in residuum from siltstone, and Dekalb are brownish loamy and channery soils formed in residuum from sandstone. Woodsfield are reddish clayey soils formed in residuum from shale. Ridgetops make up about a third of the association. Zanesville, Clymer, and Keene soils are on ridgetops; Upshur and Summitville soils are on side slopes; Hayter soils are on low colluvial benches; and Hartshorn soils are on narrow flood plains.

The side slopes are mostly wooded. Southwest of the village of Cutler are many rocky cliffs and rock caves that favor recreational use of this area. Most ridgetops are used for beef and dairy enterprises and for part-time farming. Farmland on some of the ridgetops has been abandoned and now supports good stands of Virginia pine that can be marketed for pulpwood. Only a few roads are in this association. The slope and the moderate depth over bedrock are limitations for many nonfarm uses.

6. Upshur-Zanesville Association

Reddish clayey soils formed in residuum from shale on side slopes and brownish loamy soils formed in residuum from siltstone on ridgetops

This association is on moderately steep to steep side slopes and wide, gently sloping to sloping ridgetops.

This association makes up about 10 percent of the county. It is about 25 percent Upshur soils, 15 percent Zanesville soils, and 60 percent less extensive Gilpin, Woodsfield, Summitville, Dekalb, Vandalia, Hackers, and Moshannon soils.

Upshur soils are on side slopes and formed in residuum from shale. They are well-drained, reddish clayey soils. Zanesville soils are on ridgetops and are underlain by siltstone and sandstone. They are moderately well drained, brownish loamy soils that have a fragipan. Woodsfield soils are on ridgetops; Gilpin, Summitville, and Dekalb soils are on side slopes; Vandalia soils are on low colluvial benches; Hackers soils are on low terraces; and Moshannon soils are on narrow flood plains.

Slightly more than half of this association is used for crops and pasture. The rest is steep and is mostly wooded. Most farms are small, part-time beef cattle enterprises. There is also some dairy and hog farming. A small acreage is used for vegetables. Much of the woodland on the steep Upshur soils is nearly pure stands of white oak and Virginia pine.

Most farms, homesites, and roads are confined to the ridgetops, upper slopes, and narrow valleys. The slope, the hazard of landslips, and the slow permeability of some of the soils are limitations for nonfarm uses.

Soils on Gently Sloping and Sloping High Terrace Remnants and Surrounding Steep Side Slopes and Ravines

These associations are on gently sloping and sloping high terrace levels in preglacial valleys and terrace remnants on ridgetops. They are mostly in the western and central parts of the county. These levels have been entrenched so that the areas include steep walls of inner valleys and narrow bottom land. The soils on the terrace levels and remnants are deep and formed in thick old alluvium. They are used mainly for farming. The steep side slopes and ravines are wooded. The associations make up about 17 percent of the county.

7. Vincent-Otwell Association

Reddish clayey and brownish loamy soils formed in water-laid material on extensive terrace remnants

This association is on gently sloping to rolling high terrace remnants in preglacial valleys and on uplands covered with thick deposits of lacustrine material. In places it is dissected by deep ravines and narrow valleys.

This association makes up about 10 percent of the county. It is about 25 percent Vincent soils, 25 percent Otwell soils, and 50 percent less extensive Upshur, Gilpin, Summitville, Licking, Allegheny, Gallia, and Moshannon soils.

Vincent and Otwell are deep soils formed in water-laid, or lacustrine, material. Vincent are well-drained, reddish clayey soils formed in lacustrine clay. Otwell are moderately well drained, brownish loamy soils formed in loamy water-laid material. They have a fragipan. Upshur, Gilpin, and Summitville soils are on hills and the sides of ravines; Licking, Allegheny, and Gallia soils are on the same high terrace levels as Vincent soils; and Moshannon soils are on narrow flood plains.

Most of the association is well suited to farming (fig. 2). Dairy cows, beef cattle, and hogs are all important enterprises. Corn, hay, and small grain are the main crops. Frost heave is a limitation in growing alfalfa.

About two-thirds of the association is gently sloping or sloping. These less sloping parts have few limitations for many nonfarm uses.

Figure 2.--Typical farm on Vincent-Otwell association. Large acreages of Vincent soils are cultivated.

8. Gilpin-Upshur-Otwell Association

Brownish loamy soils formed in residuum from siltstone and reddish clayey soils formed in residuum from shale on side slopes and brownish loamy soils formed in water-laid material on terrace remnants

This association is on moderately steep to very steep side slopes, on wide, gently sloping to sloping ridgetops, and on terrace remnants.

This association makes up about 5 percent of the county. It is about 30 percent Gilpin soils, 20 percent Upshur soils, 10 percent Otwell soils, and 40 percent less extensive Vincent, Licking, Allegheny, Woodsfield, Zanesville, Summitville, Dekalb, Vandalia, and Nolin soils.

Gilpin and Upshur are steep, moderately deep and deep, well-drained soils on side slopes. Gilpin are brownish loamy soils formed in material weathered from siltstone. Upshur are reddish clayey soils formed in material weathered from shale. Otwell are moderately well drained, brownish loamy soils that formed in thick water-laid material on terrace remnants and ridgetops. They have a fragipan. Vincent, Licking, and Allegheny are deep soils formed in water-laid material on terrace remnants and ridgetops. Zanesville and Woodsfield soils are on ridgetops, Summitville and Dekalb soils are on side slopes, Vandalia soils are on low colluvial benches, and Nolin soils are on flood plains.

The ridgetops and high terrace remnants make up about a third of this association. Most areas of Woodsfield, Zanesville, Otwell, Vincent, Allegheny, and Licking soils are used for crops. Most of the full-time farms are on these soils. Gilpin and Upshur soils, which occupy the steeper parts, are mostly in woodland and pasture.

The moderately steep to very steep slopes, the severe erosion hazard, the moderate depth over bedrock, and the hazard of landslips are limitations for farm and nonfarm uses.

9. Gallia-Allegheny Association

Reddish and brownish loamy soils formed in water-laid material on extensive terrace remnants

This association is on high terrace remnants and on uplands covered with thick lacustrine material. It is gently sloping to rolling. Very steep terrace escarpments are near drainageways.

This association makes up about 1 percent of the county. It is about 30 percent Gallia soils, 25 percent Allegheny soils, and 45 percent less extensive Otwell, Licking, Upshur, Gilpin, and Moshannon soils.

The major soils are deep, well drained, and loamy. They are on low knobs, spurs, low ridges, and gently sloping and sloping areas near escarpments. Gallia are reddish soils formed in glacial outwash and sandy lacustrine deposits. In most areas the material is more than 10 feet thick, and on ridgetops near Bartlett it is more than 70 feet thick. Allegheny are brownish soils formed in fine sandy and silty fluvial and lacustrine material. Otwell and Licking soils are on high terraces and lacustrine deposits, Upshur and Gilpin soils are on terrace escarpments and a few low hillsides, and Moshannon soils are on narrow flood plains.

Most of this association is in crops and pasture. Only the very steep parts are wooded. The major soils are used for orchards and general farm crops.

Nonfarm uses are increasing in the area near Little Hocking in the extreme southwest corner of the county. The slope and the hazard of landslips are the chief limitations.

10. Duncannon-Lakin Association

Brownish loamy and sandy soils formed in wind- and water-deposited material on low terraces and in hummocky areas

The major soils in this association formed in thick silty and sandy wind and water deposits on low terraces and in hummocky areas. They are in two small areas near Reno and Newport.

This association makes up about 1 percent of the county. It is about 35 percent Duncannon soils, 25 percent Lakin soils, and 40 percent less extensive Sparta, Upshur, Gilpin, and Watertown soils.

The major soils are deep, well drained, and brownish. Duncannon are gently sloping loamy soils on undulating hilltops and low ridges and on hillsides where they are interlaced with Lakin soils. Lakin are sandy soils on undulating and hummocky surfaces and hillsides. Upshur and Gilpin are very steep soils on side slopes, and Sparta and Watertown soils are on the tops of low hills and on terraces.

This association is used for urban and industrial development, woodland, and pasture. The gently sloping major soils have few limitations for nonfarm uses. Lakin soils are suitable for sprinkler irrigation. They are subject to soil blowing. This association is near the Ohio River, which offers a water supply and barge transportation. There are excellent stands of yellow-poplar on the steep hillsides.

Soils on Nearly Level Flood Plains and Nearly Level to Sloping Low Terraces

These are nearly level to sloping associations along the Ohio and Muskingum Rivers and their larger tributaries. The soils are deep and well drained. They formed in silt, sand, gravel, and clay deposits. They are used intensively for truck and general farming and for various nonfarm enterprises. The associations make up about 9 percent of the county.

11. Mentor-Watertown-Huntington Association

Brownish loamy and sandy soils formed in water-laid material on terraces and flood plains

This association is a band 1/2 to 1 mile wide and 50 miles long between the Ohio River and the very steep valley walls. The landscape is one of flood plains and two levels of low terraces of glacial outwash and alluvium.

This association makes up about 3 percent of the county. It is about 20 percent Mentor soils, 10 percent Watertown soils, and 8 percent Huntington soils. Much of the remaining 62 percent is used for urban and industrial purposes and is mapped as Fill land and Urban land. Less extensive are Hackers, Nolin, Ashton, Wheeling, Chili, and Chagrin soils.

Mentor are deep, well-drained loamy soils on both terrace levels. Watertown are sandy, gravelly, well-drained soils on the higher terrace level. Huntington are dark-colored, well-drained soils on the flood plain. Hackers, Wheeling, and Chili soils are on the upper terrace level; Ashton soils are on the lower terrace level just above the flood plain; and Nolin and Chagrin soils are on the flood plain.

This association is used intensively for farming, urban purposes, transportation, and industry (fig. 3). Most of it is owned by commercial interests, but farming is still the predominant enterprise. Both truck and grain crops produce high yields. Many of the soils

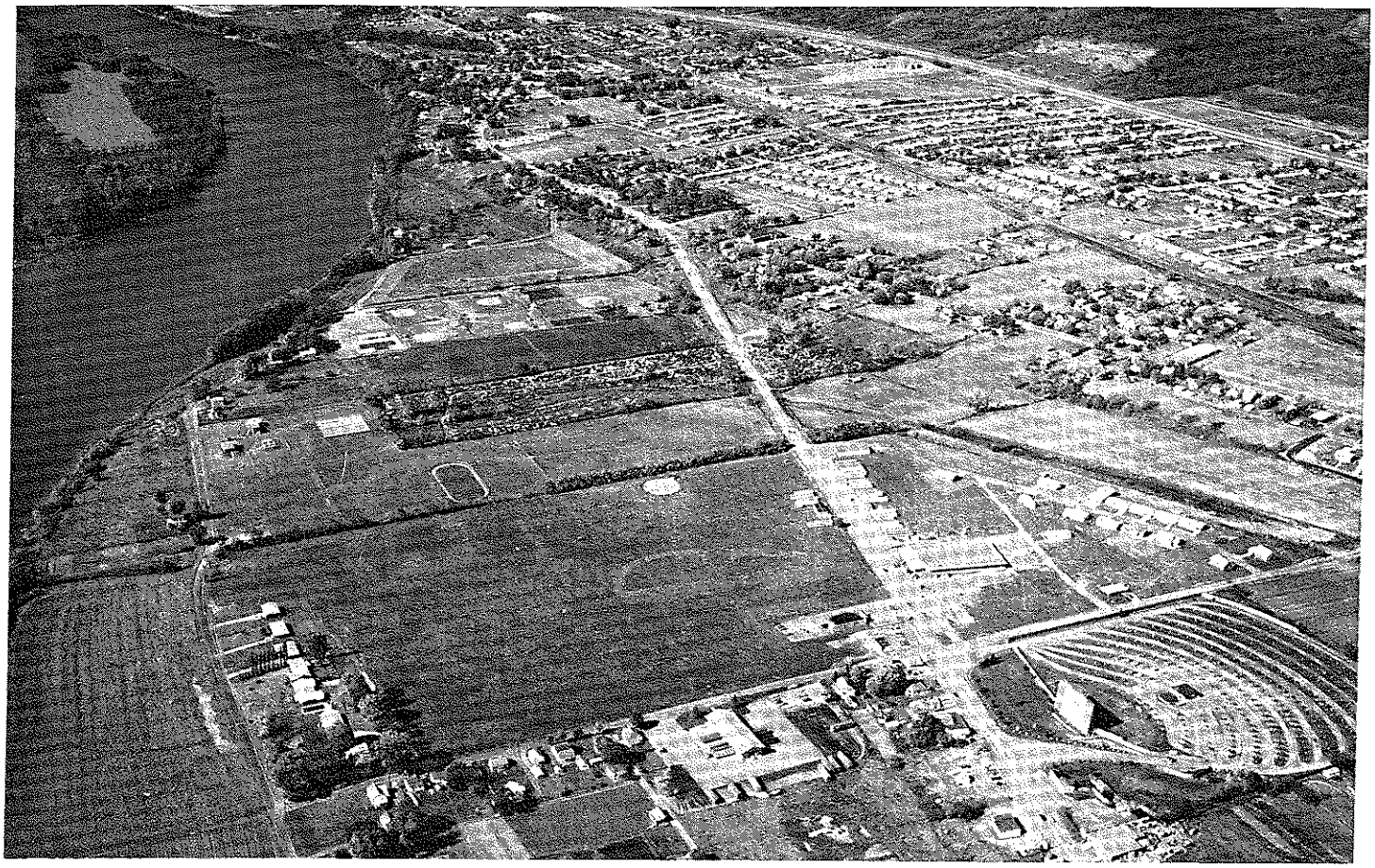

Figure 3.--Residential and industrial development on Mentor-Watertown-Huntington association along the Ohio River.

are suitable for sprinkler irrigation. Vegetable crops are important in the Marietta area. The soils on the flood plain are frequently flooded, but Ashton soils and the lower areas of Mentor soils are infrequently flooded.

Except in areas that are subject to flooding, this association has few limitations for nonfarm uses. Ohio Route 7 serves the entire length of the association, and railroads serve the area below Marietta. The Ohio River provides barge transportation and water supply. The underlying sand and gravel of Wheeling, Chili, and Watertown soils is suitable for commercial use.

12. Chagrin-Mentor-Chili Association

Brownish loamy soils formed in water-laid material on flood plains and terraces

This association is a band 1/2 to 1 mile wide on both sides of the Muskingum River and is bordered by steep valley walls. The landscape is one of flood plains and several levels of low terraces separated by escarpments that create a step effect. The coarser textured soils are on the higher terrace levels.

This association makes up about 3 percent of the county. It is about 25 percent Chagrin soils, 10 percent Mentor soils, 10 percent Chili soils, and 55 percent less extensive Wheeling, Watertown, Conotton, Nolin, and Tioga soils.

All are brownish, well-drained soils. Chagrin are deep loamy soils on the flood plain. Mentor are deep soils on terraces and formed in silty fluvial material. Chili are deep soils on terraces and formed in gravelly and sandy glacial outwash. Wheeling, Watertown, and Conotton soils are on terraces, and Nolin and Tioga soils are on the flood plain.

Most of this association is used for farming. Vegetables are grown on the terraces, and grain and hay are grown on the flood plain. Most of the vegetables grown in the county are from this association. Most of the soils are suitable for sprinkler irrigation.

Except for the flood plain and the lowest level terraces, all of which are subject to flooding, this association has few limitations for many nonfarm uses. The underlying material of Chili, Conotton, Watertown, and some Wheeling soils is a source of sand and gravel.

The Muskingum River has good potential for recreational development. It offers scenic attractions and good boating and fishing. Small locks accommodate pleasure boats through the entire county.

13. Chagrin-Markland-Nolin Association

Brownish loamy and clayey soils formed in water-laid material on flood plains and terraces

This association is on nearly level and gently sloping flood plains and low terraces along tributaries to the Ohio and Muskingum Rivers.

This association makes up about 3 percent of the county. It is about 30 percent Chagrin soils, 20 percent Markland soils, 20 percent Nolin soils, and 30 percent less extensive Glenford, Hackers, McGary, and Mentor soils.

The major soils are brownish and well drained. Chagrin are loamy soils on flood plains; Markland are clayey soils on terraces; and Nolin are loamy soils on flood plains. Glenford, Hackers, McGary, and Mentor soils are on terraces.

Nearly all of this association is farmed, mostly to grain and hay. Flooding is a limitation on the flood plains, but most floods come late in winter and early in spring and the damage to crops is not serious. Large-scale fieldwork is hindered by the irregularly shaped fields, which are dissected by stream meanders.

Nearly all of this association is accessible by improved roads. A railroad traverses the length of Duck Creek. Nonfarm uses are hindered by flooding on Chagrin and Nolin soils and by the clayey texture and slow permeability on Markland soils.

This association has potential for recreational uses. Much of it is scenic and picturesque. The Little Muskingum River and Wolf Creek provide good fishing.

Use and Management of the Soils

The soils of Washington County vary widely in use and management. They are used chiefly for field crops, pasture, and specialty crops. General practices in managing the soils for these purposes are suggested in the pages that follow. The capability grouping used by the Soil Conservation Service, in which the soils are grouped according to their suitability for crops, is explained, and management is defined by capability units. Estimated yields of the principal crops, under two levels of management, are listed in tables 1 and 2.

This part of the survey also contains information on suitability of the soils for woodland and general suggestions on improving wildlife habitat. It reports data from engineering tests and interpretations of soil properties that affect highway construction and other engineering structures. It also contains soil information to be considered in town and country planning.

Information about suitable crop varieties, erosion control, artificial drainage, and other management practices can be obtained at offices of the Soil Conservation Service or the Ohio Cooperative Extension Service.

Cultivated Crops

Many soils in the county need lime or fertilizer or both. The amount needed depends on the natural content of lime and plant nutrients, as determined by laboratory analysis of soil samples; on the needs of the crop; and on the level of yield desired. Only general suggestions for applications of lime and fertilizer are given in this publication.

The content of organic matter in the soils is low. Building it up to a high level is not economical, but it is important to return organic matter by adding farm manure, leaving plant residue on the surface, and growing sod crops, cover crops, and green-manure crops.

Tillage tends to break down soil structure. It should be kept to the minimum necessary to prepare a seedbed and control weeds. Maintaining the level of organic matter in the plow layer is essential. Most soils that have a silt loam surface layer are subject to crusting and are likely to form a hard crust after a heavy rain. On such soils the tillage needed should be sufficient for aeration of the soil and establishment of plants, but not excessive.

The soils in Washington County are dominantly well drained or moderately well drained. Except for small, wet, seepy spots, artificial drainage is seldom needed in crop production. By draining these wet spots, some fields are made more usable and productive. The somewhat poorly drained soils are on bottom land and low terraces. Some receive excess runoff from the adjacent uplands. Some receive water from seeps and springs in the nearby hillsides. All can be tile drained if suitable outlets can be located.

All of the gently sloping and steeper soils that are cultivated are subject to erosion. The erodibility of a particular soil depends in part on its physical properties. For example, an Upshur soil is more susceptible to erosion than a Dekalb soil, assuming that both soils have comparable slopes and vegetative cover. The hazard of erosion on all soils increases as the percentage of slope increases. The hazard of erosion on any particular soil becomes more severe with increasing intensity of use; for example, a soil in a cultivated area is more susceptible to erosion than one in a wooded area. Erosion is commonly controlled by diversions, grassed waterways, contour stripcropping, contour tillage, minimum tillage, crop residue, and sod crops. Chemical weed control, along with no-till planting, is a common practice in corn production. The effectiveness of a particular combination of these measures differs from one soil to another, but different combinations can be equally effective on the same soil. The local representative of the Soil Conservation Service can assist in planning an effective combination of practices.

Pasture

Nearly one-fifth of the land area in Washington County is used for pasture. Pasture and hay plants commonly grown are alfalfa, red clover, white clover, bluegrass, orchardgrass, tall fescue, timothy, and bromegrass.

The ability of a pasture to produce forage and protect the soils is influenced by the number of livestock, the length of time they graze, the season they graze, and the availability of water. Practices that contribute to good pasture management are proper stocking rates to maintain key forage species, rotation of pastures and deferred grazing, grazing in the proper season, mowing for weed control, application of appropriate amounts of lime and fertilizer, and ample water supplies that are strategically located.

Erosion control is a major need because many of the soils used for pasture are steep and already eroded. Control of erosion is particularly important during seeding. Mulch seeding or use of a small grain as a companion crop can help prevent further erosion.

The need for lime and fertilizer should be determined by soil tests, and adequate amounts should be supplied to meet the requirements of the crop to be grown.

Soil compaction, caused by grazing when the soils are wet, can greatly reduce the vigor of

pasture plants. Compaction is particularly a hazard on Belpre, Elba, Lowell, and Upshur soils.

Special Crops

A sizable acreage in Washington County is used for fruit and vegetables. Most vegetable crops and small fruit crops are grown on the terraces and flood plains of the Ohio River, between Belpre and Newport, and along the Muskingum River, between Marietta and Beverly. The orchards are on upland ridgetops where severe frost damage is less likely. Vegetables and fruits are grown for sale to commercial canneries and as fresh produce at roadside stands.

Special crops warrant intensive management because of their high value per acre. For crops that are not irrigated, yields depend as much on the weather as on any other single factor. Favorable weather that permits early planting in spring increases the returns from early cabbage, sweet corn, tomatoes, and snap beans.

The following soils have the best potential for producing most of the vegetable crops commonly grown in the county: Alford, Allegheny, Ashton, Chili, Duncannon, Gallia, Hackers, Markland, Mentor, Vincent, Watertown, Wellston, Wheeling, and Woodsfield.

Sweet corn is the chief special field crop. In 1969, it was harvested from about 190 acres. Little or none of the acreage was irrigated. Sweet corn can be grown about anywhere that field corn can be grown. Good drainage is needed. The sandier soils, such as Watertown and Chili, are best suited to early varieties. Soil texture is less important for late varieties. Yields are drastically reduced during extended dry periods.

Tomatoes are grown on more individual farms than any other single vegetable crop. In 1969, they were grown on 122 acres, of which 48 acres was irrigated. Farms having 3 to 15 acres in tomatoes are along the Ohio and Muskingum Rivers. Many 1- to 3-acre tracts are on upland farms mainly in Warren, Watertown, and Barlow Townships. Most of the crop is sold as fresh produce, either locally or in city markets. Tomatoes are grown under a wide range of soil conditions. The sandier soils are most suitable for early varieties. Soil texture is less important for late varieties. Many buyers prefer the quality of tomatoes grown on upland soils. Good drainage is needed because the root system is not moisture tolerant.

Cabbage is commonly grown, but is less extensively grown than sweet corn or tomatoes. It is grown almost entirely along the Ohio and Muskingum Rivers. It is best suited to soils that are nearly level, medium to coarse textured, well drained to moderately well drained, neutral in reaction, and high in organic-matter content. Sandy soils are best suited to early varieties.

Irish potatoes, which were harvested on 186 acres in 1969, require loose, friable soils that are well supplied with plant nutrients. They are suited to loamy and gravelly, well-drained soils. They can be successfully grown on Watertown, Chili, Wheeling, and Mentor soils and have potential on Gallia, Allegheny, and Clymer soils.

Peppers, snap beans, cucumbers, cantalopes, watermelons, pumpkins, and *squash* are other special crops. Tracts of each of these crops range from 10 to 50 acres. Production is concentrated along the Ohio and Muskingum Rivers. Most of these vegetables are sold as fresh produce. All require good drainage, adequate fertility, and a slightly acid to neutral soil. Most need irrigation during dry periods.

Fruit trees have been decreasing in number since 1930, but recently new fruit varieties and the introduction of dwarf trees, which are replacing some older orchards, have slowed or reversed this trend. According to the census, there were 454 acres of orchards in 1964 and 341 in 1969. In 1969, there were 182 acres of peaches, 99 acres of apples, 11 acres of cherries, 5 acres of pears, and 2 acres of plums.

Fruit trees need porous, well-drained soils that have a deep root zone. Because they also need good air drainage, most orchards are on rounded ridgetops, chiefly on Gallia, Allegheny, Zanesville, Woodsfield, Upshur, Gilpin, Otwell, and Vincent soils. The soils poorly suited to fruit production are poorly drained and somewhat poorly drained and are on colluvial slopes, flood plains, and low terraces where the air drainage is poor.

Strawberries are grown on about 25 acres. They are best suited to medium-textured to moderately coarse textured, well-drained, medium-acid soils that are nearly level to gently sloping. Irrigation is needed in achieving the best production and in preventing frost damage. Good air drainage is also helpful.

A large acreage of Washington County is well suited to *grapes* and *raspberries*. Grapes have an especially wide range of soil adaptability. Both crops require good air drainage. Grape production has recently been encouraged in southeastern Ohio.

Irrigation

Sprinkler irrigation is used successfully for vegetables and berries that have high value per acre. The stability of the soil is an important consideration in determining whether irrigation is feasible. With minor exceptions, only soils that have slopes of less than 6 percent are suited to irrigation. The lack of good sources of water also limits irrigation in many areas. Most irrigation water comes from farm ponds, rivers, and streams, and from wells along the Ohio and Muskingum Rivers.

The following well drained to moderately well drained, medium-textured to moderately

coarse textured soils that have slopes of less than 6 percent are suitable for irrigation: Alford, Allegheny, Ashton, Chagrin, Chili, Conotton, Duncannon, Gallia, Gilpin, Hackers, Tioga, Hartshorn, Hayter, Huntington, Lakin, Mentor, Moshannon, Nolin, Sparta, Watertown, Wellston, and Wheeling.

The following medium-textured to fine-textured, slowly permeable soils that have slopes of less than 6 percent can be irrigated if good soil structure is maintained: Glenford, Keene, Licking, Markland, Otwell, Vincent, Woodsfield, and Zanesville.

Some sandy soils that have slopes of as much as 12 percent can be successfully irrigated if erosion is controlled by mulch or by plant cover. Some soils that have slopes of more than 6 percent can be made suitable for irrigation by reshaping.

If adequately drained, Fitchville, McGary, Melvin, Newark, and Peoga soils can be irrigated.

Features affecting the use of soils for irrigation are described in the section "Engineering Interpretations" and are shown for each soil in table 7.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife.

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

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

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

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter e, w, s, or c to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by w, s, and c, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or woodland, wildlife, or recreation.

The hazard of erosion (e) is the main limitation on about 76 percent of Washington County; wetness (w) on 6 percent; and droughtiness or shallowness (s) on 14 percent. About 4 percent of the acreage has no major limitation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-2. Thus, in one symbol,

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

Management by Capability Units

The use and improved management of the soils of Washington County are suggested by capability units on the pages that follow. General characteristics, properties, and qualities of the soils are described, and features that limit their use for crops and pasture are pointed out.

In some units, one or two soils differ slightly from the rest. For some of these exceptions, the acreage is too small to justify a separate capability unit. The exceptions are noted as they relate to use and management.

Ratings for available moisture capacity apply to the typical root depths of the commonly grown field crops, such as corn or small grain.

Because many different methods are suitable for controlling erosion, achieving drainage, or otherwise managing any given kind of soil, no specific management is suggested. Additional information concerning soil erosion control, artificial drainage, suitable crop varieties, or other management can be obtained from offices of the Soil Conservation Service or the Ohio Cooperative Extension Service.

The capability classification for each soil in the county is designated in the "Guide to Mapping Units" at the back of this publication. Fill land, Strip mine spoil, and Urban land are not classified.

Capability Unit I-1

This unit consists of well drained and moderately well drained, level or nearly level soils that have a silt loam surface layer. Slopes are 0 to 2 percent. These soils occupy stream terraces that are generally above the flood level. Some low areas are occasionally flooded. The soils have a deep root zone, moderate to slow permeability, and a loamy texture throughout. Available water capacity is high. Sandy and gravelly material is at a depth of 48 inches or more in some soils.

These are among the best soils in the county for farming. No features limit their use for field crops or pasture. There is little or no hazard of erosion under average or improved management. Good soil structure can be maintained by growing crops that supply a large amount of crop residue.

These soils are suited to all cultivated crops and all hay or pasture plants commonly grown in the county. Under improved management, they are suited to cultivated crops year after year. They are also well suited to irrigation and normally have an adequate supply of water nearby. Some are well suited to early season planting of special crops. The soils that are slightly acid or neutral ordinarily require little or no lime. Lime requirements are moderate or high if the subsoil is acid.

Capability Unit IIe-1

This unit consists of well drained and moderately well drained, gently sloping soils that have a silt loam or loam surface layer. Slopes are 2 to 6 percent. These soils are on ridgetops and terraces in small areas throughout the county. All are slightly eroded. The root zone is moderately deep or deep. Available water capacity ranges from low to high. Permeability is mostly moderate to moderately rapid, but in some soils it is slow. The root zone is medium to extremely acid unless lime has been applied.

A moderate hazard of erosion is the main limitation for cultivated crops. Runoff is medium. Good tilth is difficult to maintain if the soils are frequently cultivated. Returning crop residue to the soil and minimizing tillage are beneficial. The soils are subject to crusting.

These soils are well suited to all the field crops and the hay and pasture plants commonly grown in the county. If well managed, they can be cultivated frequently. The Chili and Wheeling soils in this unit are suited to early season planting and irrigation.

Capability Unit IIe-2

This unit consists of well-drained, gently sloping soils that have a silt loam surface layer. Slopes are 2 to 6 percent. These soils are on high terraces and broad upland ridges throughout the county. All are slightly eroded. Some have a compact subsoil, or fragipan, and some have a clayey subsoil. Permeability is slow to moderate. The root zone is moderately deep to deep. Reaction ranges from medium acid to very strongly acid unless lime has been applied. The available water capacity is medium to high.

A moderate hazard of erosion is the main limitation for cultivated crops. A deep-rooted legume is subject to frost heave. Runoff is medium. Good tilth is difficult to maintain if the soils are frequently cultivated. Returning crop residue to the soil and minimizing tillage are beneficial. The soils are subject to crusting.

These soils are well suited to all field crops and hay and pasture plants commonly grown

in the county. If well managed, they can be cultivated frequently.

Capability Unit IIe-3

This unit consists of moderately well drained and well drained soils that have a silt loam surface layer. Slopes are 2 to 6 percent. These soils are on uplands and terraces. They have either a fragipan or a restrictive clayey subsoil. Permeability is mostly slow. The root zone is moderately deep to deep. Available water capacity is mostly medium. Reaction is medium acid to very strongly acid.

A moderate hazard of erosion is the major limitation for row crops. Runoff is medium. During wet periods in spring, a perched water table causes the moderately well drained soils to dry out more slowly than the well drained soils. Seeps or wet spots are in places. If tilled or grazed when wet, the soils are susceptible to surface crusting and compaction.

These soils are suited to most field crops and the hay and pasture plants commonly grown in the county. Under improved management, they can be cultivated frequently.

Capability Unit IIw-1

This unit consists of somewhat poorly drained soils that have a silt loam surface layer. These soils are on low-lying terraces or flood plains. They have a seasonal high water table that results mainly from runoff and seep water from the adjacent higher areas. They are subject to flooding particularly in winter and spring. Whether flooded or not, they stay wet until late in spring or early in summer unless they are artificially drained. The root zone is deep if the soils are adequately drained. Available water capacity is high. Permeability ranges from slow to moderate.

Wetness is the major limitation. Good soil structure is difficult to maintain if the soils are tilled or grazed when wet. Excess water from adjacent slopes can be intercepted by tile drains or by diversions. The seasonal high water table can be lowered by tile drains if outlets are available. There is little or no hazard of erosion.

These soils are used mainly for pasture. Under improved management, they can be cultivated year after year. If adequately drained, they are suitable for most commonly grown field crops and for hay or pasture plants that can tolerate wetness. The soils should be protected by trees or grass in areas where flooding is frequent.

Capability Unit IIw-2

This unit consists of nearly level, well-drained soils that have a silt loam surface layer. Slopes are 0 to 2 percent. These soils are on broad flood plains throughout the county and on narrow flood plains along the smaller streams. All are subject to flooding. Most are light colored, but some are dark colored. All are slightly acid to moderately alkaline and rarely require lime. Permeability is moderate. Most of the soils have a moderately deep to deep root zone and a high available water capacity. Some, however, have a shallower root system and a medium to low available water capacity.

Seasonal flooding is the major limitation. The hazard of erosion is slight. Some areas are subject to scouring.

These soils are well suited to all the field crops and the hay and pasture plants commonly grown in the county. Flooding, however, limits their use largely to summer-grown row crops. Under improved management, row crops can be grown year after year without significantly damaging the soil. Areas subject to frequent flooding are better suited to trees or grass than to row crops. The soils are well suited to bluegrass and Ladino clover. Many areas along the smaller streams are in permanent pasture.

Capability Unit IIs-1

This unit consists of well-drained, nearly level soils that have a loam or sandy loam surface layer. Slopes are 0 to 2 percent. These soils are on terraces mostly along the Ohio and Muskingum Rivers. The root zone is gravelly or sandy and deep. Available water capacity is low. Reaction is slightly to strongly acid.

The low available water capacity is the dominant limitation for cultivated crops. Tilth generally is good. The content of organic matter is low. The soils can be tilled soon after heavy rains.

These soils are suitable for most field crops and pasture plants commonly grown in the county. Because they are droughty, they are better suited to small grain than to corn. Because they dry out and warm up quickly in spring, they are well suited to short-season crops and to nursery crops (fig. 4). Also, they are well suited to irrigation. Unless irrigated, pasture declines in summer.

Capability Unit IIIe-1

This unit consists of well-drained soils that have a silt loam or loam surface layer.

Figure 4.--Sparta loamy sand in foreground. This nearly level soil is well suited to nursery crops. It is also well suited to irrigation.

Slopes range from 6 to 12 percent. Most of these soils are on terraces, but some are on alluvial fans and high bottoms. The root zone is deep or moderately deep. The available water capacity is mostly high, but in places is medium to low. Permeability is moderate, but in places is moderately rapid or rapid. Reaction in the root zone is slightly acid to very strongly acid.

The hazard of erosion is severe for cultivated crops. Some lower lying areas of Hackers soil are occasionally flooded.

These soils are suited to the field crops commonly grown in the county. Under improved management, they can be frequently cultivated. Irregular slopes, however, make erosion control difficult. Part of the acreage is used for orchards, and part for special crops. All the soils are well suited to native or improved pasture.

Capability Unit IIIe-2

This unit consists of well-drained, sloping soils that have a loam or silt loam surface layer. Slopes are 6 to 12 percent. These soils are on uplands throughout the county. They are predominantly loamy throughout. They are underlain by interbedded bedrock. The root zone is deep or moderately deep. The available water capacity is medium. The surface layer is generally friable and easy to till. Permeability is moderate or moderately rapid. Reaction is slightly acid to very strongly acid.

A severe hazard of erosion is the major limitation for cultivated crops. Maintaining fertility, good tilth, and the level of organic matter are management concerns if the soils are frequently cultivated.

Capability Unit IIIe-3

This unit consists of well drained and moderately well drained, gently sloping to sloping soils that have a silt loam or silty clay loam surface layer. Slopes are 2 to 12 percent. These soils are on terraces or uplands. The root zone is deep or moderately deep, and the available water capacity is medium or high. Permeability ranges from slow to moderate. Reaction in the root zone is medium acid to very strongly acid.

These soils are suited to the field crops commonly grown in the county. Under improved management, they can be cultivated frequently. Erosion, however, is difficult to control. The soils are well suited to native or improved pasture.

Capability Unit IIIe-4

This unit consists of well-drained, light-colored, sloping soils, most of which have a silt loam or loam surface layer. Slopes are 6 to 12 percent. These soils are on uplands. They are underlain by sandstone, siltstone, or clay shale. The root zone is moderately deep or deep, and the available water capacity is low or medium. Permeability ranges from slow to rapid. Reaction is medium acid or very strongly acid.

A severe hazard of erosion is the major limitation for cultivated crops. Runoff generally is rapid. Most of the soils are susceptible to crusting.

These soils are suited to all the field crops and the hay and pasture plants commonly grown in the county. Under improved management, cultivated crops can be grown frequently. Erosion, however, is difficult to control. The soils are suited to bluegrass and white clover, but are better suited to tall grasses and legumes.

Capability Unit IIIe-5

The only soil in this unit is Watertown sandy loam. Slopes are 6 to 12 percent. This sloping soil is on terraces. The root zone is sandy and deep, and the available water capacity is low. Reaction is strongly acid to slightly acid.

A severe hazard of erosion is the main limitation for cultivated crops. The low available water capacity is also a limitation. Tilth generally is good, but the organic-matter content is low.

This soil is suited to most field crops and pasture plants commonly grown in the county. Because it is droughty, it is better suited to small grain than to corn. Because it dries out and warms up quickly in spring, it is well suited to short-season crops. It also is well suited to irrigation. Pasture declines in summer because the soil is droughty.

Capability Unit IIIe-6

This unit consists of well drained or moderately well drained, sloping soils that dominantly have a silty clay loam, silt loam, or clay surface layer. Slopes are 6 to 12 percent. These soils are on ridgetops, high terraces, and colluvial benches. They are underlain by interbedded bedrock, alluvium, or lacustrine material. All have clayey layers in the subsoil. The root zone is deep or moderately deep, and the available water capacity ranges from medium to high. Permeability is slow to moderate. Reaction generally is medium to very strongly acid, but in places is mildly alkaline to medium acid.

A severe hazard of erosion is the major limitation for cultivated crops. Runoff is rapid, and all the soils are eroded. Small wet spots in some areas are a minor limitation.

These soils are suited to improved pasture and to most field crops commonly grown in the county. They are well suited to bluegrass. Maintaining fertility, good tilth, and the level of organic matter are management concerns if the soils are frequently cultivated. Some areas are used for pasture, hay, or trees.

Capability Unit IIIw-1

This unit consists of poorly drained, nearly level soils that have a silt loam surface layer. These soils are on low-lying terraces or flood plains. They have a seasonal high water table that results mainly from runoff and seep water from the adjacent higher areas. They are subject to flooding particularly in winter and spring. Whether flooded or not, they stay wet until late in spring or early in summer unless they are artificially drained. The root zone is moderately deep. Available water capacity is high.

Severe wetness is the main limitation for farming. Good soil structure is difficult to maintain if the soils are tilled or grazed when wet. Excess water from adjacent slopes can be intercepted by tile drains or by diversions. The seasonal high water table can be lowered by tile drains if outlets are available. There is little or no hazard of erosion.

These soils are used mainly for pasture. Under improved management, they can be cultivated year after year. If adequately drained, they are suited to most commonly grown field crops and hay or pasture plants. In areas where flooding is frequent, the soils should be protected by trees or grass.

Capability Unit IIIs-1

This unit consists of well-drained, nearly level to sloping soils that have a sandy or gravelly surface layer. Slopes are 0 to 12 percent. These soils are on terraces mostly along the Ohio and Muskingum Rivers. The root zone is gravelly and deep to moderately deep. The available water capacity is low. Reaction is very strongly acid to slightly acid.

The low available water capacity is the main limitation for cultivated crops. The hazard of erosion under average or improved management is slight. Tilth is generally good, though the organic-matter content is low. Some soils are subject to soil blowing.

These soils are suited to most field crops and pasture plants commonly grown in the county. Because they are droughty, they are better suited to small grain than to corn. Because they dry out and warm up quickly in spring, they are well suited to short-season crops. They also are well suited to irrigation. Unless irrigated, pasture declines in summer.

Capability Unit IVe-1

This unit consists of moderately steep, well-drained soils that have a loam, silt loam, or loamy fine sand surface layer. Slopes are 10 to 20 percent. These soils are on uplands and terraces. They are underlain by siltstone, shale, sandstone, or lacustrine material. The root zone is moderately deep or deep, and the available water capacity is low to high. Permeability is moderate to rapid. The root zone is strongly acid to very strongly acid, and the lime requirement is moderate to high.

A severe hazard of erosion is the main limitation for cultivated crops. Runoff is very rapid. Maintaining fertility, good tilth, and the level of organic matter are management concerns in cultivated areas.

The soils are suited to all the field crops and the hay and pasture plants commonly grown in the county. Under improved management, they are suited to occasional cultivation. More than occasional cultivation commonly results in excessive erosion.

Capability Unit IVe-2

This unit consists of well-drained, moderately steep to steep soils, most of which have a gravelly or channery loam surface layer. Slopes are 12 to 25 percent. These soils are on terraces and uplands throughout the county. The root zone is deep or moderately deep and is gravelly, sandy, or channery. Available water capacity is generally low or medium, but in places is high. Reaction ranges from mildly alkaline to very strongly acid.

A severe erosion hazard is the main limitation for cultivated crops. Tilth is generally good, but the organic-matter content is low.

These soils are suited to pasture plants commonly grown in the county. Pasture declines during the dryer summer months. A small grain can be grown occasionally.

Capability Unit IVe-3

This unit consists of moderately steep, well-drained soils that dominantly have a loam or silt loam surface layer. Slopes are 12 to 18 percent. These soils are on uplands. Some have a clayey subsoil. All are underlain by siltstone, shale, clay shale, or sandstone. The root zone is moderately deep or deep, and the available water capacity is medium to low. Permeability ranges from rapid to slow. The root zone is medium to extremely acid in most places, and the lime requirement is moderate to high.

A severe erosion hazard is the main limitation for cultivated crops. Runoff is very rapid. Maintaining fertility, good tilth, and the level of organic matter are management concerns if the soils are cultivated. These soils are more droughty than other soils on uplands.

The soils are suited to all the field crops and the hay and pasture plants commonly grown in the county. Under improved management, they are suited to occasional cultivation. More than occasional cultivation commonly results in excessive erosion.

Capability Unit IVe-4

This unit consists of steep, well-drained soils, most of which have a loam or silt loam surface layer. Slopes are 18 to 25 percent. These soils are on uplands. They are underlain by stratified bedrock. The root zone is mostly moderately deep to deep, and the available moisture capacity is medium to low. Permeability ranges from slow to rapid. The root zone is medium acid to extremely acid, and the lime requirement is moderate to high.

A severe erosion hazard is the main limitation for cultivated crops. Runoff is very rapid. Maintaining fertility, good tilth, and the level of organic matter are management concerns if the soils are cultivated.

These soils are suited to all the field crops and the hay and pasture plants commonly grown in the county. Under improved management, they are suited to occasional cultivation. More than occasional cultivation commonly results in excessive erosion.

Capability Unit IVe-5

This unit consists mostly of moderately steep, well-drained soils that dominantly have a clay, silty clay loam, or silt loam surface layer. Slopes are 12 to 18 percent. These soils are on terraces, uplands, and colluvial slopes. They are dominantly loamy, but are clayey in the lower part of the subsoil. Some have a very firm, compact fragipan in the subsoil, at a depth of about 24 inches. The pan and the clayey subsoil restrict water movement. Interbedded bedrock underlies the soils on uplands. The root zone is moderately deep to deep in most soils. Available water capacity is medium to high. Permeability is mostly slow, but in places is moderately slow or moderate. The soils that have a fragipan also have a perched water table above the pan during extended wet periods, particularly in winter and spring. Reaction is mildly alkaline to very strongly acid.

A severe erosion hazard is the major limitation for cultivated crops. Maintaining fertility, good tilth, and the level of organic matter is important if the soils are cultivated.

These soils are suited to most of the field crops and the hay and pasture plants commonly grown in the county. Good stands of a deep-rooted crop, such as alfalfa, are difficult to maintain in long rotations on some soils. Under improved management, the soils are suited to occasional cultivation. More than occasional cultivation commonly results in excessive erosion. The small seep spots can normally be drained by random tile.

Capability Unit VIe-1

This unit consists of moderately steep to very steep, well-drained soils. Slopes are 12 to 35 percent. These soils are on uplands. They are underlain by siltstone, sandstone, or clay shale. Most are loamy throughout. Some have a clayey subsoil. The root zone is moderately deep to deep. Available water capacity is mostly low or medium. Permeability is dominantly moderate, but ranges from slow to rapid. Runoff is rapid to very rapid in winter and early in spring when the soils are wet.

Erosion is a severe hazard. Unless protective cover is maintained, the soils are generally not suitable for cultivation. Also, they are droughty during periods of limited rainfall.

These soils are suited to permanent pasture or woodland. Overgrazing, grazing when the soils are wet, and failing to maintain a high level of fertility result in poor growth of hay and pasture plants. Under improved management, these soils produce satisfactory forage. Seep spots in some areas provide sufficient water for the development of springs.

Capability Unit VIe-2

This unit consists of well drained, moderately steep to very steep soils. Slopes are 12 to 35 percent. These soils are on upland hillsides, benches, and colluvial slopes. Most have a clayey subsoil. Permeability is mostly moderately slow to slow. The root zone is moderately deep to deep, and the available water capacity is mostly medium to high.

Runoff is very rapid during winter and spring when the soils are likely to be saturated. Consequently, erosion is a severe hazard unless a thick protective plant cover is maintained. The soils in some areas are subject to cracking and slippage.

In most places the soils are not suited to cultivated crops because the risk of erosion is too great. They are, however, well suited to permanent hay or pasture. The soils on benches are suited to more intensive use. Seep spots are common. Some provide enough water for the development of springs.

Capability unit VIe-3

This unit consists of well-drained, very steep soils. Slopes are 25 to 35 percent. These soils are on upland hillsides. All have a clayey subsoil. Permeability is mostly moderately slow to slow. The root zone is moderately deep to deep. The available water capacity is mostly medium, but ranges from low to high.

Runoff is very rapid during winter and spring when the soils are likely to be saturated. Consequently, erosion is a severe hazard unless a thick protective plant cover is maintained. The soils in some areas are subject to cracking and slippage.

In most places the soils are not suited to cultivated crops because the risk of erosion is too great. They are, however, well suited to permanent hay or pasture. Some are well suited to alfalfa and tall-grass pasture. The more acid soils require large amounts of lime. Seep spots are common. Some provide enough water for the development of springs.

Capability Unit VIIe-1

This unit consists of well-drained, steep or very steep soils. Slopes are 18 to 70 percent. These soils are on uplands or terraces. Some are severely eroded. The texture, the depth, and the kinds of underlying bedrock or lacustrine material vary. In most places the root zone is moderately deep or deep, and the available water capacity is medium. Runoff is very rapid in most areas.

The slope and the severe erosion hazard are the major limitations. The use of machinery is limited mostly by slope, but also by landslips and seep spots. Most of the acreage that has been cleared of trees and tilled excessively or otherwise poorly managed is eroded.

These soils are suited to a permanent plant cover, either grass or trees. Some areas have been planted to trees. Others have been left idle, and natural vegetation has satisfactorily checked active erosion. This vegetation generally is a combination of broomsedge, povertygrass, and native trees. The tree species are commonly undesirable, but there are good stands of Virginia pine in some areas. The warmer slopes generally face southeast to west. Improved management is required if pasture is renovated.

Capability Unit VIIe-2

This unit consists of well-drained, steep to very steep soils on uplands. Slopes are 25 to 70 percent. Benches are common in some areas. Some soils are severely eroded. The texture and depth of the soils and the kinds of underlying bedrock vary. In most places the root zone is moderately deep to deep, and the available water capacity is medium. Runoff is very rapid in most areas.

The slope and the severe erosion hazard are the major limitations. The use of machinery is limited mostly by slope, but also by landslips and seep spots. The less steep benches are accessible to machinery. Most of the acreage that has been cleared of trees and tilled excessively or otherwise poorly managed is eroded.

These soils are suited to permanent plant cover, either grass or trees. Some areas have been planted to trees. Others have been left idle, and natural vegetation has satisfactorily checked active erosion. This vegetation generally is a combination of broomsedge, povertygrass, and native trees. The tree species are commonly undesirable, but there are good stands of Virginia pine in some areas. The warmer slopes generally face southeast to west. Improved management is required if pasture is renovated.

Capability Unit VIIs-1

This unit consists of well-drained, steep to very steep, very stony or bouldery soils. Slopes are 18 to 70 percent. These soils are on uplands. They include all of the stony or bouldery soils in the county. Most have a moderately deep or deep root zone, a medium to low available water capacity, and a mildly alkaline to extremely acid reaction.

The stones and the slope are the major limitations. Erosion is a hazard unless a thick plant cover is maintained.

These soils have very limited use for pasture. They are used mostly for woodland. The stones and the very steep slopes hinder logging.

Estimated Yields

Table 1 shows, for most of the soils in the county, the estimated average acre yields of principal crops. The yields are the averages of those expected over a period of several years under two levels of management. Table 2 shows estimated yields for special crops. These yields are averages of those expected over a period of several years under intensive management.

Figures in columns A in table 1 represent yields obtained under improved management. Those in columns B are the yields obtained under intensive management. Under intensive management--

1. The intake of water and the water-holding capacity of the soils are increased. Excess water is disposed of by appropriate means.
2. Erosion is controlled.
3. Suitable methods of plowing, preparing the seedbed, and cultivating are used.
4. Weeds, diseases, and insects are controlled.
5. Fertility is maintained at the highest level. Lime and fertilizer are applied according to needs of the soil and crop. Trace elements are applied if needed.
6. Crop varieties that are suited to the soil are selected.
7. All fieldwork is done at the proper time and in the proper way.

Improved management includes some, but not all, of the practices listed under intensive management. It also includes some practices that are not adequate for the needs of the crops.

The yields shown in table 1 do not apply to a specific field for any particular year because the soils vary from place to place, management practices vary from farm to farm, and weather conditions vary from year to year. They are intended only as a guide that shows the relative productivity of the soils, the response of soils to management, and the relationship of soils to each other.

The estimates are based primarily on information obtained from farmers and on observations and field trials made by the county agent and district conservationists of the Soil Conservation Service. They are also based on experiments made by the Ohio Agricultural

Research and Development Center and on field observations made by members of the soil survey party.

Woodland[1]

Approximately 60 percent of Washington County is wooded. More than 90 percent of the wooded acreage consists of privately owned stands and farm woodlots (fig. 5). The most extensive wooded areas are in the eastern part of the county, where more than 16,000 acres is in the Wayne National Forest.

The woodland is largely mixed hardwoods dominated by oak (fig. 6). About 11,000 acres of former farmland is predominantly Virginia pine. Most of the wooded acreage is on steep and very steep slopes where the dominant soils formed in material weathered from the underlying siltstone, shale, and sandstone. Fewer trees grow on the colluvial foot slopes at the base of very steep slopes, and still fewer on ridgetops and high terraces, all of which are suited to farming. Very little woodland remains on low terraces and bottom land. These areas are used intensively for farming and for industrial and urban purposes. The wooded acreage has increased in recent years particularly in areas where the topography is steep and the soils formed in the underlying bedrock. In these areas crop productivity is low. Farms have been abandoned and are reverting to woodland.

In places the woodland shows the result of abuse and neglect. Heavy cutting without planning for future timber crops has resulted in understocked stands of mature trees. High grading has continually removed the best trees and left the worst. Culls and low-value trees have accumulated and occupy valuable growing space on excellent woodland soils. Low-value white elm, cull beech, poorly formed black cherry, and maple now occupy thousands of acres where yellow-poplar, oak, and sugar maple once grew. Grazing livestock has destroyed leaf litter and desirable young trees, damaged roots, and packed the soil. Good management, in time, can restore this woodland to a higher level of production.

Potential productivity for selected species is shown in table 3. The only limitation is on the very steep and stony soils where the use of mechanized equipment is limited.

1/ A. N. Quam, woodland conservationist, SCS, helped prepare this section.

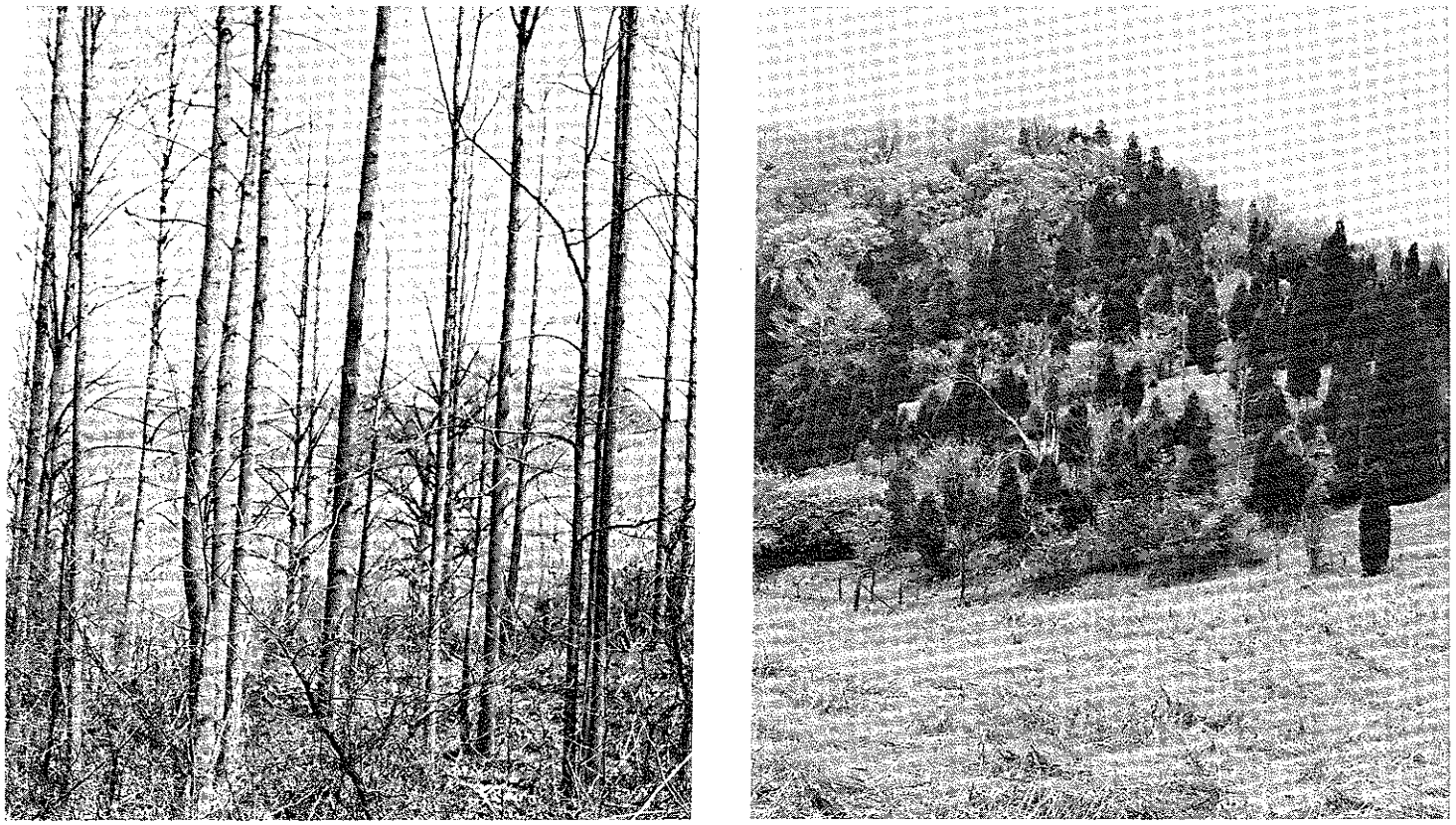

Figure 5.--Left: Yellow-poplar on a Duncannon soil. Right: Natural stand of eastern redcedar on an Upshur soil that is no longer used for crops.

Figure 6.--Young stand of red and white oak on Upshur soils.

Soils differ greatly in productivity for woodland. The factors influencing tree growth differ somewhat from those influencing annual crops or pasture. The capacity of a soil to supply moisture, for example, is most important in tree growth. The available water capacity of a soil is influenced by depth, texture, permeability, and internal drainage. The direction of exposure, or aspect, and the position of the soil on the landscape are also important. Other properties to be considered in evaluating a soil for woodland are the percent of slope, the degree of past erosion, the acidity, and the fertility.

Aspect is the compass direction toward which the slope faces. Trees grow better and soil moisture is more abundant on north and east aspects. Some of the factors that make south and west aspects less suitable are higher soil temperature as a result of more direct sunrays, high evaporation by prevailing winds, earlier melting of snow, and more freezing and thawing.

The position of the soil on the landscape is important in determining moisture supply for tree growth. Soil moisture increases as elevation decreases. On the lower part of slopes the soils are generally deeper than on the upper part, the loss of soil moisture by evaporation is less, and the soil temperature is somewhat lower.

Steepness of slope is an important factor in woodland management. Steep slopes present serious equipment limitations. As the percent of slope increases, the rate of water infiltration decreases and the rate of runoff and the hazard of erosion increase.

Erosion reduces the volume of soil available for water storage. Severe erosion removes the protective surface layer and exposes the less increasing runoff and porous subsoil, thus lowering the water-intake rate. Both tree growth and natural reseeding are adversely affected.

Soil reaction and fertility influence the growth and adaption of different kinds of trees. For example, black walnut trees do better on such soils as Huntington and Brookside, which have natural lime in all or part of the root zone. Fertility is not a major factor in tree

production, but growth is slower on soils having low fertility.

Woodland groups.--In order to assist owners in planning management for wood crops, the soils of Washington County have been grouped according to their suitability for woodland. Each group is made up of soils that are suited to the same kinds of trees, have the same potential production, and require about the same management. The "Guide to Mapping Units" at the back of this survey indicates the woodland group to which each soil has been assigned.

Each woodland group is identified by a three-part symbol, for example, 1o1, 2w1, or 3c3. The potential productivity of the soils in the group is indicated by the first number in the symbol: 1 means very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on field determination of average site index of an indicator species. Site index of a given soil is the height, in feet, that the dominant and codominant trees reach in a natural, essentially unmanaged stand in 50 years. Site index can be converted into approximate expected growth and yield per acre (4, 5, 6, 9) 2/.

The second part of the symbol, a small arabic letter x, w, c, s, f, r, or o, identifies the subclass. Except for the letter o, the arabic letter indicates an important soil property that imposes a hazard or limitation in managing the soils for trees. The letter x indicates stones or rocks; w, excessive wetness either seasonal or all year; and c, the kind or amount of clay in the upper part of the soil. The letter s indicates dry, unstable, and abrasive sandy soils that have little or no difference in texture between the surface layer and subsoil; f, large amounts of gravel, cobbles, or other coarse rock fragments less than 10 inches in diameter; and r, steep slope, a hazard of erosion, and possible limitations to use of equipment. The letter o indicates no limitation or only a slight limitation that restricts use of the soil for trees. If a soil has more than one limitation, priority in determining the subclass is in order of the letters listed.

The last part of the symbol, a second number, indicates differences in soil properties or other factors that affect management and suitability for specified trees.

Managing wood crops.--In table 3 each woodland group is rated according to various management limitations. These limitations are expressed as slight, moderate, or severe.

Erosion hazard refers to the potential hazard of soil loss in common woodland management. The hazard is slight if the expected loss is small; moderate, if some loss is expected and care is needed during logging and construction; and severe, if special management is needed to prevent excessive loss.

Equipment limitations depend on soil characteristics that restrict or prohibit the use of harvesting equipment, either seasonally or continually. Slight indicates no restriction in the kind of equipment or time of year it is used; moderate means that use of equipment is restricted for 3 months of the year or less; severe means that special equipment is needed and use is severely restricted for more than 3 months of the year.

Seedling mortality refers to mortality of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions. Plant competition is assumed not to be a factor. Slight indicates a loss of 0 to 25 percent; moderate, a loss of 25 to 50 percent; and severe, loss of more than 50 percent of the seedlings. It is assumed that seed supplies are adequate.

Plant competition is the degree to which undesirable plants invade openings in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. Conifers and hardwoods are rated separately in table 3. Slight means that plant competition does not prevent adequate natural regeneration and early growth or interfere with seedling development; moderate means that competition delays natural or artifical establishment and growth rate, but does not prevent the development of fully stocked normal stands; severe means that competition prevents adequate natural or artificial regeneration, unless the site is properly prepared and well managed.

Windthrow hazard depends on the soil characteristics that enable trees to resist being blown down by wind. Slight means that most trees withstand the wind; moderate means that some trees are expected to be blown down during excessive wetness and high wind; severe means that many trees are expected to be blown down during periods when the soil is wet and winds are moderate to high.

Table 3 also lists species to be favored in existing stands and suitable species for planting. The estimated site index in table 3 is the average height, in feet, that the dominant and codominant trees reach at 50 years of age.

Wildlife

The welfare of a wildlife species depends largely on the amount and distribution of food, shelter, and water (1). If any one of these elements is missing, inadequate, or inaccessible, the species is absent or scarce. The kinds of wildlife that live in a given area and the number of each kind are closely related to land use, to the resulting kinds and

2/ Numbers underscored refer to Literature Cited, p. 204.

patterns of vegetation, and to the supply and distribution of water. These, in turn, are generally related to the kinds of soil.

Habitat can be created or improved by planting suitable vegetation, by properly managing the existing plant cover, by fostering the natural establishment of desirable plants, or by using a combination of these measures.

Table 4 rates the soils of Washington County according to their suitability for six elements of wildlife habitat and three classes of wildlife.

The ratings can help in--

1. Broad planning of parks, refuges, nature-study areas, and other recreational developments.
2. Selecting the better soils for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the intensity of management needed for individual habitat elements.
4. Eliminating sites that would be difficult or not feasible to manage for specific kinds of wildlife.
5. Acquiring suitable areas to be developed as habitat.

Suitability of the soils is expressed as good, fair, poor, and very poor in table 4. Not considered in the ratings are present land use, the location of a soil in relation to other soils, and the mobility of wildlife. Areas that are artificially drained are seldom used for development of wildlife habitat.

Habitat Elements

Various kinds of plants and other elements that make up wildlife habitat are defined in the paragraphs that follow.

Grain and seed crops are seed-producing annuals, such as corn, sorghum, wheat, barley, oats, millet, buckwheat, cowpeas, and other plants commonly grown for grain or for seed. The major soil properties affecting this habitat element are effective root depth, available water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are established by planting and that furnish wildlife cover and food. Among the plants are bluegrass, fescue, brome, timothy, orchardgrass, reed canarygrass, clover, and alfalfa. The major soil properties affecting this habitat element are effective root depth, available water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer.

Wild herbaceous plants are native or introduced perennial grasses and weeds that generally are established naturally; for example, bluestem, quackgrass, panicgrass, goldenrod, wild carrot, nightshade, and dandelion. They provide food and cover principally to upland forms of wildlife. The major soil properties affecting this habitat element are effective root depth, available water capacity, natural drainage, surface stoniness, hazard of flooding or ponding, and texture of the surface layer.

Hardwood trees are nonconiferous trees, shrubs, and woody vines that produce nuts or other fruits, buds, catkins, twigs, or foliage that wildlife eat. They are generally established naturally, but can be planted. Among the native kinds are oak, cherry, maple, poplar, apple, hawthorn, dogwood, persimmon, sumac, sassafras, hazelnut, black walnut, hickory, sweetgum, bayberry, blueberry, huckleberry, blackhaw, viburnum, grape, and briers. The major soil properties affecting this habitat element are effective root depth, available water capacity, and natural drainage.

Also in this group are several varieties of fruit-bearing shrubs that are raised commercially for planting. Autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crabapple, multiflora rose, highbush cranberry, and silky dogwood generally are available and can be planted on soils that are rated well suited. Hardwoods that are not available commercially can commonly be transplanted successfully.

Wetland plants are wild, herbaceous, annual and perennial plants that grow on moist to wet sites exclusive of submerged or floating aquatics. They produce food and cover extensively used mainly by wetland forms of wildlife. Smartweed, wild millet, bulrush, sedges, barnyardgrass, pondweed, duckweed, duckmillet, arrowarum, pickerelweed, water willow, wetland grasses, wildrice, and cattails are examples. The major soil properties affecting this habitat element are natural drainage, surface stoniness, slope, and texture of the surface layer.

Shallow water areas are naturally wet, or they are created by dams or levees or by water control devices in marshes and streams. The average depth of water is less than 5 feet. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds. The major soil properties affecting this habitat element are depth to bedrock, natural drainage, slope, permeability, and surface stoniness or rockiness.

Classes of Wildlife

The three classes of wildlife in the county are defined as follows:

Openland wildlife are quail, pheasant, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. These mammals and birds commonly inhabit areas of cropland, pasture, meadow, and lawns and areas overgrown with grasses, herbs, and shrubs.

Woodland wildlife are woodcock, thrush, vireo, scarlet tanager, gray squirrel, fox squirrel, gray fox, white-tailed deer, raccoon, and opossum. All obtain food and cover in stands of hardwoods, conifers, shrubs, or a mixture of these plants.

Wetland wildlife are ducks, geese, rails, herons, shore birds, mink, and muskrat. These are familiar examples of birds and mammals that commonly inhabit ponds, marshes, swamps, and other wet areas.

Each rating under "Kinds of Wildlife" in table 4 is based on the ratings listed for the habitat elements in the first part of the table. For openland wildlife the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous plants, and hardwood trees. The rating for woodland wildlife is based on the ratings listed for grasses and legumes, wild herbaceous plants, and hardwood trees. For wetland wildlife the rating is based on the ratings shown for wetland plants and shallow water areas.

Engineering[3]

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

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

Information in this section of the soil survey can be helpful to those who--

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate 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 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, results of laboratory tests on soil samples, estimates of soil properties significant in engineering, and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used in making interpretations in addition to those given in table 7, and it also can be used in constructing other useful maps.

This information, however, does not 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 shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for engineering structures.

Some terms in this survey have special meanings in soil science that may not be familiar to engineers. Many of these terms are defined in the Glossary.

Classification Systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the SCS engineers, Department of Defense, and others and the AASHO system adopted by the American Association of State Highway Officials.

In the Unified system (17), soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL-ML.

The AASHO system (2) is used to classify soils according to those properties that affect use in highway construction and maintenance. In

3/ ROBERT L. BURRIS, civil engineer, and KYLE L. MORAN, assistant State conservation engineer, Soil Conservation Service, helped prepare this section.

this system, a soil is classified 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, which have high bearing strength and are the best soils for subgrade, or foundation. At the other extreme, in group A-7, are clay soils, which have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 5. The estimated classification for all soils mapped in the survey area is shown in table 6.

Test Data

Samples from 15 Washington County soils were tested according to standard AASHO procedures to help evaluate the soils for engineering purposes. All samples are modal for the series. Only selected layers of each soil were sampled. The results of these tests are shown in table 5. The column headings in table 5 are explained in the following paragraphs.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Sand," "silt," "clay," and other terms are defined in the Glossary.

The engineering soil classification shown in table 5 is based on data obtained by grain-size analysis and by tests to determine liquid limit and plastic limit.

The mechanical analysis, or grain-size analysis, was made by using a combination of the sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used in naming the textural class for soil classification.

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

Moisture density is shown in table 5 for some of the tested soils. If a soil material is compacted at increasing moisture content, assuming that the compaction effort remains constant, the density of the compacted material will increase until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed "maximum dry density." Moisture-density data are important in earthwork for, as a rule, maximum stability is obtained if the soil is compacted to the maximum dry density when it is at approximately the optimum moisture content.

Estimated Properties

Estimates of soil properties significant in engineering are listed in table 6. They are made for typical soil profiles, by layers sufficiently different to differ significantly in soil engineering. Estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Explanations of some of the columns in table 6 follow.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Depth to bedrock is distance from the surface of the soil to the upper surface of the rock layer.

Soil texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand."

Permeability is the quality that enables a soil to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks when dry or swells when wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Risk of corrosion, as used in table 6, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion on uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. The rate of corrosion on concrete is based mainly on soil texture and acidity. Installations that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A rating of low indicates a low probability of soil-induced corrosion damage. A rating of high indicates a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Engineering Interpretations

Soil interpretations in table 7 are based on the engineering properties of soils shown in table 6; on test data for the soils in this survey area, shown in table 5, and for other soils nearby or adjoining; and on the experience of engineers and soil scientists with the soils of Washington County. Ratings in table 7 summarize the limitation or suitability of the soils for some listed purposes, but not for highway location, drainage of crops and pasture, irrigation, reservoir areas, embankments, terraces or diversions, and grassed waterways. For these particular uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Winter grading is affected chiefly by soil features that are relevant to moving, mixing, and compacting soil in roadbuilding when temperatures are below freezing.

Soils most susceptible to damaging frost action are silt loams and fine sandy loams that are wet or saturated most of the winter. Such soils are rated high.

Topsoil is used in topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability. Also considered in the ratings is damage that will result in the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance about where to look for probable sources. A soil rated as a good or fair source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials. Neither do they indicate quality of the deposit

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the ease of excavating the material at borrow areas.

Soil properties that most affect highway and road location are the load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones and organic material in a soil are among the factors that are unfavorable.

Drainage of crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer, for example, in a fragipan or other layer that restricts movement of water; amount of water held available to plants; need for drainage; and depth to the water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff and seepage so that it soaks into

the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Waterway layout and construction are affected by such soil properties as texture, depth, and erodibility of the soil material; stones or rock outcrops; and the steepness of slope. Other factors affecting waterways are seepage, natural soil drainage, available water capacity, susceptibility to siltation, and ease in establishing and maintaining vegetation.

The steep slopes prevalent throughout the county and the related need for control of runoff and erosion are limitations to be considered in designing structures. The hazard of erosion on steep soils is very severe in construction areas. Flooding is a severe hazard to structures on flood plains in the county, especially in the Ohio River Valley.

Washington County is still essentially rural, but urban expansion and highways are permanently removing many acres from farm use (fig. 7). A freeway or superhighway can displace up to

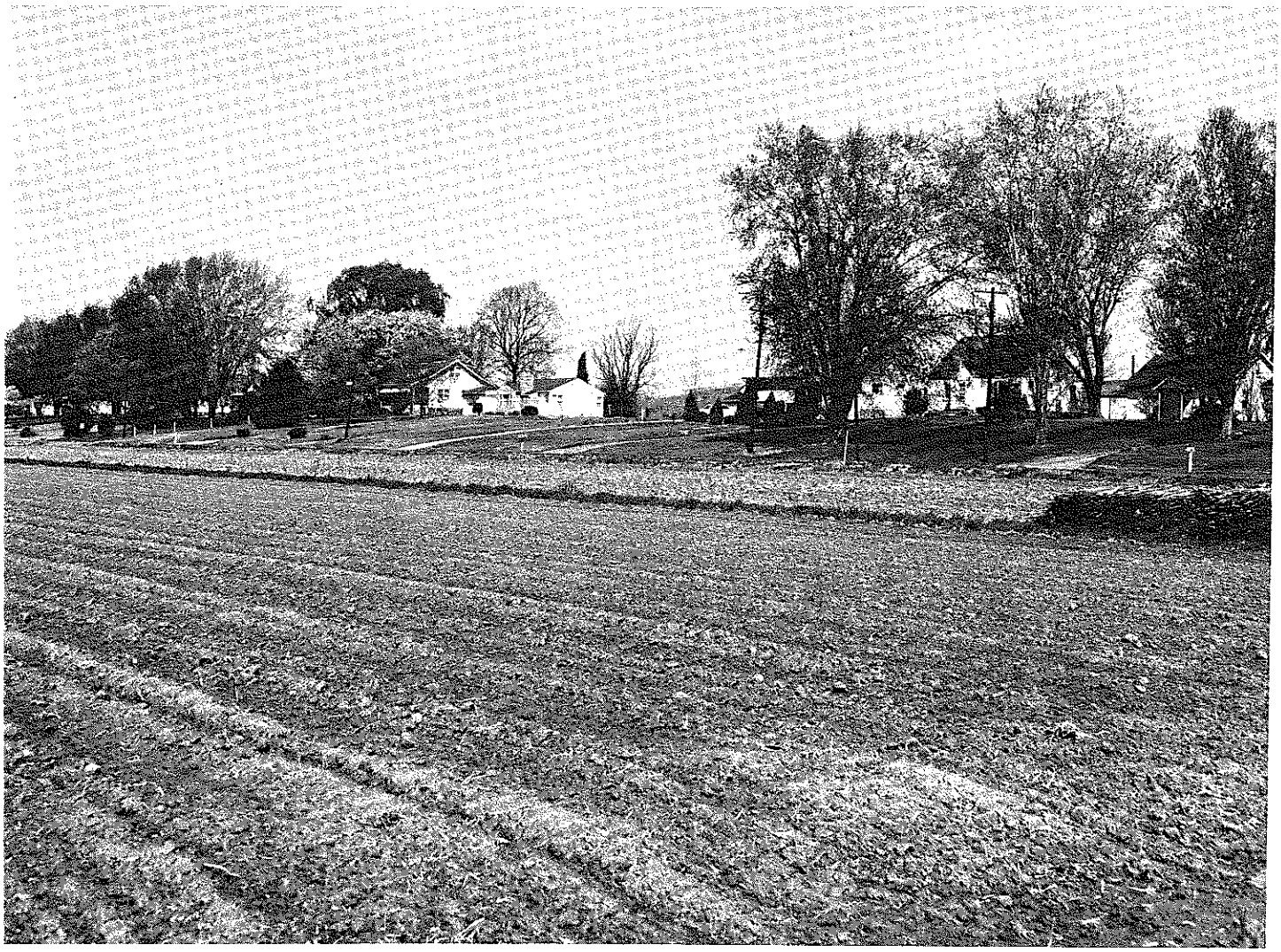

Figure 7.--Huntington soils, in foreground, are well suited to farming. Houses in background are on Wheeling soils.

about 50 acres per mile. One shopping center can easily replace 50 to 100 acres of farmland.

The pages that follow provide information on the properties of soils and their effect on selected nonfarm uses. Because development and maintenance costs are related to soil limitations, this information can help community and industrial planners in selecting the areas least costly to develop and maintain and in considering alternative uses in long-range planning and zoning.

The estimated degree and kinds of limitation for selected uses are shown in table 8. The degree of limitation is expressed as slight, moderate, or severe. Slight indicates no important limitation to the specified use. Moderate indicates some limitations that need to be recognized, but can be overcome or corrected. Severe indicates limitations that are serious and are costly and difficult to overcome. Because extensive manipulation of the soil alters some of its natural properties, some ratings shown in table 8 no longer apply if the area has undergone extensive cutting and filling. Explanations of columns in table 8 follow.

Farming.--Soils are rated according to their limitations for cultivated crops only. The degree of limitation is based on the slope and the erosion hazard or on the ease or difficulty of obtaining artificial drainage.

Septic tank absorption fields.--Most of the soils in the county are somewhat limited for disposal of effluent from septic tanks. Such limitations are excessive slope, a seasonal high water table, restricted permeability, poor natural drainage, flooding, and limited depth to bedrock.

Flooding and a seasonal high water table prevent proper functioning of disposal fields for varying periods. All soils subject to flooding are rated severe. The frequency of flooding is not considered.

Many of the soils are rated severe because permeability is moderately slow or slower (see table 6 for estimated permeability of each soil in the county). A severe limitation is imposed by shale or rock or another restrictive layer or by a dense compact layer, such as the fragipan in Otwell soils, which interferes with adequate filtration and the movement of effluent.

If the filter bed for a septic tank is on a slope of more than 12 percent, erosion and seepage downslope can be expected, or the soil can become unstable when saturated.

Some soils in the county have a gravelly and sandy substratum, through which effluent that is inadequately filtered can flow and thus contaminate ground water or nearby springs, lakes, or streams. Such soils dispose of the effluent quickly, but the hazard of polluting underground water supplies must be considered.

Before a septic tank system is installed, an investigation should be made at the proposed site to determine suitable design or an alternative solution to the soil limitation. An improperly functioning filter field is a health hazard and a major source of pollution to water supplies.

Sewage lagoons.--A sewage lagoon is a shallow pond built to dispose of sewage through oxidation. It may be needed where a septic tank or a central sewage system is not feasible or practical. In rating the limitations of a soil, it is assumed that the natural soil will be used as the reservoir site and as a source of embankment material. Among the features that control the degree of limitations are the hazard of flooding, the degree of slope, the depth to bedrock, the permeability, the content of coarse fragments, and the content of organic matter.

Dwellings.--Major soil features that limit use of a soil as a homesite are limited depth to bedrock, flooding, poor natural drainage, and excessive slope. Ratings in table 8 are for houses of three stories with or without a basement, but also apply to small industrial, commercial, and institutional buildings.

Soils subject to flooding are severely limited for permanently used structures. Flooding can be infrequent, but it is costly and damaging when it does occur. A wet basement is likely in a house built on a naturally wet soil, for example, on McGary, Peoga, or Taggart soil, unless adequate drainage is provided. In some areas of the county, open ditch drains have been installed for agricultural use. Excavations for structures, such as houses, in these areas can disrupt the established drainage system, and the soil reverts to its natural wet condition.

Some soils, such as Duncannon or Zanesville, have a high silt content. Such soils are not as favorable for supporting structural foundations as coarser textured soils, such as Chili and Wheeling. Soils having high shrink-swell properties are likely to heave and crack foundations unless precautions are taken. Also, high shrink-swell properties affect the alinement of sidewalks, patios, floors, and rock walls. To minimize this hazard, a subgrade, or layers of sandy or gravelly material directly below the structure, is desirable.

Excavating basements and installing underground utility lines are difficult and expensive in soils that have limited depth to bedrock. If the slope is more than 12 percent, the erosion hazard as well as problems in excavation and leveling have to be considered.

Local roads and streets.--This column in table 8 refers to roads and streets in residential areas where traffic is not heavy. Considered in estimating the ratings were the hazard of flooding, the slope, the depth to bedrock and the kind of bedrock, the depth to the water table, and the number of stones. Estimates of soil properties and soil features important in designing, constructing, and maintaining highways are listed in tables 6 and 7 in the engineering section of this publication.

Shallow excavations.--Among the desirable soil characteristics for excavations to a depth of only 5 or 6 feet are good workability, moderate resistance to sloughing, no more than gentle slopes, no rock outcrops of big stones, no flood hazard, and no seasonal high water table.

Sanitary landfill.--Among the properties affecting the use of soils for the trench type of sanitary landfill are depth to rock, seasonal wetness, permeability, slope, texture of the soil material, and hazard of flooding. A deep, nearly level, well-drained soil that is slowly permeable generally has the least limitation for sanitary landfill. Ponding or a high water table increases the difficulty of excavation and proper covering. A clayey soil is less desirable for cover than a coarser textured soil because it is difficult to grade properly and is also subject to cracking when dry. All soils having bedrock within 60 inches are rated severe.

Lawns, landscaping, and golf fairways.--In most areas developed for homes and golf courses, the natural surface soil, or topsoil, can be used for lawns, flowers, shrubs, and trees. It can be removed from the site, stored until construction and grading are completed, and then returned to the site. The natural surface soil from areas graded for streets also can be saved and used for lawns and fairways. Among the soil properties that determine whether a good lawn or golf fairway can be established are natural drainage, slope, depth to bedrock, texture of the surface layer, number of stones and rocks, and hazard of flooding.

Playgrounds.--Properties to be considered in selecting sites to be used as athletic fields and other intensive play areas are the natural drainage, the slope, the depth to the water table, the depth to bedrock and the kind of bedrock, the permeability, the number of stones, the hazard of flooding, and the texture of the surface layer. Soils on flood plains can be used as ball diamonds and other intensive play areas unless they are subject to costly damage by floodwater and are used during expected periods of flooding. The information in the column headed "Local roads and streets" can also apply to tennis courts. The use of fill material from other areas is not considered in table 8.

Picnic areas.--Many kinds of soil, for example, soils on flood plains, having severe limitations for most other uses can be used as picnic areas and other extensive play areas. Considered in the ratings are the hazard of flooding, the number of rocks and stones, the slope, the texture of the surface layer, and the depth to the water table.

Camp areas.--Sites suitable for tents and trailers are those suitable as unsurfaced parking lots for cars and camping trailers. Properties to be considered in selecting a campsite are a hazard of flooding, a seasonal high water table, the permeability rate, the slope, and the soil texture. Slopes of less than 12 percent are the most desirable for use as tent campsites; less slope is required for trailers. Soils having a medium-textured surface layer have fewer limitations as campsites than clayey or sandy soils.

Paths and trails.--It is assumed that areas used for local and cross-country footpaths and trails and for bridle paths will be used as they occur in nature and little or no soil will be moved. Properties considered in rating the soils for this use are a seasonal high water table, a flood hazard, the slope, the soil texture, and the number of rocks or stones.

Descriptions of the Soils

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

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. Coarse fragments are reported as a percentage of the total volume of the soil material. The profile described in the series is representative for mapping units in that series. If the profile is the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Fill land, loamy materials, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

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

The acreage and proportionate extent of each mapping unit are shown in table 9. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (14).

TABLE 9.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Soil	Acres	Extent
Alford silt loam, 2 to 6 percent slopes	182	(1/)
Alford silt loam, 6 to 12 percent slopes	282	0.1
Allegheny silt loam, 2 to 6 percent slopes	536	.1
Allegheny silt loam, 6 to 12 percent slopes	1,801	.4
Allegheny silt loam, 12 to 18 percent slopes	1,479	.4
Allegheny silt loam, 18 to 50 percent slopes	497	.1
Ashton silt loam, 0 to 2 percent slopes	631	.2
Ashton silt loam, 2 to 6 percent slopes	101	(1/)
Belpre clay, 6 to 12 percent slopes	637	.2
Belpre clay, 12 to 18 percent slopes	1,193	.3
Belpre clay, 18 to 25 percent slopes	756	.2
Belpre clay, 25 to 35 percent slopes	694	.2
Brookside silty clay loam, 6 to 12 percent slopes	588	.1
Brookside silty clay loam, 12 to 18 percent slopes	881	.2
Brookside silty clay loam, 18 to 25 percent slopes	1,733	.4
Brookside bouldery silty clay loam, 18 to 35 percent slopes	479	.1
Chagrin silt loam	7,284	1.8
Chili loam, 0 to 2 percent slopes	314	.1
Chili loam, 2 to 6 percent slopes	792	.2
Chili loam, 6 to 12 percent slopes	381	.1
Clymer silt loam, 6 to 12 percent slopes	761	.2
Clymer silt loam, 12 to 18 percent slopes	735	.2
Conotton gravelly loam, 1 to 6 percent slopes	307	.1
Conotton-Chili gravelly loams, 18 to 25 percent slopes	140	(1/)
Dekalb loam, 6 to 12 percent slopes	227	.1
Dekalb loam, 12 to 18 percent slopes	762	.2
Dekalb loam, 18 to 25 percent slopes	1,185	.3
Dekalb loam, 25 to 35 percent slopes	2,090	.5
Dekalb and Gilpin stony soils, 25 to 70 percent slopes	14,772	3.6
Duncannon silt loam, 2 to 6 percent slopes	156	(1/)
Duncannon silt loam, 6 to 12 percent slopes	147	(1/)
Duncannon-Lakin complex, 12 to 18 percent slopes	205	(1/)
Duncannon-Lakin complex, 18 to 25 percent slopes	373	.1
Elba-Belpre complex, 12 to 18 percent slopes	149	(1/)
Elba-Belpre complex, 18 to 25 percent slopes	305	.1
Elba-Belpre complex, 25 to 35 percent slopes	388	.1
Fill land, sandy, gravelly, and channery materials	107	(1/)
Fill land, loamy materials	284	.1
Fill land, clayey materials	589	.1
Gallia silt loam, 2 to 6 percent slopes	441	.1
Gallia silt loam, 6 to 12 percent slopes	1,433	.3
Gallia silt loam, 12 to 18 percent slopes	341	.1
Gilpin silt loam, 2 to 6 percent slopes	259	.1
Gilpin silt loam, 6 to 12 percent slopes	1,554	.4
Gilpin silt loam, 12 to 18 percent slopes	1,236	.3
Gilpin silt loam, 18 to 25 percent slopes	699	.2
Gilpin silt loam, 25 to 35 percent slopes	480	.1

See footnotes at end of table.

Alford Series

The Alford series consists of deep, well-drained soils formed in thick loess on uplands. These soils are on ridgetops and benches and on low hills near the heads of ravines. They occur in only a few places in the county, dominantly on west-facing landscapes east of the Ohio River and Muskingum River Valleys. They range from gently sloping to sloping.

In a representative profile in a cultivated area, the surface layer is brown silt loam 8 inches thick. The subsoil is yellowish-brown and strong-brown silt loam that extends to a depth of 50 inches. The underlying material is dark yellowish-brown silt loam. Weathered sandstone bedrock is at a depth of 55 inches.

Alford soils have moderate permeability, a deep root zone, and a high available water capacity. They dry out readily in spring and are easily managed. They have medium natural fertility. Crops respond well to lime and fertilizer.

Alford soils are used chiefly for crops and pasture. Some areas are wooded. The crops are corn, wheat, and hay. Yellow-poplar grows well on these soils and is dominant in many stands.

Representative profile of Alford silt loam, 6 to 12 percent slopes, about 1.5 miles south of Coal Run along the west side of Township Road 32:

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

B1--8 to 12 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; friable; many roots; common medium pores; thin, very patchy, dark-brown (7.5YR 4/4) silty films; very strongly acid; abrupt, smooth boundary.

B21t--12 to 19 inches, yellowish-brown (10YR 5/6) silt loam; many, medium, faint-brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; friable; common roots; many fine and medium pores; thin, very patchy, dark-brown (7.5YR 4/4) clay films and silty films; very strongly acid; abrupt, smooth boundary.

B22t--19 to 44 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, angular blocky structure; friable, becoming firm with increasing depth; common roots; few fine pores; thin, patchy, strong-brown (7.5YR 5/6) clay films; very strongly acid; gradual, smooth boundary.

B3--44 to 50 inches, yellowish-brown (10YR 5/6) silt loam; common, medium, faint-brown (10YR 5/3) mottles; moderate, fine, angular blocky structure; firm; few roots; few fine pores; very patchy dark-brown (7.5YR 4/4) clay films; strongly acid; gradual, smooth boundary.

C--50 to 55 inches, dark yellowish-brown (10YR 4/4) silt loam; many, medium, faint yellowish-brown (10YR 5/4) and light olive-brown (2.5Y 5/4) mottles; massive; few, randomly oriented, brown (7.5YR 4/4) clay films; few roots; few medium and fine pores; medium acid; abrupt, smooth boundary.

R--55 inches, weathered brown sandstone bedrock.

The solum is 40 to 60 inches thick. In unlimed areas it ranges from very strongly acid to medium acid. Depth to bedrock ranges from 4 to more than 10 feet.

The Ap horizon ranges from dark brown (10YR 4/3) to dark grayish brown (10YR 4/2). An uncultivated soil has an A1 horizon 1 to 3 inches thick and is very dark grayish brown (10YR 3/2) to black (10YR 2/1). The A2 horizon, which does not occur in all soils, is 4 to 10 inches thick and brown (10YR 5/3) to dark brown (10YR 4/3). The B2 horizon is 4 or 5 in value, 4 through 6 in chroma, and 7.5YR and 10YR in hue. It is silt loam or light silty clay loam. The B3 horizon has value of 4 or 5 and chroma of 3 to 6 in the 10YR hue. The C horizon ranges from 4 to 5 in value and 3 to 5 in chroma in the 10YR hue. The substratum is bedrock or unconsolidated material.

Alford soils are on the same landscape as Zanesville, Wellston, Allegheny, and Duncannon soils. They do not have the fragipan that is typical of Zanesville soils. They differ from Wellston soils in not having coarse fragments in the lower part of the solum. They have a more clayey B horizon than Duncannon soils. In contrast with Allegheny soils, they did not form in stratified material.

AfB--Alford silt loam, 2 to 6 percent slopes. This soil is on ridgetops and benches. Most areas are ¼ to ½ mile long and 400 to 600 feet wide, are blocky in shape, and range from 5 to 20 acres in size.

Included with this soil in mapping are spots of Zanesville soils near the center of some broad areas. Zanesville soils have a compact layer in the subsoil that restricts drainage.

This Alford soil has no severe limitations for most farm and nonfarm uses. It is well suited to crops. Runoff is medium. The erosion hazard is moderate in cultivated areas. Capability unit IIe-1; woodland suitability group 1o1.

AfC--Alford silt loam, 6 to 12 percent slopes. This soil is on rounded ridgetops and uniform to convex benches. Some individual areas vary widely in size and shape, but areas on benches are commonly long and narrow. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few severely eroded spots that are less productive of farm crops and more difficult to till. Also included are areas of a moderately steep Alford soil.

This soil is used chiefly for crops and pasture. It is well suited to crops, but if it

is cultivated, the erosion hazard is severe. Slope is the main limitation for nonfarm uses. Capability unit IIIe-1; woodland suitability group 1o1.

Allegheny Series

The Allegheny series consists of deep, well-drained soils that formed in old alluvial material on high terraces, mainly above very steep soils. These soils are commonly on ridgetops, on benches, and in coves near the heads of drainageways. They are mostly gently sloping to moderately steep, but in a few areas they are steep and dissected.

In a representative profile in a cultivated area, the surface layer is brown silt loam 8 inches thick. The subsoil is strong brown and extends to a depth of 62 inches. In sequence downward, it is 7 inches of clay loam, 9 inches of loam, 17 inches of sandy loam, and 21 inches of sandy clay loam. The underlying material to a depth of 135 inches is strong-brown stratified loam, fine sandy loam, and sandy clay loam.

Allegheny soils have a high available water capacity and moderate permeability. They dry out readily in spring and are easily managed. The root zone is deep, and natural fertility is medium.

Representative profile of Allegheny silt loam, 6 to 12 percent slopes, in NE¼SW¼SE¼ sec. 22, Wesley Township, T. 7 N., R.11 W., 40 feet north of U.S. Highway 50A, 500 feet west of junction with Township Road 61 (see profile WS-22 in section on laboratory data):

Ap--0 to 8 inches, brown (10YR 4/3) silt loam; weak, very fine, angular blocky structure parting to moderate, fine, granular; friable; many roots; many fine to coarse pores; neutral; abrupt, smooth boundary.

B21t--8 to 15 inches, strong-brown (7.5YR 5/6) clay loam; moderate, fine, angular blocky structure; firm; many roots; many fine and medium pores; thin, patchy, brown (7.5YR 4/4) clay films; thin, patchy, pale-brown (10YR 6/3) silt coatings; very strongly acid; clear, smooth boundary.

B22t--15 to 24 inches, strong-brown (7.5YR 5/8) loam; moderate, medium, angular blocky structure; firm; common roots; common fine and medium pores; thin, patchy, brown (7.5YR 4/4) clay films; thin patchy silt coatings; very strongly acid; abrupt, wavy boundary.

B23t--24 to 41 inches, strong-brown (7.5YR 5/6) sandy loam; moderate, coarse, angular blocky structure; firm; slightly brittle; common roots; common fine and medium pores; thin, patchy, brown (7.5YR 4/4) clay films; thin patchy silt coatings; common black concretions; very strongly acid; gradual, smooth boundary.

B24t--41 to 51 inches, strong-brown (7.5YR 5/6) sandy clay loam; moderate, medium and coarse, angular blocky structure; firm; slightly brittle; few fine and medium pores; thin, continuous, brown (7.5YR 4/4) clay films; thin patchy silt coatings; common black concretions; very strongly acid; gradual, smooth boundary.

B3t--51 to 62 inches, strong-brown (7.5YR 5/6) sandy clay loam; weak, very coarse, subangular blocky structure parting to very thick platy in the lower part; firm; common fine and medium pores; thin, patchy, brown (7.5YR 4/4) clay films; thin patchy silt coatings; common black concretions; strongly acid; gradual, boundary.

C--62 to 135 inches, strong-brown (7.5YR 5/8) stratified sandy clay loam, loam, and fine sandy loam; massive; friable; strongly acid.

The solum is 50 to 70 inches thick. Unless limed, it is strongly to very strongly acid. In places gray mottles are below a depth of 36 inches. Depth to bedrock is 6 to more than 10 feet.

The Ap horizon is 3 to 5 in value and 3 or 4 in chroma in 7.5YR or 10YR hue. An uncultivated soil has a 1- to 3-inch A1 horizon having chroma of 3 or less and value of 3 or 2 and an A2 horizon having value of 4 or 5 and chroma of 3 or 4 in 10YR hue. The B2t horizon is clay loam through very fine sandy loam and is 4 or 5 in value and 3 to 8 in chroma in the 7.5YR and 10YR hue. The B3 horizon has the same range in color and texture as the B2t horizon, but in places it is gravelly. The C horizon ranges from very fine sandy loam to gravelly clay loam.

Allegheny soils are on about the same kind of landscape as Gallia, Mentor, Otwell, and Wheeling soils and are near the similar Alford, Duncannon, and Wellston soils. They have a thicker solum and in most places are more acid than Mentor and Wheeling soils. They do not have the fragipan that is typical of Otwell soils, nor the red colors of Gallia soils. They differ from Wellston soils in having stratified underlying material. In contrast with Alford and Duncannon soils, they formed in water-laid material, whereas those soils formed in loess. In addition, they have a more clayey B horizon than Duncannon soils.

AlB--Allegheny silt loam, 2 to 6 percent slopes. This gently sloping soil is on rounded high terraces. Slopes are uniform to convex. Most areas are 10 to 40 acres in size.

Included with this soil in mapping, in the center of some areas, are spots of Otwell soils, which have a fragipan. Near the margin of some areas are included soils that have a clayey layer in the lower part of the subsoil.

This soil is suited to general farm crops, orchards, and some specialized crops. Erosion is a moderate hazard if this soil is cultivated. Runoff is medium. There are no severe limitations for most nonfarm uses. Capability unit IIe-1; woodland suitability group 1o1.

A1C--Allegheny silt loam, 6 to 12 percent slopes. This sloping soil is on high terraces. Slopes are uniform to convex and 100 to 300 feet long. Areas range from about 5 to more than 50 acres in size. Long areas are crossed by shallow drainageways. This soil has the profile described as representative of the series.

Included with this soil in mapping are some knobs that have lost nearly all of the original surface layer through erosion. Also included are spots of Vincent and Licking soils in drainageways and near slope breaks. These included soils dry out more slowly than this Allegheny soil.

This soil is suited to crops, pasture, and orchards. The erosion hazard is severe if this soil is cultivated. Runoff is rapid. Slope is a limitation for most nonfarm uses. Capability unit IIIe-1; woodland suitability group 1o1.

A1D--Allegheny silt loam, 12 to 18 percent slopes. This moderately steep soil is adjacent to less steep soils in areas of dissected terrace remnants. Slopes are 50 to 300 feet long and are generally convex on interfluves and concave around the drainage heads. Areas are up to 250 feet wide, half a mile long, and 3 to 30 acres in size. The surface layer and subsoil are thinner in the profile of this soil than in the one described as representative of the series.

Included with this soil in mapping are spots of Vincent and Licking soils, near drainageways, which dry out more slowly in spring than Allegheny soils. Also included are spots of severely eroded soils, which are lower in productivity of farm crops.

The erosion hazard is severe if this soil is cultivated. Runoff is very rapid. The moderately steep slopes limit many engineering uses.

This soil is used for pasture, woodland, and crops. Formerly it was extensively used for crops. Many severely eroded spots are being converted to woodland. Capability unit IVe-1; woodland suitability group 1r1.

A1G--Allegheny silt loam, 18 to 50 percent slopes. This soil is on deeply dissected terrace remnants in coves at the heads of ravines and along valley sides. It is very steep bordering drainageways, but is less steep on the crests of interfluves. Slopes are irregular and mainly less than 100 feet long. Areas are generally blocky in shape and range from 10 to 40 acres in size. The profile of this soil has a thinner surface layer and subsoil than the one described as representative of the series.

Included with this soil in mapping are narrow strips of less sloping soils along the drainageways and on the interfluves. On the steeper slopes, areas of Dekalb, Upshur, and Gilpin soils and some stony soils are included.

The erosion hazard is very severe if this soil is cleared of forest. Runoff is very rapid. The irregular, steep slopes limit logging and many nonfarm uses.

This soil is mostly used for woodland. In coves it is highly productive of timber. Capability unit VIIe-1; woodland suitability group 1r1.

Ashton Series

The Ashton series consists of nearly level to gently sloping soils that are deep and well drained. These soils are on low terraces that are subject to flooding under abnormal conditions. They formed in water-deposited material.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 8 inches thick. The subsoil is 44 inches of dark yellowish-brown silt loam over 8 inches of dark yellowish-brown loam. The substratum to a depth of 84 inches is dark yellowish-brown loam that grades to fine sandy loam in the lower part.

Ashton soils have slow to medium runoff and moderate permeability. Water and air move readily through the soil, but drainage is not excessive. Ashton soils have a deep root zone, a high available water capacity, and high natural fertility. Lime is not needed for most crops.

Ashton soils are used intensively for cultivated crops and are suited to this use.

Representative profile of Ashton silt loam, 0 to 2 percent slopes, in Waterford Township, 2,400 feet west of junction of Ohio State Highway 83 and Ohio State Highway 60, about 1½ miles northwest of Beverly:

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

B21t--8 to 17 inches, dark yellowish-brown (10YR 3/4) silt loam; moderate, medium, subangular blocky structure; friable; few fine roots; few fine and medium pores; 90 percent of ped faces have dark-brown (10YR 3/3) thin clay films; neutral; gradual, smooth boundary.

B22t--17 to 31 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, prismatic structure parting to moderate, medium, angular blocky; friable; common roots; common fine pores; thin, continuous, dark-brown (10YR 3/3) clay films; slightly acid; gradual, smooth boundary.

B23t--31 to 40 inches; dark yellowish-brown (10YR 4/4) silt loam; moderate, medium, angular blocky structure; friable; few roots; few fine pores; thin, continuous, dark-brown (10YR 3/3) clay films; slightly acid; gradual, smooth boundary.

B24t--40 to 52 inches, dark yellowish-brown (10YR 4/4) silt loam; common, fine, faint,

yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; friable; few roots; few fine and medium pores; thin, patchy, dark-brown (10YR 3/3) clay films; slightly acid; clear, smooth boundary.

B3t--52 to 60 inches, dark yellowish-brown (10YR 4/4) loam; few, medium, faint, yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure parting to very weak, fine, subangular blocky; friable; few fine pores; thin, patchy, dark-brown (10YR 3/3) clay films on vertical faces and in pores; slightly acid; gradual boundary.

C--60 to 84 inches, dark yellowish-brown (10YR 4/4) loam grading to fine sandy loam in lower part; massive; friable; slightly acid.

The solum is 45 to 60 inches thick. It is generally neutral to slightly acid throughout, but in places ranges to medium acid in the B horizon. Thickness of the alluvium over unconforming material varies, but generally is more than 6 feet. The solum ordinarily is less than 3 percent small pebbles and coarse fragments.

The Ap horizon ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3). The B horizon is generally silt loam or light silty clay loam, but ranges to loam in the lower part. It has value of 3 or 4 and chroma of 3 or 4 in hue of 10YR and 7.5YR. The C horizon is loam, fine sandy loam, and sandy loam.

Ashton soils have a more strongly defined B horizon than Huntington and Chagrin soils, which occupy the flood plains nearer the stream. They are commonly less acid than the Mentor soils on nearby terraces.

AsA--Ashton silt loam, 0 to 2 percent slopes. This nearly level soil is on broad, relatively low terraces. Areas are smooth or slightly convex and range from 5 to 10 acres in size. This soil has the profile described as representative of the series.

A few spots of somewhat poorly drained soils are included with this soil in mapping. They are in slight depressions where they receive runoff or underground seepage from adjacent soils on uplands.

This Ashton soil is easy to till. Water ponds in small depressions for short periods, but does little or no damage to crops. Runoff is slow. Erosion is not a hazard. Rare to occasional flooding is a hazard for many nonfarm uses, such as building sites.

This is one of the best farming soils in the county. It is well suited to irrigation. Capability unit I-1; woodland suitability group 1o1.

AsB--Ashton silt loam, 2 to 6 percent slopes. This gently sloping and undulating soil is on low terraces. It occurs as long narrow strips parallel to the stream. Areas are commonly less than 20 acres in size. Some are dissected by intermittent shallow drainageways. Slopes are convex and generally short. Some are as much as 300 feet long.

Included with this soil in mapping are areas of more loamy soils and small areas where the surface layer is lighter colored. These included soils are not so productive as the Ashton soil.

This soil has very good tilth and is easily managed, but the erosion hazard is moderate. Runoff is medium. Most areas are subject to rare or occasional floods of short duration. Flooding is also the principal hazard for nonfarm uses.

This soil is intensively used for general farm and specialized crops. Capability unit IIe-1; woodland suitability group 1o1.

Belpre Series

The Belpre series consists of deep, well-drained soils that are sloping to very steep. These soils occur on ridgetops, benches, and side slopes. They formed in material weathered from calcareous shale.

In a representative profile the surface layer is dark reddish-brown clay 8 inches thick. The upper 18 inches of the subsoil is dark reddish-brown clay that is slightly heavier than the surface layer and contains less organic matter. The lower 18 inches is mottled dusky red silty clay loam. The underlying material is dusky red shaly silty clay loam. Soft, reddish-gray shale bedrock is at a depth of 63 inches.

Belpre soils are slowly permeable and have a moderate available water capacity. The root zone is moderately deep, and natural fertility is medium.

Belpre soils are more extensively farmed than the nearby more acid soils. Steep slopes are commonly used for pasture or woodland. Walnut is prominent in wooded areas.

Representative profile of Belpre clay, 12 to 18 percent slopes, in SE¼NE¼NE¼ sec. 22, Warren Township, T. 2 N., R. 9 N.:

Ap--0 to 8 inches, dark reddish-brown (5YR 3/2) clay, dark reddish gray (5YR 4/2) when dry; moderate, fine, granular and very fine, angular blocky structure; firm; many roots; neutral; abrupt, smooth boundary.

B21t--8 to 23 inches, dark reddish-brown (2.5YR 3/4) clay; moderate, medium, angular blocky structure parting to strong, fine, angular blocky; firm; common roots; thin, continuous, dark reddish-brown (5YR 3/4) clay films on fine peds; neutral; gradual, smooth boundary.

B22t--23 to 26 inches, dark reddish-brown (2.5YR 3/4) clay; weak, coarse, angular blocky structure parting to weak, very fine, angular blocky; firm; few roots; thin, patchy, reddish-brown (5YR 4/3) clay films; mildly alkaline, calcareous; clear, smooth boundary.

B3--26 to 44 inches, dusky red (10R 3/4) heavy silty clay loam; few, fine, distinct, reddish-gray (10R 5/1), olive-yellow (2.5Y 6/6) and pinkish-gray (5YR 7/2) mottles; weak, very fine, angular and subangular blocky structure; friable; thin, very patchy, dusky red (10R 3/4) clay films; moderately alkaline, calcareous; clear, wavy boundary.

C--44 to 63 inches, dusky red (10R 3/3) shaly heavy silty clay loam; common, fine, distinct, reddish-gray (10R 5/1), olive-yellow (5Y 6/6) and pinkish-gray (5YR 7/2) mottles; conchoidal fracture inherited from parent material; friable; reddish-gray (10R 5/1) and dusky red (10R 3/2) stains on fracture faces; 40 percent soft shale fragments; moderately alkaline, calcareous.

R--63 inches; reddish-gray (10R 5/1) soft shale; many, coarse, dusky red (10R 3/3) and olive-yellow (2.5Y 6/6) mottles; weakly bedded shale that breaks to conchoidal surfaces; moderately alkaline, calcareous.

The solum ranges from 25 to 50 inches in thickness. It is neutral to moderately alkaline. The content of coarse fragments, dominantly limestone channers, is 0 to 10 percent. Depth to soft shale is 36 to 70 inches. The maximum depth to carbonates is 30 inches. In places the profile is weakly calcareous to the surface.

The Ap or A1 horizon of an uncultivated soil is 7.5YR to 2.5YR hue and value and chroma of 3.5 or less. The B2t horizon is 5YR to 10R hue and value and chroma of 3 to 5. It is silty clay to clay. The B3 horizon, which has the same color range as the B2t horizon, is silty clay loam to clay. The C horizon is olive to dusky red and reddish-gray silty clay loam to clay.

Belpre soils are associated with Upshur, Elba, and Lowell soils on the uplands. They have a darker colored A horizon than Upshur soils and are not so acid. They have redder colors in the B horizon than Elba and Lowell soils.

BeC--Belpre clay, 6 to 12 percent slopes. This sloping soil is on ridgetops in the western, northern, and central parts of the county. Slopes are rounded and convex. Individual areas are commonly small and are either blocky or long.

Included with this soil in mapping are spots of Gilpin soils and spots of severely eroded soils, which have a surface layer that is low in organic matter and has poor tilth.

Because the surface layer of this Belpre soil is clayey, careful management is needed to maintain or improve tilth. The soil is generally plowed in winter so that it will be easier to work in spring. The erosion hazard is severe in cultivated areas. Runoff is medium to rapid. The clayey texture and slow permeability are limitations for most nonfarm uses. Slow permeability is a severe limitation for septic tank absorption fields. The soil will not support traffic when wet. It has high shrink-swell potential that can crack foundations.

This soil is used mostly for crops and pasture. It is moderately suited to grain crops, but is well suited to grasses. Capability unit IIIe-6; woodland suitability group 3c1.

BeD--Belpre clay, 12 to 18 percent slopes. This moderately steep soil is on upper and middle side slopes that are commonly even to convex. Some areas are dissected by shallow drainageways. A few areas are on narrow, rounded ridgetops and hilltop knolls. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Vandalia soils, which are deeper over bedrock. Also included are spots of Gilpin soils and some areas where the soil is severely eroded.

Because the surface layer is clayey, this Belpre soil has poor tilth unless it is well managed. The erosion hazard is very severe in areas bare of vegetation. Runoff is very rapid. The slope, slow permeability, and clayey texture severely limit most nonfarm uses. The soil has high shrink-swell potential, will not support traffic when wet, and is subject to landslides.

This soil is poorly suited to grain crops, but is moderately suited to hay and pasture. It is used mostly for crops and pasture and is used more intensively for general farm crops than most other nearby soils. Capability unit IVe-5; woodland suitability group 3c2.

BeE--Belpre clay, 18 to 25 percent slopes. This steep soil is on side slopes, mostly in the central and northern parts of the county, and in most areas is crossed by drainageways. It is generally shallower over soft bedrock than is typical. Included in mapping are severely eroded areas where tilth is poor.

This steep soil is subject to landslides and to very severe erosion if it is bare of vegetation. Runoff is very rapid. Steep slopes and poor stability are the main limitations for most nonfarm uses.

This soil is not suited to cultivated crops, but is suited to hay and pasture. It is used for hay, pasture, and woodland. It is used more intensively for farming than the very steep Belpre soils. Capability unit VIe-2; woodland suitability group 3c2.

BeF--Belpre clay, 25 to 35 percent slopes. This very steep soil is on side slopes mostly in the central and northern parts of the county. Most areas are long and narrow, have irregular slopes, and are crossed by deep drainageways. This soil has a thinner solum than is typical. Included in mapping are narrow bands of severely eroded soils and small areas of stony soils, which limit pasture management.

This Belpre soil is too steep for any use but pasture and woodland. It is subject to landslides and is too steep for most nonfarm uses. Runoff is very rapid. The erosion hazard is very severe if the soil is bare of vegetation. Capability unit VIe-3; woodland suitability group 3c2.

Brookside Series

The Brookside series consists of deep, well-drained, sloping to very steep soils on foot slopes along valley sides. These soils formed in thick deposits of colluvial material that contains fragments of limestone, siltstone, shale, and sandstone.

In a representative profile in a pasture, the surface layer is very dark grayish-brown silty clay loam 5 inches thick. The subsoil extends to a depth of 60 inches. The top 5 inches is dark-brown channery silty clay loam. The next 50 inches is dark-brown channery silty clay. Below this is 10 inches of massive dark-brown channery silty clay.

Brookside soils have moderately slow permeability, a deep root zone, high available water capacity, and high natural fertility. The mostly irregular, but in places hummocky, surfaces make management for farming somewhat difficult. Generally the upper slopes are concave and the lower slopes are convex.

Hay and pasture grow well on these soils. Practically all the acreage has been cleared and is used mostly for hay and pasture. A small acreage is in corn and small grain. Bouldery areas are in pasture and woodland. Walnut is prominent in idle areas that are reverting to woodland.

Representative profile of Brookside silty clay loam, 18 to 25 percent slopes, SE¼NW¼NW¼ sec. 21 in Aurelius Township, T. 5 N., R. 8 W., in a brushy pasture, 400 feet south of Ohio State Highway 821:

A1--0 to 5 inches, very dark grayish-brown (10YR 3/2) silty clay loam; strong, coarse, granular structure; friable; many fine and medium roots; many medium pores; 10 percent coarse fragments; slightly acid; clear, smooth boundary.

B21t--5 to 10 inches, dark-brown (7.5YR 4/4) channery silty clay loam; moderate, fine and medium, angular blocky structure; firm; common roots; few medium pores; thin, patchy, dark-brown (7.5YR 4/4) clay films; 15 percent coarse fragments; slightly acid; clear, smooth boundary.

B22t--10 to 41 inches, dark-brown (7.5YR 4/4) channery silty clay; moderate, medium, subangular and angular blocky structure; firm; few roots; few medium pores; thin, patchy, dark-brown (7.5YR 4/4) clay films; 20 percent coarse fragments; neutral; gradual, smooth boundary.

B3t--41 to 60 inches, dark-brown (10YR 4/3) channery silty clay; weak, fine, subangular and angular blocky structure; firm; common fine pores; thin, patchy, light brownish-gray (10YR 6/2) clay films; 35 percent coarse fragments; neutral; gradual, smooth boundary.

C--60 to 70 inches, dark-brown (10YR 4/3) channery silty clay; massive; firm; few fine pores; 35 percent coarse fragments; mildly alkaline, calcareous.

The solum is 40 to 80 inches thick. It is medium acid to mildly alkaline. The upper part is 5 to 20 percent coarse fragments, and the lower part as much as 35 percent. Depth to bedrock is more than 6 feet.

The Ap or A1 horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. If the soil is rubbed and is more than 6 inches thick, value is more than 3.5 and chroma is 2 or 3. The B horizon has hue of 10YR and 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam to clay. The C horizon has the same range in hue, value, and chroma as the B horizon. It is heavy silty clay loam, clay loam, silty clay, and clay and is 20 to 35 percent coarse fragments, which occur in a disoriented pattern.

Brookside soils are associated with Lowell, Westmore, and Elba soils on the uplands and with Vandalia and Hayter soils on nearby colluvial slopes and terraces. They are deeper over bedrock than Lowell soils and contain more coarse fragments than Westmore soils. They are deeper over bedrock than Elba soils. They do not have the red colors typical of Vandalia soils. They contain more clay than Hayter soils.

BsC--Brookside silty clay loam, 6 to 12 percent slopes. This sloping soil is mainly below steep soils on hillsides. A few areas are on alluvial fans at the mouth of waterways. Slopes are commonly even or slightly irregular. Individual areas are commonly no more than 5 to 10 acres in size. This soil has a slightly thicker profile than is typical.

Included with this soil in mapping are small areas of dark-colored soils and somewhat poorly drained soils in concave areas and low areas. Also included are narrow bands of Hayter soils in the higher parts of some areas.

This soil is subject to landslides if it is used for nonfarm purposes, but this hazard is less severe than for steeper Brookside soils. Runoff is medium. The erosion hazard is severe if the soil is cultivated. Tile drainage is needed in some small wet spots.

This soil is used mainly for pasture and crops. Capability unit IIIe-6; woodland suitability group 2c1.

BsD--Brookside silty clay loam, 12 to 18 percent slopes. This moderately steep soil is on colluvial foot slopes along lower valley sides. A few areas occupy hillside benches.

Areas are mostly long, are 200 to 600 feet wide, and are dissected by shallow drainageways. They fringe the valley walls for ½ mile to 1½ miles.

Included with this soil in mapping, below seep spots and in concave areas, are small areas of dark-colored, somewhat poorly drained soils. These areas increase the hazard of landslide and interfere with tillage and pasture management. Also included, along the upper edge of some areas, are narrow bands of Hayter soils. There are a few large stones and boulders.

The hazard of landslide is severe if this soil is used for nonfarm purposes. Runoff is very rapid. The erosion hazard is severe if this soil is bare of vegetation.

This soil is used for pasture and crops. Capability unit IVe-5; woodland suitability group 2c2.

BsE--Brookside silty clay loam, 18 to 25 percent slopes. This steep soil is on colluvial foot slopes. Slopes are 100 to 1,500 feet long and are generally uneven because of old landslip scars and small drainageways. The shorter slopes are on interfluves between the drainageways. Areas are mostly long and winding. This soil has the profile described as representative of the series.

Mass movement and colluvial action are still active on this soil. In a few areas, large fragments of sandstone and limestone are on the surface and in the soil.

Included with this soil in mapping, commonly below seeps and springs and in concave areas, are areas of somewhat poorly drained soil. These areas interfere with pasture management and increase the hazard of landslides. Also included in some areas are narrow bands of very steep soils.

The very severe hazard of landslide is the main limitation for nonfarm uses. Runoff is very rapid, and the erosion hazard is severe if the soil is bare of vegetation.

This soil is used for pasture and woodland. Capability unit VIe-2; woodland suitability group 2c2.

BtF--Brookside bouldery silty clay loam, 18 to 35 percent slopes. This steep to very steep soil is on colluvial foot slopes below very steep soils of the uplands and below rock cliffs. Slopes are irregular. Areas are typically long and narrow and are dissected by drainageways.

Large stones and boulders about 10 to 30 feet apart are on the surface. Many boulders are 2 to 4 feet in diameter, and a few are 10 feet across. This soil contains more sand and rock fragments than is typical. Included in mapping on bottom land are narrow bands of Hartshorn soils, which are too small to be shown on the soil map.

The erosion hazard limits the use of this soil for logging roads. Runoff is very rapid. Large stones and boulders limit use of the soil to woodland, but they also limit tree planting and preparation of sites. Machinery can be used for harvesting timber.

This soil has good cabin and tent sites on the hummocks and gently sloping narrow benches. It furnishes excellent wildlife habitat and picturesque recreational areas. Boulders limit other uses.

This soil is used for woodland and is suited to this purpose. About half the acreage was once cleared of trees and pastured, but has since been abandoned and is reverting to trees and brush. The trees are dominantly maple, beech, walnut, hickory, oaks, and yellow-poplar. Capability unit VIIs-1; woodland suitability group 2x1.

Chagrin Series

The Chagrin series consists of deep, well-drained, smooth and nearly level soils on flood plains along most streams in the county. These soils formed in silt loam or loam alluvium.

In a representative profile in a cultivated area, the surface layer is brown silt loam 8 inches thick. The subsoil is dark yellowish-brown, friable silt loam or loam that extends to a depth of 48 inches. The substratum to a depth of 62 inches is dark yellowish-brown loam.

Chagrin soils have moderate permeability, high natural fertility, and high available water capacity. They have a deep root zone and are easily tilled. They are subject to flooding. Lime is not required for most crops.

Most areas are used for crops.

Representative profile of Chagrin silt loam in a pasture SW¼NW¼NE¼ sec. 25, Ludlow Township, T. 3 N., R. 6 W., 0.8 mile southeast of Township Road 64 on Ohio State Highway 26, 300 feet south of road:

Ap--0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; common fine roots; few fine and medium pores; slightly acid; abrupt, smooth boundary.

B21--8 to 12 inches, dark yellowish-brown (10YR 4/4) loam; weak, coarse, angular blocky structure parting to weak, fine, subangular blocky; friable; few fine roots; few fine and medium pores; slightly acid; clear, smooth boundary.

B22--12 to 30 inches, dark yellowish-brown (10YR 4/4) silt loam or loam; weak, medium, subangular blocky structure; friable; few fine roots; few fine pores; slightly acid; gradual, smooth boundary.

B23--30 to 48 inches, dark yellowish-brown (10YR 4/4) silt loam or loam; weak, fine, subangular blocky structure; friable; slightly acid; gradual, smooth boundary.

C--48 to 62 inches, dark yellowish-brown (10YR 4/4) loam; massive; friable; slightly acid.

Depth to loose gravel and sand is 3½ to more than 10 feet. The solum is 40 to 48 inches thick. The soil is medium acid to neutral. The Ap horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 3. If the soil is rubbed, value is higher than 3.5. The B horizon is loam or silt loam in hue of 10YR and 7.5YR, value of 4 or 5, and chroma of 3 or 4. The C horizon is silt loam, loam, or very fine sandy loam in hue of 10YR and 7.5YR, value of 3 to 5, and chroma of 3 or 4.

Nearby soils on flood plains and terraces are Huntington, Nolin, Hartshorn, Moshannon, Tioga, and Ashton soils. Chagrin soils are coarser textured than Huntington and Nolin soils and are deeper than Hartshorn soils. They differ from Ashton soils in having a less well-defined profile. They are less red than Moshannon soils and are finer textured than Tioga soils.

Cg--Chagrin silt loam. This nearly level soil is on flood plains along the Muskingum and Ohio Rivers. Areas are 5 to 80 acres in size. Included in mapping are very small areas of poorly drained soils, which are identified by spot symbols on the soil map. Escarpments along the riverbank of the Muskingum River and in a few areas along the Ohio River also are identified by spot symbols on the map.

This soil has good tilth, and it warms up early in spring. It is subject to flooding, but is flooded less frequently in areas along the Muskingum River than in other areas. Flooding seldom damages crops, but is a hazard for nonfarm uses. Runoff is very slow. Erosion is not a hazard. Along the Muskingum River, the soil is neutral.

Nearly all the acreage is used for crops, mainly corn and hay. Capability unit IIw-2; woodland suitability group 1o2.

Chili Series

The Chili series consists of deep, well-drained soils formed in Wisconsin-age glacial outwash. These nearly level to sloping soils occur on terraces along the Ohio and Muskingum Rivers.

In a representative profile in a cultivated area, the surface layer is dark-brown loam 7 inches thick. The upper 12 inches of the subsoil is brown loam. The lower 22 inches is brown gravelly loam, gravelly sandy loam, and loamy sand that becomes more sandy and gravelly with increasing depth. The substratum is 14 inches of medium acid, stratified sand and gravel over 5 inches of calcareous, loose sand and gravel.

Chili soils have moderately rapid permeability, good tilth, medium natural fertility, a deep root zone, and moderate to low available water capacity. They warm up early in spring. They tend to be droughty, however, and are suited to irrigation.

Chili soils are productive, particularly of vegetables and other special crops. They are used mainly for corn, special crops, and hay. They also provide suitable industrial and residential sites. They are a good source of gravel.

Representative profile of Chili loam, 0 to 2 percent slopes, SW¼ sec. 14, Warren Township, T. 2 N., R. 9 W., 0.2 mile north of Ohio State Highway 7 on County Road 10 and 525 feet west of road:

Ap--0 to 7 inches, dark-brown (10YR 3/3) loam, brown (10YR 4/3) when crushed; moderate, fine, granular structure; friable; many roots; 5 percent pebbles; medium acid; abrupt, smooth boundary.

B21t--7 to 19 inches, brown (7.5YR 4/4) loam; weak, medium, subangular blocky structure; firm; many roots; common fine vesicular pores; thin, patchy, brown (7.5YR 4/4) clay films in pores and on pebbles; 10 percent pebbles; strongly acid; clear, wavy boundary.

B22t--19 to 22 inches, brown (7.5YR 4/4) gravelly loam; weak, medium, subangular blocky structure; firm; few roots; few fine pores; thin, continuous, brown (7.5YR 4/4) clay films on gravel; clay bridging on sand grains; 35 percent pebbles; medium acid; clear, wavy boundary.

B31t--22 to 28 inches, brown (7.5YR 4/4) gravelly sandy loam; very weak, medium, subangular blocky structure; friable; common roots; clay bridging on sand grains; 35 percent pebbles; medium acid; abrupt, smooth boundary.

IIB32--28 to 41 inches, brown (7.5YR 4/4) loamy sand; ½ to 1-inch thick bands of brown (7.5YR 4/2) sandy loam; single grained; friable; few fine pores; 5 percent pebbles; medium acid; abrupt, smooth boundary.

IIIC1--41 to 55 inches, brown (7.5YR 4/4) sand and gravel pockets and bands of reddish-brown (5YR 4/3) gravelly sandy loam; single grained; very friable; clay bridging of sand grains in bands; 40 percent pebbles less than 3 inches in diameter; medium acid; clear, smooth boundary.

IIIC2--55 to 60 inches, loose sand and gravel; slightly acid in upper part grading to moderately alkaline; calcareous.

The solum is 40 to 60 inches thick and is medium to strongly acid. Depth to carbonates is more than 40 inches.

The Ap horizon ranges from 10YR to 7.5YR in hue, 3 to 5 in value, and 2 to 4 in chroma. It is loam to gravelly loam. If the soil is rubbed, value is more than 3.5. An undisturbed soil has a dark-colored A1 horizon 1 to 3 inches thick and an A2 horizon having the same range in colors as the Ap horizon. The B

horizon ordinarily is 7.5YR hue, but ranges from 10YR to 5YR; value is 3 or 4, and chroma 4 to 6. The Bt horizon is loam, sandy loam,on sandy clay loam and in places is gravelly. The C horizon ranges from hue of 7.5YR to 10YR; value and chroma are 4 or 5. Depth to loose sand and gravel ranges from 40 to 60 inches.

Chili soils commonly occur near Conotton, Wheeling, Watertown, and Mentor soils. They are finer textured than Watertown soils and are coarser textured than the more silty Mentor soils. They are not so gravelly as Conotton soils. They contain more sand and gravel in the upper part of the solum than Wheeling soils.

ChA--Chili loam, 0 to 2 percent slopes. This nearly level soil is smooth and even. It occurs as long narrow areas that are readily accessible and easily farmed. Most areas are more than 20 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Watertown, Conotton, and gravelly Chili soils, all of which are more droughty than this Chili loam. Also included are very gravelly spots, which are identified by spot symbols on the soil map.

This Chili soil has good tilth and medium natural fertility, is easily managed, and warms up early in spring. It is droughty in most years, but is well suited to irrigation. It is suited to most nonfarm uses. Runoff is very slow, and erosion is not a hazard. Capability unit IIs-1; woodland suitability group 2o1.

ChB--Chili loam, 2 to 6 percent slopes. This gently sloping soil is uniform to slightly convex. Areas are blocky to long and narrow and 10 to 50 acres in size.

Included with this soil in mapping are narrow bands of the coarser textured, more droughty Watertown soils. Also included are areas, identified by spot symbols on the soil map, where the surface layer is gravelly loam.

This soil is well suited to farming and has favorable properties for irrigation. It has few limitations for most nonfarm uses. Runoff is slow to medium. The erosion hazard is moderate in areas bare of vegetation. Capability unit IIe-1; woodland suitability group 2o1.

ChC--Chili loam, 6 to 12 percent slopes. This sloping soil generally occurs as long narrow bands between terrace levels. Slopes are convex and 500 to 2,000 feet long. Areas range from 10 to 20 acres in size.

Included with this soil in mapping are areas where the surface layer is gravelly loam. These areas are identified by spot symbols on the soil map. Also included are small areas of coarser textured Watertown soils. All included soils are more droughty than this Chili soil.

If cultivated, this soil has medium runoff and a severe erosion hazard. It is suited to farming, however, particularly to the production of hay. Slope is the main limitation for most nonfarm uses. Capability unit IIIe-1; woodland suitability group 2o1.

Clymer Series

The Clymer series consists of deep, well-drained, sloping to moderately steep soils on uplands. These soils formed in material weathered from sandstone. They occupy ridgetops and high benches. Slopes are mostly smooth and convex.

In a representative profile the surface layer is dark yellowish-brown silt loam about 7 inches thick. It is underlain by 2 inches of brown silt loam. The subsoil is 15 inches of dark yellowish-brown loam over 10 inches of yellowish-brown very channery loam. The substratum is weathered sandstone that has cracks filled with clay loam material. Weathered sandstone bedrock is at a depth of 42 inches.

Clymer soils have moderate permeability, moderate available water capacity, and medium natural fertility. They dry out early in spring and are easily worked. The root zone is moderately deep. Depth to bedrock is a limitation to some nonfarm uses.

Nearly all the acreage is in crops and pasture. Some small areas are reverting to brush and forest.

Representative profile of Clymer silt loam, 6 to 12 percent slopes, 2 miles north of Watertown, 4,000 feet south of Township Road 107, one-half mile east of Ohio State Highway 339, Watertown Township:

Ap--0 to 7 inches, dark yellowish-brown (10YR 3/4) silt loam; moderate, fine and medium, granular structure; friable; many fine roots; 5 percent coarse fragments; slightly acid; abrupt, smooth boundary.

A2--7 to 9 inches, brown (10YR 4/3) silt loam; moderate, fine and medium, granular structure; friable; many fine roots; 5 percent coarse fragments; slightly acid; clear, smooth boundary.

B1t--9 to 15 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine, angular blocky structure; friable; common fine roots; common fine and medium pores; thin, patchy, dark yellowish-brown (10YR 4/4) clay films; 10 percent coarse fragments; strongly acid; gradual, smooth boundary.

B21t--15 to 24 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine, angular and subangular blocky structure; friable; common fine and medium pores; thin, patchy, dark yellowish-brown (10YR 4/4) clay films; 15 percent coarse fragments; strongly acid; gradual, irregular boundary.

B22t--24 to 34 inches, yellowish-brown (10YR 5/6) very channery loam; moderate, medium, angular and subangular blocky structure; friable; many fine to coarse pores; thin,

patchy, brown (7.5YR 5/4) clay films and bridges; 60 percent coarse fragments; strongly acid; gradual, smooth boundary.
C--34 to 42 inches, yellowish-brown (10YR 5/6) clay loam in cracks of weathered, micaceous sandstone.
R--42 inches, weathered micaceous sandstone bedrock.

The solum is 24 to 40 inches thick. Unless limed, it is strongly to very strongly acid throughout. Depth to bedrock ranges from 3½ to 6 feet.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. An undisturbed soil has a 1- to 2-inch thick dark-colored A1 horizon and an A2 horizon having value of 3 to 5 and chroma of 2 to 4 in the 10YR hue. The B horizon is loam, sandy clay loam, or clay loam and has 10YR to 7.5YR hue, 4 or 5 value, and 4 to 6 chroma. The C horizon ranges from sandy loam to clay loam. It has hue of 7.5YR or 10YR and value and chroma of 4 through 6.

Clymer soils are associated with Wellston, Zanesville, Dekalb, and Gilpin soils on the uplands. They are deeper over bedrock than Dekalb and Gilpin soils and contain more sand than Wellston and Zanesville soils. They also contain fewer coarse fragments than Dekalb soils and are not so sandy.

ClC--Clymer silt loam, 6 to 12 percent slopes. This sloping soil is on rounded ridgetops and upper hillside benches. Areas are blocky and irregular on ridge spurs and broad ridgetops and are long and winding on narrow benches and narrow ridgetops. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Zanesville soils, which have a compact layer in the lower part of the subsoil. These included soils are commonly near the center of the wider ridgetops.

The erosion hazard is severe if this soil is cultivated. Runoff is medium. Most nonfarm uses are limited by slope and depth to bedrock.

This soil is suited to crops and pasture. Most areas are too small and scattered to be used extensively for truck crops. Larger areas on high ridges are suited to early vegetable crops and small fruits. Capability unit IIIe-2; woodland suitability group 2o1.

ClD--Clymer silt loam, 12 to 18 percent slopes. This moderately steep soil is on the tops and upper sides of high benches. It is even to convex on the upper slopes and slightly concave on the benches. The surface layer is slightly thinner and more sandy than is typical.

Included with this soil in mapping are narrow bands of the coarser textured, stony Dekalb soils, which are generally along the upper edges of hillsides and along the lower edge of benches near slope breaks.

The depth to bedrock and the steep slope are limitations for most nonfarm uses. Runoff is medium to rapid, and the erosion hazard is very severe if the soil is cultivated.

This soil is well suited to hay and is suited to pasture and meadow. It is used for crops and pasture. Capability unit IVe-1; woodland suitability group 2r1.

Conotton Series

The Conotton series consists of nearly level to steep, well-drained soils formed in gravelly outwash material on low terraces along the Ohio and Muskingum Rivers. Slopes are even and convex.

In a representative profile in a cultivated area, the surface layer is dark-brown gravelly loam 7 inches thick. The subsoil is 6 inches of brown very gravelly loam over 47 inches of very gravelly sandy loam. The substratum to a depth of 75 inches is brown, loose sand and gravel.

Conotton soils have rapid permeability in the subsoil and very rapid permeability in the substratum. They dry out rapidly after heavy rains and wet periods. They are droughty during dry periods in summer. The root zone is moderately deep, but because of the high gravel content, the available water capacity is low. The surface layer is friable and easily tilled.

Conotton soils are not extensive. They are mainly on river terraces near Devola. They are easily managed and are used extensively for truck crops. They are a very good source of gravel.

Representative profile of Conotton gravelly loam, 1 to 6 percent slopes, in a cultivated field on the east bank of a gravel pit just northwest of Devola, 600 feet north of Township Road 549, 1,300 feet west of its junction with County Road 341, Muskingum Township:

Ap--0 to 7 inches, dark-brown (10YR 3/3) gravelly loam; moderate, medium, granular structure; friable; 25 percent pebbles; mildly alkaline; abrupt, wavy boundary.
B21t--7 to 13 inches, brown (7.5YR 4/4) very gravelly loam; weak, medium, subangular blocky structure; friable; thin, patchy, brown (7.5YR 4/4) clay films; 40 percent pebbles; strongly acid; clear, wavy boundary.
B22t--13 to 60 inches, brown (7.5YR 4/4) very gravelly sandy loam; very weak, medium, subangular blocky structure; friable; clay bridges between sand grains; 70 percent pebbles; very strongly acid; clear, wavy boundary.
C--60 to 75 inches, brown (7.5YR 4/4) loose sand and gravel; strongly acid, becoming neutral at a depth of 75 inches.

The solum is 40 to 80 inches thick. Unless limed, it is strongly or very strongly acid.

The content of coarse fragments generally increases from 15 to 40 percent in the A horizon to 90 percent in the B and C horizons. Thin coarse sandy layers that do not contain pebbles are common throughout the profile. The sandy and gravelly C horizon is 5 to more than 100 feet thick. It is generally medium to strongly acid in the upper part, but becomes less acid with increasing depth.

An undisturbed soil has an A1 horizon that is very dark grayish brown (10YR 3/2) to black (10YR 2/1) and 1 to 3 inches thick. In places the A2 horizon is dark brown (10YR 4/3) to brown (10YR 5/3) and is 2 to 7 inches thick. The Ap horizon is dark brown (10YR 4/3) to brown (10YR 5/3).

The B horizon is reddish-brown (5YR 4/4) to dark yellowish-brown (10YR 4/4) gravelly or very gravelly loam or sandy loam. Clay films on the pebbles are common in the B horizon, and sandy layers have clay bridges.

Nearby soils on the terraces are Chili, Watertown, Wheeling, and Mentor soils. Conotton soils are more gravelly than Chili soils and are less sandy than Watertown soils. They are more gravelly and sandy in the upper part of the solum than Wheeling and Mentor soils.

CoA--Conotton gravelly loam, 1 to 6 percent slopes. This nearly level to gently sloping soil is on broad terraces. Areas are uniform to undulating, are 15 to 150 acres in size, and are commonly long. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of the less gravelly Watertown and Chili soils. Also included are a few areas of more sloping soils where the hazard of erosion is more serious.

A drought hazard and small cobbles on the surface limit cultivation. Runoff is slow, and the erosion hazard is slight.

This soil is suited to truck crops and to irrigation. It has few limitations for most nonfarm uses and is suited to urban development. Capability unit IIIs-1; woodland suitability group 3f1.

CpE--Conotton-Chili gravelly loams, 18 to 25 percent slopes. This mapping unit occurs on steep terrace escarpments in such intricate, irregular patterns that it is not practical to map or manage the soils separately. Areas are 10 to 20 acres in size, are ¼ to ½ mile long, and wind between terraces or between terraces and the river flood plains. Slopes are dominantly only 50 to 150 feet long.

This mapping unit is about 40 percent Conotton gravelly loam and 40 percent Chili gravelly loam. The rest is the less gravelly Watertown and Wheeling soils. Both Conotton and Chili soils have profiles similar to those described as typical, but slightly thinner.

This mapping unit is used mostly for woodland, wildlife, and pasture. Productivity for pasture is low. A few areas border Urban land. Runoff is very rapid, and the erosion hazard is very severe if the soils are cultivated. Capability unit IVe-2; woodland suitability group 3f1.

Dekalb Series

The Dekalb series consists of moderately deep, sloping to very steep, well-drained soils on uplands. These soils formed in residuum weathered from acid sandstone. They are mainly on the upper slopes and on knolls. They also occur with the stony, very steep Gilpin soils. Slopes are mainly convex.

In a representative profile in a wooded area the surface layer is very dark grayish-brown loam 2 inches thick. The subsurface layer is 5 inches of brown loam. The upper 9 inches of the subsoil is dark yellowish-brown channery loam, and the lower 5 inches is yellowish-brown very channery loam. The substratum is yellowish-brown loam and 90 percent coarse fragments. Sandstone bedrock is at a depth of 28 inches.

Dekalb soils are acid and have rapid permeability, low natural fertility, and low available water capacity. Nonstony areas are easily tilled. The root zone is moderately deep.

The sloping to moderately steep Dekalb soils are generally farmed. Steeper soils are stony and are generally pastured and wooded.

Representative profile of Dekalb loam from an area of Dekalb and Gilpin stony soils, 25 to 70 percent slopes, 0.8 mile west of County Road 138 on Township Road 403, 20 feet south of road, SE¼NW¼NW¼ sec. 3 of Ludlow Township, T. 3 N., R. 6 W.:

A1--0 to 2 inches, very dark grayish-brown (10YR 3/2) loam; moderate, very fine, granular structure; very friable; many fine and medium roots; 15 percent coarse fragments; medium acid; abrupt, irregular boundary.

A2--2 to 7 inches, brown (10YR 4/3) loam; weak, medium and coarse, subangular blocky structure; friable; many fine and medium roots; few fine pores; 15 percent coarse fragments; strongly acid; abrupt, wavy boundary.

B21--7 to 16 inches, dark yellowish-brown (10YR 4/4) channery loam; weak, medium, subangular blocky structure; friable; common fine and medium roots; few fine and medium pores; 30 percent coarse fragments; strongly acid; clear, wavy boundary.

B22--16 to 21 inches, yellowish-brown (10YR 5/4) very channery loam; weak, fine, subangular blocky structure; friable; few fine roots; 60 percent coarse fragments; medium acid; abrupt, wavy boundary.

C--21 to 28 inches, 90 percent coarse fragments, yellowish-brown (10YR 5/4) loam between fragments; medium acid.

R--28 inches, medium-grained sandstone bedrock.

The solum is 20 to 30 inches thick. Unless limed, it is very strongly acid to medium acid. It is 10 to 60 percent coarse fragments. Depth to bedrock is 24 to 40 inches.

The Ap horizon is 10YR hue and 3 or 4 in value and chroma. If the soil is crushed, value is higher than 3.5. An undisturbed soil has a dark-colored A1 horizon 1 to 2 inches thick and an A2 horizon having value of 4 or 5 and chroma of 3 or 4 in 10YR hue. The B horizon has hue of 10YR or 7.5YR in value of 4 or 5 and chroma of 4 to 6. It is loam, fine sandy loam, or sandy loam and in most places is 35 to 60 percent fragments.

Dekalb soils are on the same landscape as Gilpin, Wellston, and Clymer soils. They are coarser textured and have more coarse fragments than those soils. They are shallower over bedrock than Wellston and Clymer soils.

DkC--Dekalb loam, 6 to 12 percent slopes. This sloping soil in on convex and smoothly rounded knolls and ridgetops. Areas are commonly 3 to 10 acres in size. They tend to be blocky, but ridge spurs are long and narrow. The surface layer contains fewer stony fragments than is typical.

Shallowness over bedrock is a limitation for some nonfarm uses. If the soil is cultivated, the erosion hazard is severe. Runoff is medium.

This soil is well suited to alfalfa in limed areas. It is suited to crops, but most areas are small and narrow. Capability unit IIIe-4; woodland suitability group 3o1.

DkD--Dekalb loam, 12 to 18 percent slopes. This moderately steep soil is on knolls and upper side slopes. Slopes are convex and 100 to 500 feet long. Most areas are long, narrow, and winding and 5 to 20 acres in size.

Included with this soil in mapping are narrow bands of shallow soils over sandstone and a few outcrops of sandstone bedrock. These areas are difficult to till. The larger rock outcrops are identified by spot symbols on the soil map.

Runoff is rapid, and the erosion hazard is very severe if this soil is cropped. Depth to bedrock and slope are severe limitations for nonfarm uses.

This soil is used for crops, pasture, and woodland. Capability unit IVe-3; woodland suitability group 3r1.

DkE--Dekalb loam, 18 to 25 percent slopes. This steep soil is on the upper part of side slopes. Slopes are mostly convex, but around the heads of ravines they are concave. Areas are generally long and winding and 5 to 40 acres in size. This soil commonly has a thinner, lighter colored surface layer than is typical, but in the lower areas and on concave slopes, the profile is thicker because soil material has accumulated through downslope movement.

Included with this soil in mapping are soils that are shallow over bedrock, a few sandstone outcrops, and very steep soils near drainageways all of which have more limitations than this soil. Most of the larger rock outcrop is identified by spot symbols on the map.

Runoff is very rapid, and the erosion hazard is very severe if the soil is cultivated. Steep slope and shallowness over bedrock severely limit nonfarm uses.

This Dekalb soil is used for woodland, pasture, and hay. Capability unit IVe-4; woodland suitability group 3r1.

DkF--Dekalb loam, 25 to 35 percent slopes. This very steep soil is on side slopes and along deep ravines. Slopes are convex and concave and mostly irregular. They vary in length, but range from 1,000 feet on an undissected side slope to 100 feet near drainageways. Areas are 10 to 80 acres in size. Most are long, but many are blocky. This soil is more variable than the Dekalb soils on lesser slopes. It is deep in places where material has accumulated through downslope movement and more shallow than typical where material has been lost through downslope movement.

Included with this soil in mapping are soils that are shallow over bedrock and a few sandstone outcrops, the larger of which are identified by spot symbols on the soil map.

The erosion hazard is very severe if vegetation is removed. The very steep slopes and limited depth to bedrock seriously limit nonfarm uses. Runoff is very rapid.

This Dekalb soil is used mostly for woodland. The dominant trees are chestnut oak on southern exposures and black and white oaks in a mixed forest of beech, sugar maple, yellow-poplar, elm, and hickory on northern exposures. The soil is poorly suited to pasture. Many areas formerly pastured have a canopy of brush and young forest. Only a few areas are in pasture and hay. Capability unit VIe-1; woodland suitability group 3r1.

DsG--Dekalb and Gilpin stony soils, 25 to 70 percent slopes. This very steep mapping unit is on valley sides. Some areas are only one soil. Some are both. In most places the unit is dissected by ravines and drainageways, and in places it is benched. Areas are long and winding and are 40 to 500 acres in size, 200 to 500 feet wide, and a half mile to 4 miles long. The stony Dekalb soil makes up about 35 percent of the total acreage of this unit, and the stony Gilpin soil about 35 percent. Included soils and rock cliffs make up the other 30 percent. Except for stones on the surface, the Dekalb and Gilpin soils have profiles similar to the ones described as representative of their series.

Included with this unit in mapping are spots of Hayter very stony soils on benches and narrow areas of Hartshorn soils along streams. Some areas are very stony and bouldery. Rock

cliffs are identified by spot symbols on the soil map.

The erosion hazard is severe along skid roads during logging and harvesting, when the vegetation is removed. Runoff is very rapid. Forest management is hindered by large stones, boulders, and cliffs. The chestnut oak forest type is on the southern exposures, and a mixed type of oak and trees that grow under medium moisture conditions is on northern exposures.

This mapping unit is used for woodland and recreation. Stones and very steep slopes limit many nonfarm uses. Capability unit VIIs-1; woodland suitability group 3x1.

Duncannon Series

The Duncannon series consists of deep, gently sloping to steep, well-drained soils that formed in thick wind-deposited silt and very fine sand. These soils are on low hills near the Ohio River terraces. The largest acreage is adjacent to the towns of Reno and Newport.

In a representative profile in a wooded area, the surface layer is very dark grayish-brown silt loam about 3 inches thick. The subsurface layer is 10 inches of dark yellowish-brown silt loam. The subsoil is yellowish-brown silt loam that extends to a depth of 60 inches. The substratum to a depth of 120 inches is yellowish-brown silt loam.

Duncannon soils are moderately permeable. They have a high available water capacity, medium natural fertility, and a deep root zone.

These soils are used for general farm crops, pasture, woodland, and urban purposes. There are excellent stands of yellow-poplar (fig. 8) in most forested areas.

Representative profile of Duncannon silt loam, 6 to 12 percent slopes, in a wooded area,

Figure 8.--Yellow-poplars grow well on Duncannon soils.

NW¼NW¼SE¼ sec. 9, T. 2 N., R. 8 W., Marietta Township, 0.55 mile east of Ohio State Highway 7 on Township Road 543, 1,500 feet north of Road 543, 150 feet east of fence, 100 feet south of half-section line (see profile WS-W54 in section on laboratory data):

A1--0 to 3 inches, very dark grayish-brown (10YR 3/2) light silt loam; moderate, very fine, granular structure; very friable; many roots; strongly acid; abrupt, wavy boundary.

A2--3 to 13 inches, dark yellowish-brown (10YR 4/4) light silt loam; weak, fine, granular structure; friable; many roots; strongly acid; abrupt, wavy boundary.

B21t--13 to 17 inches, yellowish-brown (10YR 5/4) silt loam; moderate, medium and fine, subangular blocky structure; friable; many roots; few fine pores; thin, very patchy, brown (7.5YR 5/4) clay films on some peds; few light yellowish-brown (10YR 6/4) silt films; very strongly acid; clear, wavy boundary.

B22t--17 to 30 inches, yellowish-brown (10YR 5/6) silt loam; moderate, medium, angular blocky structure; friable; common roots; few fine pores; thin, patchy, brown (7.5YR 5/4) clay films; few light yellowish-brown (10YR 6/4) silt films; very strongly acid; clear, smooth boundary.

B23t--30 to 38 inches, yellowish-brown (10YR 5/6) light silt loam; moderate, medium, angular and subangular blocky structure; firm, slightly brittle; few roots; common fine pores; thin, very patchy, brown (7.5YR 5/4) clay films; few pale-brown (10YR 6/3) silt films; very strongly acid; gradual, smooth boundary.

B3--38 to 60 inches, yellowish-brown (10YR 5/4) light silt loam or silt; sandy, pale-brown (10YR 6/3) seams; massive; few roots; few fine pores; brown (7.5YR 5/4) clay films in pores; strongly acid; gradual, smooth boundary.

C1--60 to 75 inches, yellowish-brown (10YR 5/4) silt loam; many, coarse, faint, gray (10YR 6/1) mottles; massive; friable; medium acid; gradual, smooth boundary.

C2--75 to 90 inches, yellowish-brown (10YR 5/4) silt loam; few, medium, faint, gray (10YR 6/1) mottles; massive; friable; slightly acid; gradual, smooth boundary.

C3--90 to 120 inches, yellowish-brown (10YR 5/4) light silt loam; many, medium, faint, dark yellowish-brown (10YR 4/4) mottles; massive; friable; medium acid.

The solum is 40 to 60 inches thick. Unless limed, it ranges from strongly to very strongly acid. In most areas depth to bedrock is more than 6 feet and in some places it is more than 20 feet.

The Ap horizon in cultivated areas and the A2 horizon range from silt loam to very fine sandy loam and from 10YR 4/3 to 5/4. An uncultivated soil has an A1 horizon less than 5 inches thick and chroma and value of 1 to 3. The B2t horizon ranges from light silt loam to very fine sandy loam that is 10YR to 7.5YR in hue, 4 or 5 in value, and 4 to 6 in chroma. The C horizon is silt loam or very fine sandy loam that has value of 4 or 5 and chroma of 3 or 4 in 10YR hue.

Duncannon soils are more silty and less sandy than the Lakin soils mapped with the steep Duncannon soils. They have a less clayey B horizon than the nearby Allegheny and Alford soils.

DtB--Duncannon silt loam, 2 to 6 percent slopes. This gently sloping soil is on low hills and ridges near Newport, Belpre, and Reno. Areas are up to 50 acres in size. Slopes commonly are smooth and gently undulating. This soil has a profile similar to the one described as representative of the series, but in cultivated areas the original surface layer is mixed with the underlying layers and has a brownish color.

This soil has good tilth and favorable properties for irrigation. It has no serious limitations for most nonfarm uses. Runoff is slow to medium. The erosion hazard is moderate in cultivated areas. Capability unit IIe-1; woodland suitability group 1o1.

DtC--Duncannon silt loam, 6 to 12 percent slopes. This sloping soil is on the crests and sides of low hills near Reno and Newport. It is convex on the crests of hills, but is irregular on the sides where it has been cut by shallow drainageways. Areas are 5 to 30 acres in size. On the crests, they are narrow and winding. On the hillsides they are blocky. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Lakin and Watertown soils, which are sandy and more droughty than this Duncannon soil.

This soil is easy to cultivate and has good tilth, but gullies form rapidly unless it is well managed. If the soil is cultivated, the erosion hazard is severe. Runoff is medium.

This soil is used for crops, pasture, and woodland and also for urban uses. Capability unit IIIe-1; woodland suitability group 1o1.

DuD--Duncannon-Lakin complex, 12 to 18 percent slopes. This moderately steep mapping unit occurs on the tops and sides of low hills and in ravines. It is about 40 percent Duncannon soil, 40 percent Lakin soil, and 20 percent included soils. Duncannon and Lakin soils occur in such an intricate, irregular pattern that they can not be mapped or managed separately. Areas are irregular, are 5 to 30 acres in size, and are uneven and hummocky. Slopes are 100 to 300 feet long. The Duncannon soil has a thinner subsoil than the one described as typical. The Lakin soil has the profile described as representative of the series.

Moderately steep slopes are limitations for most nonfarm uses. The erosion hazard is very severe if vegetation is removed. Runoff is very rapid.

These soils are used mostly for woodland and pasture. Small areas around Reno are used for housing developments. Capability unit IVe-1; woodland suitability group 1r1.

DuE--Duncannon-Lakin complex, 18 to 25 percent slopes. This steep mapping unit is on the tops and sides of small hills near Newport and Reno. It is in irregular areas where the topography is mainly ravines and dunes. It is about 40 percent Duncannon soil, 40 percent Lakin soil, and 20 percent included soils. Duncannon and Lakin soils occur in such an intricate, irregular pattern that it is not practical to map or manage them separately. Areas are 10 to 80 acres in size. The subsoil of the Duncannon soil is only 20 to 35 inches thick. Otherwise, the profile is similar to the one described as typical.

Included with these soils in mapping are small areas of the clayey Upshur and loamy Gilpin soils, which are shallower over bedrock than the Duncannon and Lakin soils. Also included, along ravines, are areas of very steep soils.

The erosion hazard is very severe if the plant cover is removed. Gullies form rapidly. Runoff is very rapid. Steep slopes are limitations for nonfarm uses.

This mapping unit is used chiefly for woodland. It supports good stands of yellow-poplar. Capability unit IVe-2; woodland suitability group 1r1.

Elba Series

The Elba series consists of deep, well-drained, moderately steep to very steep soils that formed in material weathered from limestone and shale interbedded with siltstone. These soils occur on the tops and sides of ridges, mostly across the northern part of the county.

In a representative profile the surface layer is mainly brown silty clay loam 5 inches thick. The upper 15 inches of the subsoil is dark yellowish-brown silty clay loam. The lower 28 inches is brown and light olive-brown channery clay. The substratum is 6 inches of channery clay weathered from limestone and shale. Weathered limestone and shale is at a depth of 54 inches.

Elba soils have slow permeability, moderate available water capacity, and medium natural fertility. The root zone is moderately deep. Tilth is poor. The soil is slightly acid or neutral, and lime is not generally needed.

These soils are used mostly for pasture and hay crops.

Representative profile of Elba silty clay loam from an area of Elba-Belpre complex, 25 to 35 percent slopes, NW¼NE¼SW¼ sec. 16, Aurelius Township, T. 5 N., R. 8 W., about one-fourth mile northeast of the junction of Township Roads 305 and 306:

Ap1--0 to 1½ inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, medium, angular blocky structure parting to strong, fine, angular blocky; firm; many roots; 5 percent coarse fragments; neutral; clear, wavy boundary.

Ap2--1½ to 5 inches, brown (10YR 4/3) silty clay loam; moderate, medium, angular blocky structure parting to moderate, fine, angular blocky; firm; many roots; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

B21t--5 to 20 inches, dark yellowish-brown (10YR 4/4) heavy silty clay loam grading to silty clay with increasing depth; moderate, medium, angular blocky structure; firm; common roots; common fine pores; thin, continuous, brown (10YR 4/3) silty films; 5 percent coarse fragments; slightly acid; abrupt, irregular boundary.

B22t--20 to 24 inches, brown (7.5YR 4/4) channery clay; weak, medium, angular blocky structure; firm; common roots; thin, continuous, reddish-brown (5YR 4/3) clay films; 35 percent limestone fragments; neutral; clear, wavy boundary.

B3--24 to 48 inches, light olive-brown (2.5Y 5/4) channery clay; weak, fine, angular blocky structure; firm; thin, patchy, brown (7.5YR 4/4) clay films in upper part; 50 percent limestone and weathered siltstone fragments; moderately alkaline, calcareous; gradual boundary.

IIC--48 to 54 inches, variegated light olive-brown (2.5Y 5/4) and weak red (10R 4/4) channery clay residuum from shale and limestone; massive; moderately alkaline, calcareous.

IIR--54 inches, weathered shale and limestone bedrock.

The solum is 24 to 48 inches thick. Depth to carbonates is 10 to 30 inches. Depth to bedrock is 40 to 60 inches. Coarse fragments do not occur in some horizons, but in places are as much as 60 percent of the B2 and B3 horizons. The soil is medium acid to neutral in the upper part of the B horizon, but is neutral to moderately alkaline and calcareous in the lower part and in the C horizon.

The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. A thin A1 horizon, which occurs in places, has value of 2 or 3 and chroma of 1 to 3. The A horizon is silty clay loam, heavy silt loam, silty clay, or clay. The B2 horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 to 6. In most areas it is silty clay or clay, but in subhorizons it is heavy silty clay. The B3

horizon is silty clay loam, silty clay, or clay in hue of 7.5YR to 5Y, value of 5 or 6, and chroma of 1 to 4. The C horizon is dark-gray, gray, and light olive-brown to weak red, calcareous silty clay loam, silty clay, and clay residuum, dominantly weathered from limestone and shale.

Elba soils are finer textured in the upper part of the solum than Westmore soils and are less acid than the nearby Lowell and Westmore soils. They are browner than the reddish Belpre and Upshur soils and are less acid than Upshur soils. Elba soils are shallower over bedrock than Brookside soils, which formed in colluvium.

ElD--Elba-Belpre complex, 12 to 18 percent slopes. This moderately steep mapping unit occurs on narrow, hilly ridgetops and upper hillsides. It is about 45 percent Elba soil, 20 percent Belpre soil, and 35 percent included soils. The Elba and Belpre soils are in such an intricate, irregular pattern that it is not practical to map or manage them separately. Areas are commonly long and are 5 to 25 acres in size. The profile of the Elba soil is slightly deeper than the one described as representative of the series.

Included with this unit in mapping are areas of Lowell, Wetmore, and Upshur soils. Small areas of severely eroded soils that require special management are also included and are identified by spot symbols on the soil map.

Runoff is rapid. Tillage is difficult because of the heavy surface layer. The shrink-swell potential is moderate to high. The erosion hazard is very severe in cultivated areas. Small landslips are a hazard in a few places. Moderately steep slopes and the clayey texture are the main limitations for nonfarm uses.

This mapping unit has been cleared and is used mainly for crops and pasture. Part of the acreage is wooded. Black walnut is prominent in wooded areas.

The part of the county in which this unit is most extensive is in areas where coal is strip mined. Many areas of the unit are on isolated knobs above the high wall of the mine and are abandoned. Capability unit IVe-5; woodland suitability group 3c2.

ElE--Elba-Belpre complex, 18 to 25 percent slopes. This steep mapping unit is on hilly ridgetops, spurs, and upper slopes and in coves. It is about 45 percent Elba soil, 20 percent Belpre soil, and 35 percent included soils. Elba and Belpre soils occur in such an intricate, irregular pattern that it is not practical to map or manage them separately. Slopes are irregular and are cut by drainageways, and in some places there are small landslips. Areas are generally long and about 5 to 30 acres in size.

Included with this unit in mapping are areas of Lowell, Westmore, and Uphsur soils. These soils are managed similarly to the Elba and Belpre soils. Also included are small areas of severely eroded soils, identified by spot symbols on the soil map, that require special management.

The erosion hazard is very severe if this unit is cultivated. Runoff is very rapid. Tilth is very difficult to maintain. The hazard of landslip and the moderate to high shrink-swell potential are limitations for most nonfarm uses.

This mapping unit is used mostly for grass and trees. Black walnut is prominent.

The part of the county in which this unit occurs is extensively strip mined for coal. Many areas are isolated above the high walls of the mine and are abandoned. Capability unit VIe-2; woodland suitability group 3c2.

ElF--Elba-Belpre complex, 25 to 35 percent slopes. This very steep mapping unit is on side slopes and in coves. It is about 45 percent Elba soil, 20 percent Belpre soil, and 35 percent included soils. The Elba and Belpre soils occur in such an intricate, irregular pattern that it is not practical to map or manage them separately. Slopes are irregular and in many places are cut by drainageways. In places there are landslips. Areas range from about 5 to 50 acres in size and are commonly long and winding. The Elba soil has the profile described as representative of the series. The Belpre soil has a slightly thinner profile than the one described as representative of the series.

Included with this unit in mapping are areas of Lowell and Upshur soils, both of which are managed similarly to Elba and Belpre soils. Also included are spots of severely eroded soils that have a reddish or brownish surface layer and are low in productivity. These eroded soils are identified by spot symbols on the soil map.

Runoff is very rapid, and the erosion hazard is very severe if the plant cover is removed. The very steep slopes and the landslips are limitations for most farm and nonfarm uses.

Most of the acreage is used for woodland and pasture. In wooded areas black walnut is prominent. In pastures bluegrass grows naturally.

The part of the county in which this mapping unit occurs is extensively strip mined for coal. Many areas of this unit are isolated above the high walls of the mine and are abandoned. Capability unit VIe-3; woodland suitability group 3c2.

Fill Land

Fill land consists of areas under urban and industrial development that have been covered with more than 3 feet of soil material and then leveled. The material was excavated from nearby glacial outwash terraces and alluvial deposits along the Ohio and Muskingum Rivers from

red clay shale and mudstone bedrock, and from gray clay lacustrine deposits.

Fa--Fill land, sandy, gravelly, and channery materials. This is nearly level or gently sloping land that is covered with fill of sandy, gravelly, or channery soil material. The fill is more than 3 feet thick. It is rapidly permeable and dries out rapidly after a rain. Included in mapping are small sloping and hummocky areas. This soil material is used to fill and level areas under industrial and urban development. Most of it was excavated from glacial outwash terraces along the Ohio and Muskingum Rivers. A small part was excavated from sandstone bedrock.

Because the fill and the underlying material vary, this land is not rated for nonfarm uses. Capability unit and woodland suitability group not assigned.

Fb--Fill land, loamy materials. This is nearly level to gently sloping land that is covered with fill of loamy soil material. The fill is loam, silt loam, sandy clay loam, light clay loam, and light silty clay loam. It is more than 3 feet thick. It is moderately to moderately slowly permeable, but dries out readily after a rain. It is easily worked unless compacted. In most areas it is low in organic-matter content. Included in mapping are small hummocky and sloping areas.

This soil material is used to fill and level areas under industrial and urban development. Most of it was excavated from alluvial and glacial outwash deposits along the Ohio and Muskingum Rivers. Bedrock is exposed in cuts in some areas.

Because the thickness and kinds of fill vary and the properties of the underlying soils are unknown, this land is not rated for nonfarm uses. Capability unit and woodland suitability group not assigned.

Fc--Fill land, clayey materials. This is nearly level to gently sloping land that is covered with fill of clayey soil material. The fill is clay, silty clay, shaly silty clay, heavy silty clay loam, and heavy clay loam. It is more than 3 feet thick. It is slowly to very slowly permeable, cloddy, and somewhat difficult to work. It dries out slowly after a rain. Included in mapping are small hummocky and sloping areas, escarpments, high walls of excavated material, and areas where the fill material is stony.

This soil material was excavated from red clay shale and mudstone bedrock and from gray clay lacustrine deposits. Most of it is in filled areas along four-lane highways where excess excavated material was used to fill depressions outside of the highway right of way. The rest, excavated from lacustrine deposits, was used to level industrial sites in Marietta.

Because the fill and the underlying material are extremely variable, this land is not rated for nonfarm uses. Capability unit and woodland suitability group not assigned.

Gallia Series

The Gallia series consists of deep, well-drained soils that formed in alluvium on high terraces mainly in the western part of the county. These soils are gently sloping to moderately steep.

In a representative profile in a cultivated area the surface layer is brown silt loam 8 inches thick. The subsoil extends to a depth of 83 inches. The upper 15 inches is brown silt loam and strong-brown loam, and the lower 60 inches is yellowish-red and dark-red clay loam, clay, sandy clay loam, and sandy loam. The substratum to a depth of 120 inches is brown, yellowish-red, and yellowish-brown loamy sand and gravelly loamy sand.

Gallia soils have a moderately permeable subsoil and rapidly permeable underlying material. Unless limed, they are strongly or very strongly acid. The root zone is deep, available water capacity is high, and natural fertility is medium.

Gallia soils occur locally in Belpre, Decatur, and Wesley Townships and are used mostly for general farm crops and peach orchards.

Representative profile of Gallia silt loam, 6 to 12 percent slopes, in a cultivated field in Belpre Township T. 1 N., R. 10 W., 100 feet south of County Road 84, 1,800 feet southwest of its juction with Ohio State Highway 124 (See profile WS-1 in section on laboratory data):

Ap--0 to 8 inches, brown (10YR 4/3) silt loam; weak, medium, granular structure; friable; many roots; strongly acid; abrupt, smooth boundary.

B1t--8 to 12 inches, brown (7.5YR 4/4) silt loam; moderate, fine, angular blocky structure; friable; common roots; thin, patchy, dark-brown (7.5YR 4/4) clay films; patchy pale-brown (10YR 6/3) silty ped surfaces; very strongly acid; clear, smooth boundary.

B21t--12 to 23 inches, strong-brown (7.5YR 5/6) loam; moderate, medium, subangular blocky structure parting to strong, fine, angular blocky; firm; common roots; thin, patchy, reddish-brown (5YR 4/4) clay films; very patchy pale-brown (10YR 6/3) silty ped surfaces; very strongly acid; clear, smooth boundary.

B22t--23 to 30 inches, yellowish-red (5YR 5/6) light clay loam; strong, medium, angular blocky structure; firm; few roots; medium, patchy, reddish-brown (5YR 4/4) clay films; very patchy pale-brown (10YR 6/3) silty ped surfaces; very strongly acid; abrupt, smooth boundary.

B23t--30 to 41 inches, yellowish-red (5YR 4/6) clay; strong, coarse, angular blocky

structure; firm; few roots; thick, continuous, yellowish-red (5YR 4/6) clay films; strongly acid; clear, smooth boundary.

B24t--41 to 67 inches, dark-red (2.5YR 3/6) sandy clay loam; strong, coarse, angular blocky structure parting to strong, medium and fine, angular blocky; firm; few roots; thick, patchy, pale-brown (10YR 6/3) and light yellowish-brown (10YR 6/4) silty and sandy surfaces; 5 percent soft weathered pebbles; very strongly acid; clear, smooth boundary.

B3t--67 to 83 inches, dark-red (2.5YR 3/6) sandy loam; massive, vertical partings; firm; thin, very patchy, dark reddish-brown (2.5YR 3/4) clay films on vertical surfaces and bridges between sand grains; thick, very patchy, pale-brown (10YR 6/3) and light yellowish-brown (10YR 6/4) silty surfaces; 20 percent weathered pebbles; very strongly acid; abrupt, smooth boundary.

C--83 to 120 inches, brown (7.5YR 5/4), yellowish-red (5YR 5/8), and yellowish-brown (10YR 5/8) layers of loamy sand and gravelly loamy sand; single grained; loose; very strongly acid.

The solum is 60 to 108 inches thick. It is strongly acid to very strongly acid below the A horizon. The lower part of the solum is as much as 20 percent weathered fragments and pebbles of sandstone, shale, and crystalline rock.

The Ap horizon has hue of 10YR and 7.5YR, chroma of 3 or 4, and value of 4 or 5. In wooded areas the A1 horizon is 1 to 3 inches thick. It is 10YR 4/2, 10YR 4/3, 10YR 3/2, or 10YR 3/3. The A2 horizon is 4 to 9 inches thick. It is 10YR 5/4 or 10YR 4/4.

The B1t horizon is silt loam or loam having hue of 10YR to 5YR, value of 4 or 5, and chroma of 4 to 6. In most areas the B2t horizon is dominantly hue of 5YR or 2.5YR in the matrix. In places the upper part is 7.5YR, and the lower part is 10R. Value ranges from 3 to 5, and chroma from 4 to 8. The silty ped surface is 10YR 6/3 or 10YR 6/4. The B2t horizon is sandy clay loam, clay loam, loam, gravelly clay loam, sandy clay, and clay. The B3 horizon is loamy sand, sandy loam, or gravelly sandy loam and has hue of 2.5YR or 5YR, chroma of 4 to 8, and value of 3 to 5. Black stains occur in places.

The C horizon is stratified loamy sand, sandy loam, gravelly sandy loam, loam, and sandy clay loam. Hue is 2.5YR, 5YR, or 7.5YR. Chroma is 4 to 8, and value is 3 to 5.

Gallia soils are redder than Allegheny soils, which also formed on terraces in loamy alluvium. They are coarser textured than Vincent soils. In contrast with the Otwell soils that occur on nearby terraces, they do not have a fragipan.

GaB--Gallia silt loam, 2 to 6 percent slopes. This gently sloping soil is on the highest parts of ridges and benches on high terraces. Slopes are smooth and slightly convex. Areas range from 5 to 100 acres in size. Larger areas are characteristically long. Smaller areas are blocky.

Included with this soil in mapping are spots of Otwell soils, commonly in nearly level areas near the center of larger mapped areas. Otwell soils have a compact layer in the subsoil and are moderately well drained.

This Gallia soil has good tilth and no serious limitation for most nonfarm uses. It is easily managed. Runoff is slow to medium. The erosion hazard is moderate in cultivated areas. Capability unit IIe-1; woodland suitability group 2o1.

GaC--Gallia silt loam, 6 to 12 percent slopes. This sloping soil is commonly on the outer parts of high terraces. Other areas are on smoothly rounded ridges. Slopes are smooth and slightly convex. Areas range from 5 to 150 acres in size. Larger areas are long and irregular. Smaller areas are more blocky. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Vincent and Licking soils. Also included are some severely eroded areas. The Vincent and Licking soils are more clayey than the Gallia soils and dry more slowly. This characteristic makes them more difficult to farm.

The erosion hazard is severe if this soil is farmed. Runoff is medium to rapid. Slope is a limitation for some nonfarm uses. Capability unit IIIe-1; woodland suitability group 2c1.

GaD--Gallia silt loam, 12 to 18 percent slopes. This moderately steep soil is on side slopes and along drainageways below the crests of terraces. Slopes are even and convex. Areas are 5 to 30 acres in size. Most are long and narrow and have short slopes that are crossed by small drainageways. This soil has a profile similar to the one described as representative, but in some areas the surface layer is mixed with the upper part of the subsoil. In these areas the plow layer is lower in content of organic matter, is more clayey, and has poor tilth.

Included in mapping are small areas of the reddish, clayey Upshur soils and the more shallow Gilpin soils. Upshur soils are more difficult to till, and Gilpin soils are more droughty. These included soils are commonly near drainageways and along the edge of the areas near slope breaks.

Runoff is rapid, and the erosion hazard is very severe if this soil is farmed. Slope is a limitation for many nonfarm uses. Capability unit IVe-1; woodland suitability group 2r1.

Gilpin Series

The Gilpin series consists of gently sloping to very steep, moderately deep, well-drained soils that formed in material weathered from acid interbedded siltstone and sandstone. These soils occur throughout the county.

In a representative profile the surface layer is brown silt loam 7 inches thick. The upper 9 inches of the subsoil is yellowish-brown channery silt loam. The lower 10 inches is strong-brown channery silt loam. Weathered siltstone is at a depth of 26 inches.

Gilpin soils have medium natural fertility and a moderately deep root zone. The available water capacity is low because of the high percentage of stone fragments in the lower part of the subsoil. Permeability is moderate. These soils dry out early in spring and have good tilth. Small sandstone fragments are common in the plow layer, but generally do not interfere with tillage.

Some areas are cultivated. Row crops and small grain are the principal crops. Large areas of the steeper soils are used for pasture and woodland. Also, many acres are in brushy fields that were formerly cultivated but are now reverting to forest.

Representative profile of Gilpin silt loam, in an area of Gilpin-Summitville-Upshur complex, 25 to 35 percent slopes, SW½SW¼SE¼ sec. 26, Grandview Township, T. 2 N., R. 5 W., 740 feet west of the junction of County Road 138 on Ohio State Highway 260, 70 feet north of road:

Ap--0 to 7 inches, brown (10YR 4/3) silt loam; weak, medium, granular structure; friable; many fine and medium roots; 10 percent sandstone fragments; strongly acid; abrupt, smooth boundary.

B21t--7 to 16 inches, yellowish-brown (10YR 5/4) channery silt loam; weak, medium, subangular blocky structure; friable; many fine and medium roots; thin, very patchy, yellowish-brown (10YR 5/4) clay films; 20 percent sandstone and siltstone fragments; very strongly acid; gradual, smooth boundary.

B22t--16 to 22 inches, strong-brown (7.5YR 5/6) channery silt loam; weak, medium, subangular blocky structure; friable; few roots; thin, patchy, brown (7.5YR 4/4) clay films; 35 percent sandstone and siltstone fragments; very strongly acid; gradual, smooth boundary.

B3--22 to 26 inches, strong-brown (7.5YR 5/6) channery silt loam; weak, medium, angular blocky structure; friable; 40 percent sandstone and siltstone fragments; very strongly acid; gradual, smooth boundary.

R--26 inches, weathered siltstone bedrock.

Depth to bedrock ranges from 20 to 36 inches. Unless limed, the solum is strongly to extremely acid. The Ap horizon is 10YR in hue, 4 or 5 in value, and 3 or 4 in chroma. An undisturbed soil has a dark-colored A1 horizon 1 to 2 inches thick and a 2- to 5-inch A2 horizon the same color as the Ap horizon. The B2t horizon is generally channery silt loam, but ranges to light silty clay loam. It has value and chroma of 4 to 6 in 10YR and 7.5YR hue.

Gilpin soils are on the same landscape as Zanesville, Clymer, Summitville, Wellston, and Dekalb soils. They do not have the fragipan that is typical of Zanesville soils. They are finer textured than Dekalb soils. They are shallower over bedrock than Zanesville, Clymer, Summitville, and Wellston soils.

GdB--Gilpin silt loam, 2 to 6 percent slopes. This gently sloping soil is on narrow ridgetops. Slopes are smooth and slightly convex. Areas are mostly oblong or narrow and are about 2 to 10 acres in size. This soil has a profile similar to the one described as representative of the series, but the depth to bedrock is generally 30 to 36 inches and the surface layer and upper part of the subsoil have fewer rock fragments. Included in mapping are small areas of the deeper Wellston soils, which commonly are in the center of the wider ridgetops.

This Gilpin soil is suited to farming, but areas are small. The erosion hazard is moderate if the soil is bare of vegetation. Runoff is slow to medium. Shallowness over bedrock is a limitation for many nonfarm uses.

This soil is suited to crops, pasture, and woodland. Capability unit IIe-1; woodland suitability group 3o1.

GdC--Gilpin silt loam, 6 to 12 percent slopes. This sloping soil is dominantly on ridgetops. A few areas are on side slopes and around the heads of drainageways. Slopes are short and generally convex. Areas are 2 to 40 acres in size. They are mostly long and narrow, but tend to be more blocky at the ends of ridges. Included in mapping are spots of clayey soils that are more difficult to till.

Runoff is medium, and the erosion hazard is severe if this soil is farmed. Shallowness over bedrock and steep slopes are limitations for some nonfarm uses.

This soil is suited to pasture, crops, and woodland. Capability unit IIIe-4; woodland suitability group 3o1.

GdD--Gilpin silt loam, 12 to 18 percent slopes. This moderately steep soil is on upper side slopes, narrow rolling ridgetops, and short slopes along small upland drainageways. Slopes are smooth and convex. Individual areas range from about 4 to 40 acres in size.

A profile of this soil is commonly only about 20 to 25 inches deep over bedrock and contains more fragments of siltstone and sandstone, but is otherwise similar to the one described as representative of the series. Included in mapping in a few places, mostly in narrow bands along the lower edge of side slopes, are areas

of the reddish Summitville soils and the deeper Wellston soils.

Runoff is rapid, and the erosion hazard is very severe in cultivated areas. Shallowness over bedrock and moderately steep slopes limit the use of the soil for most nonfarm uses.

This soil is suited to pasture, crops, and woodland. Capability unit IVe-3; woodland suitability group 3r1.

GdE--Gilpin silt loam, 18 to 25 percent slopes. This steep soil is on side slopes and knolls and along the sides of ravines. Areas along ravines are crossed by small drainageways. Slopes are smooth and convex. Most are about 200 to 300 feet long. Areas range from 8 to 30 acres in size. This soil has a profile similar to the one described as representative, but it contains more fragments of siltstone and sandstone and depth to bedrock is more variable.

Included with this soil in mapping are narrow bands of Summitville and Wellston soils commonly at the lower edges of the areas on hillsides. These included soils are deeper than this Gilpin soil and have a higher available water capacity. Also included are areas near slope breaks and on the crest of knolls where the depth to bedrock is only 1 foot to 1½ feet.

Runoff is very rapid, and the erosion hazard is very severe if this soil is farmed. Steep slopes and shallowness over bedrock are severe limitations for most nonfarm uses.

This soil is best suited to pasture, woodland, and hay. Capability unit IVe-4; woodland suitability group 3r1.

GdF--Gilpin silt loam, 25 to 35 percent slopes. This very steep soil is on side slopes and hilltop knolls. It occurs as long winding bands around the hillsides and heads of drainageways. It is smooth, except near ravines, where it is crossed by small drainageways. Areas are about 3 to 30 acres in size.

A profile of this soil is generally shallower over bedrock than the one described as representative of the series and it contains more rock fragments.

Included with this soil in mapping are small areas of Summitville soils and areas of brownish clayey soils, which are finer textured than the Gilpin soils and more erodible. Small severely eroded areas are identified by spot symbols on the soil map.

This soil is too steep for crops and is difficult to manage for pasture. Runoff is very rapid. In cleared areas, the erosion hazard is very severe.

This soil is suited to woodland, and building logging roads is feasible. Northern exposures have a black oak forest type. Southern exposures have a chestnut-oak type. The very steep slope and the shallowness over bedrock are severe limitations for most farm and nonfarm uses.

This soil is suited to woodland and pasture. Capability unit VIe-1; woodland suitability group 3r1.

GkC--Gilpin-Summitville-Upshur complex, 6 to 12 percent slopes. This sloping mapping unit is on broad, rolling ridgetops and on the upper parts of side slopes. It is about 35 percent Gilpin soil, 20 percent Summitville soil, 20 percent Upshur soil, and 25 percent included soils. The three major soils occur in such a mixed pattern that it is difficult to map them separately. Slopes are smooth and convex and 50 to 150 feet long. Areas are mostly less than 10 acres in size, but range from 3 to 20 acres. The profiles of these soils are slightly deeper than the ones described as representative of their respective series.

Included with this unit in mapping are areas of Woodsfield and Zanesville soils, both of which are deeper than the other soils and are mainly in the less sloping areas near the center of ridges. Also included are a few small areas of coarser textured Dekalb soils on low knolls and small, severely eroded areas, some of which are identified by spot symbols on the soil map.

The clayey Upshur soil limits the use of this unit for crops. It dries out more slowly, has slower permeability and faster runoff, and is more difficult to manage than the Gilpin and Summitville soils. Natural fertility is medium. Runoff is medium. The erosion hazard is severe in cultivated areas. The main limitations for nonfarm uses are steep slopes, the shallowness of the Gilpin soil over bedrock, and the clayey texture of the Upshur soils.

This unit is suited to crops, pasture, and woodland. It is more commonly used for crops in the western and central parts of the county than in the eastern part. The eastern part is mostly wooded. Capability unit IIIe-4; woodland suitability group 3o1.

GkD--Gilpin-Summitville-Upshur complex, 12 to 18 percent slopes. This moderately steep mapping unit occurs mainly on rolling to hilly ridgetops, benches, and upper side slopes. In a few areas it is along upland drainageways near divides. It is about 35 percent Gilpin soil, 25 percent Summitville soil, 20 percent Upshur soil, and 20 percent included soils. The three major soils occur in such a mixed pattern that it is difficult to map them separately. Areas are 5 to 100 acres in size. Most are long. Some are broad and extend along both sides of drainageways. The long areas are crossed by a few shallow drainageways. Slopes are convex and smooth. The profile of the Upshur soil is the one described as representative of the series. Included in mapping are severely eroded areas and areas where the soil has an acid, gray-colored subsoil.

The clayey Upshur soil limits the use of this mapping unit for crops. It has poor tilth, is slow to dry out, and is more difficult to manage than Gilpin and Summitville soils.

Also permeability is slower. The erosion hazard is very severe in cultivated areas. The Upshur and Summitville soils are subject to landslides. The steep Gilpin soil is shallow over bedrock. Thus, the soils are limited for many nonfarm uses.

This unit is suited to crops, pasture, and woodland. In the western part of the county, more of the acreage is used for crops than in the eastern part. The eastern part is mainly wooded. Capability unit IVe-3; woodland suitability group 3r1.

GkD3--Gilpin-Summitville-Upshur complex, 12 to 18 percent slopes, severely eroded. This moderately steep mapping unit is on narrow rounded ridgetops and in concave areas near heads of drainageways. It is about 30 percent Gilpin soil, 30 percent Summitville soil, 20 percent Upshur soil, and 20 percent included soils. The three major soils occur in such mixed patterns that it is difficult to map them separately. Slopes are convex on the ridgetops and concave at the heads of drainageways. Most areas tend to be blocky. The unit is severely gullied. The soil between gullies is less than 2 feet thick over bedrock and has lost most of the original surface layer through erosion. Included in mapping are small areas of the severely eroded, coarser textured Dekalb soil and areas that are less steep.

Erosion has seriously reduced the productivity and use of this unit and has also reduced the available water capacity. Runoff is very rapid. The erosion hazard is very severe. Severely gullied areas and the moderately steep slopes limit the use of this unit for most nonfarm uses. In addition, the Upshur soil is subject to landslides.

This unit is suited to woodland. Virginia pine forest has grown over most areas and has stabilized most gullies. A few areas are used for pasture. Capability unit VIe-1; woodland suitability group 3r1.

GkE--Gilpin-Summitville-Upshur complex, 18 to 25 percent slopes. This mapping unit is on hillsides, upper side slopes, and knolls. It is about 30 percent Gilpin soil, 30 percent Summitville soil, 25 percent Upshur soil, and 15 percent included soils. The three major soils occur in such a mixed pattern that it is difficult to map them separately. On the tops and sides of knolls, slopes are short, smooth, and convex. On hillsides, they are commonly irregular. Areas are mainly long and winding. Some are blocky where they span narrow valleys and the valley sides.

The Gilpin soil is commonly in narrow bands on the steeper or more convex part of the slope, mostly near the upper edge of this unit. The Upshur soil is generally on less steep, irregular slopes. The Summitville soil is in more concave positions near drainageways and along the lower edge of the unit. The profiles of the Gilpin and Upshur soils are shallower over bedrock than the ones described for the series. The profile of the Summitville soil is the one described as typical.

Included with this unit in mapping are small areas of the coarser textured Dekalb soil, which generally has angular blocks of sandstone on the surface. Also included are areas where the subsoil is acid and gray and small severely eroded areas, mostly at the heads of drainageways or near slope breaks. Some eroded areas are identified by spot symbols on the soil map.

If well managed, this mapping unit is suited to hay and pasture. Runoff is very rapid, and the erosion hazard is very severe in cultivated areas. The Upshur soil is subject to landslides. The steep slope is a severe limitation for many nonfarm uses. Capability unit IVe-4; woodland suitability group 3r1.

GkE3--Gilpin-Summitville-Upshur complex, 18 to 25 percent slopes, severely eroded. This steep mapping unit is on upper side slopes and at the heads of drainageways. It is about 30 percent Gilpin soil, 30 percent Summitville soil, 25 percent Upshur soil, and 15 percent included soils. The major soils are in such a mixed pattern that it is difficult to map them separately. Slopes are concave at the heads of drainageways and convex along the sides and are 150 to 400 feet long. Areas are 5 to 30 acres in size. The profiles of these soils are thinner than the ones described as representative of their series because severe sheet and gully erosion have removed much of the upper soil material.

The Upshur soil has a surface layer of reddish clay that is sticky when wet. The Gilpin and Summitville soils have a surface layer of yellowish-brown channery silt loam or loam. Gullies 1 to 3 feet deep have formed in most areas. Small landslides have occurred in a few places. Fertility and available water capacity are very low. Runoff is very rapid. The erosion hazard is very severe.

The deep gullies, the steep slopes, and the clayey texture of the Upshur soil are limitations for most nonfarm uses. Also the Upshur soil is subject to landslides.

This mapping unit is suited to woodland, and most of the acreage is wooded. Virginia pine is controlling erosion in most areas. A few areas are used for pasture and are actively gullied. Capability unit VIIe-1; woodland suitability group 3r1.

GkF--Gilpin-Summitville-Upshur complex, 25 to 35 percent slopes. These very steep soils are in alternating bands on side slopes. Areas are uniform to irregular and are crossed by drainageways at intervals of 300 to 700 feet. They are mostly long and winding, but many areas on both sides of narrow valleys are blocky and range from 15 to 300 acres in size. The Gilpin soil makes up about 40 percent of the total acreage of this unit, the Summitville soil about 30 percent, Upshur soil 20 percent, and included soils 10 percent. On the upper slopes, the

profiles of these soils are shallower than the ones described as representative of their series. On the lower slopes they are deeper. Included with this unit in mapping are small areas of Dekalb soils, which have angular blocks of sandstone on the surface. Also included are small areas of severely eroded soils, some of which are identified by spot symbols on the soil map.

Steep slopes make this unit difficult to manage. Upshur soils are subject to landslides. Runoff is rapid. Use of this unit is further limited by the shallowness of the Gilpin soil over bedrock, and the clayey texture of the Upshur soil. The erosion hazard is very severe if the plant cover is removed.

This mapping unit is mostly wooded. On southern exposures a black oak forest type is dominant. On northern exposures is a mixed forest type of beech, maple, yellow-poplar, black oak, and other upland oaks. A small acreage is pastured. The very steep slopes make pasture management difficult. Capability unit VIe-1; woodland suitability group 3r1.

G1F--Gilpin-Summitville-Upshur complex, 25 to 35 percent slopes, benched. The very steep parts of this mapping unit occur as alternating bands of Gilpin, Summitville, and Upshur soils on hillsides. The sloping to steep parts of the unit are on benches. The benches are less than 150 feet wide and extend around hillsides for distances ranging from ¼ to 1 mile. They are continuous on the upper slopes, but on the lower slopes they are crossed by drainageways. Areas are commonly long and winding and 30 to 200 acres in size.

The benchlike topography is the result of different rates of geologic weathering of the bedrock. Most of the bedrock on the steep breaks is hard, resistant sandstone and siltstone. The benches are underlain mainly by more easily weathered shales.

This unit is about 50 percent Gilpin soil, 20 percent Summitville soil, 20 percent Upshur soil, and 10 percent included soils. The Gilpin soil is very steep. The deep Summitville and clayey Upshur soils are sloping to steep and are dominantly on benches. The profiles of all three soils are more stony than the ones described as representative of the series, and depth to bedrock is more variable. Wet spots and springs, some of which are identified by spot symbols on the soil map, commonly are on benches.

Included with this unit in mapping in some of the larger areas are narrow stream valleys and areas of Hartshorn soils on flood plains. Also included are areas of the very steep sandy Dekalb soils and, on the benches and at the lower edge of most mapping units, small areas of Hayter and Vandalia soils.

The steeper slopes and the many lower benches cut by drainageways severely limit this unit for many uses. Runoff is very rapid. If the plant cover is removed, the erosion hazard is very severe. In addition, Upshur soils are subject to landslides.

The benches are well suited to pasture and also furnish good locations for logging roads. A few of the wider benches are cropped. Much of the acreage is wooded. Southern exposures support a black oak forest type, and northern exposures a mixed forest type of beech, maple, yellow-poplar, black oak, and other upland oaks. Capability unit VIe-2; woodland suitability group 3r1.

G1G--Gilpin-Summitville-Upshur complex, 35 to 70 percent slopes, benched. The very steep parts of this mapping unit occur as alternating bands of the Gilpin, Summitville, and Upshur soils on hillsides. The less steep parts are on benches. The benches are less than 150 feet wide and up to a mile long. They are fairly continuous on the upper slopes, but are dissected by drainageways and have irregular surfaces on the lower slopes. Areas range from 30 to 400 acres in size.

This unit is about 50 percent Gilpin soil, 20 percent Summitville soil, 20 percent Upshur soil, and 10 percent included soils. The deep Summitville and clayey Upshur soils predominate on benches. Their profiles contain more rock fragments than those described for the series.

Included in mapping in the larger areas are strips of Hartshorn soils, on flood plains, that are too narrow to delineate on the soil map. Also included are areas of the steep, stony Gilpin and stony Dekalb soils and areas of soils that are shallow over bedrock; a few sandstone cliffs, the most prominent of which are identified by spot symbols on the soil map; and bands of Vandalia and Hayter soils, mainly on the lower benches and narrow foot slopes. Springs and wet spots are common on the benches. Some are identified by spot symbols on the soil map.

Most areas of this unit are wooded or pastured. The benches are generally too narrow and the intervening slopes are too steep for cultivation. A few of the wider benches are used occasionally for row crops and pasture. Some furnish good locations for logging roads. On northern exposures the benches and coves support good stands of beech, maple, yellow-poplar, black oak, and other upland oaks. Southern exposures have a black oak forest type.

The very steep slopes and the shallowness of the Gilpin soil over bedrock severely limit this mapping unit for most uses. Many benches are cut by the drainageways. Upshur soils are subject to landslides. Runoff is very rapid. If the plant cover is removed, the erosion hazard is very severe. Capability unit VIIe-2; woodland suitability group 3c3.

Glenford Series

The Glenford series consists of deep, moderately well drained, nearly level to gently sloping soils on fairly low stream terraces along the larger streams. These soils formed in water-deposited material.

In a representative profile in a cultivated area the surface layer is brown silt loam 10 inches thick. The subsoil is 30 inches of brown or yellowish-brown silt loam that has a higher clay content than the surface layer and is mottled below a depth of 16 inches. The substratum to a depth of 80 inches is brown loam.

Glenford soils have moderately slow permeability. The root zone is deep, but is restricted by a seasonal high water table. The soils are easily tilled, but tend to be wet later in spring than adjacent better drained soils. The available water capacity is high, and natural fertility is medium.

Most of the acreage is cropped. Corn, small grain, and meadow are commonly grown.

Representative profile of Glenford silt loam, 0 to 2 percent slopes, about 1 mile south of Whipple, 50 feet west of U.S. Highway 21, 1,000 feet north of junction with Township Road 318, Fearing Township, T. 3 N., R. 8 W.

Ap--0 to 10 inches, brown (10YR 4/3) silt loam; strong, fine and medium, granular structure; friable; many roots; many fine pores; slightly acid; abrupt, smooth boundary.

B21t--10 to 16 inches, brown (7.5YR 5/4) silt loam; strong, medium, subangular blocky structure; friable; common fine and medium roots; common medium pores; thin, patchy, brown (7.5YR 5/4) clay films; medium acid; clear, smooth boundary.

B22t--16 to 21 inches, brown (7.5YR 5/4) silt loam; few, fine, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; friable; common roots; common medium pores; thin, patchy, brown (7.5YR 5/4) clay films; medium acid; clear, smooth boundary.

B23t--21 to 29 inches, yellowish-brown (10YR 5/4) silt loam; common, coarse, distinct, light-gray (10YP 7/2) mottles; moderate, fine, subangular blocky structure; friable; few roots; common medium pores; thin, patchy, brown (7.5YR 5/4) clay films; medium acid; abrupt, wavy boundary.

B24t--29 to 40 inches, brown (7.5YR 4/4) silt loam; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; firm; few roots; few medium pores; thick, continuous, light-gray (10YR 7/2) and thin, very patchy, brown (7.5YR 4/4) clay films; medium acid; gradual, smooth boundary.

C--40 to 80 inches, brown (7.5YR 4/4) loam that has thin layers of sand in lower part; massive; friable; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; medium acid.

The solum is 30 to 60 inches thick. The B horizon ranges from medium to strongly acid. Depth to sand or gravel is more than 6 feet. Depth to low chroma mottles ranges from 15 to 20 inches. The Ap horizon has 10YR or 7.5YR hue, value of 3 to 5, and chroma of 2 or 3. If the soil is rubbed, value is greater than 3.5. An undisturbed soil has a 1- to 2-inch, dark-colored A1 horizon. The A2 horizon is 2 to 8 inches thick and has value of 5 or 6 and chroma of 3 or 4 in the 10YR hue. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. The B horizon is dominantly silty clay loam or silt loam, but ranges to light clay loam in the lower part.

Associated with Glenford soils on terraces are the Taggart, Peoga, Mentor, Otwell, and Markland soils.

Glenford soils are better drained than Taggart and Peoga soils. They are not so well drained as Mentor soils and do not have the fragipan typical of Otwell soils. They are coarser textured than Markland soils.

GnA--Glenford silt loam, 0 to 2 percent slopes. This nearly level soil is on fairly low terraces along the Little Muskingum, Muskingum, and Ohio Rivers and along Duck and Wolf Creeks. It has a smooth surface. Areas are both blocky and long and range from 5 to 15 acres in size.

A profile of this soil is described as representative of the series. Included in mapping are spots and narrow bands of somewhat poorly drained Taggart soil in slight depressions and along shallow drainageways. These wet spots often delay tillage in spring.

This soil has good tilth and is easily worked. Runoff is slow, and erosion is not a hazard. Crop yields are reduced somewhat in wet years, but unless high-value crops are grown, installing a complete tiling system is generally not justified. Except for slight wetness, this soil has no limitations for intensive cropping. Seasonal wetness is a limitation for some nonfarm uses. Capability unit I-1; woodland suitability group 1o1.

GnB--Glenford silt loam, 2 to 6 percent slopes. This gently sloping soil is on fairly low terraces along the Little Muskingum, Muskingum, and Ohio Rivers and along Duck and Wolf Creeks. Slopes are smooth and slightly convex. Areas are both blocky and long.

Included with this soil in mapping are narrow bands of the somewhat poorly drained Taggart soils, generally in slight depressions or adjacent to side slopes. The wet spots often delay tillage in spring.

This soil has good tilth, but is slower to dry out in spring than other better drained soils that are nearby. Runoff is medium, and the erosion hazard is moderate in cultivated areas. This soil has few limitations for most nonfarm uses. Capability unit IIe-1; woodland suitability group 1o1.

Hackers Series

The Hackers series consists of deep, well-drained, nearly level to sloping soils that formed in alluvial material. These soils are on alluvial fans or high bottoms along major upland streams.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 5 inches thick. In sequence from the top, the subsoil is 7 inches of dark reddish-brown silt loam, 26 inches of reddish-brown silty clay loam, and 22 inches of dark reddish-brown clay loam. The substratum to a depth of 120 inches is 46 inches of reddish-brown silt loam and 14 inches of dark reddish-brown loam.

Hackers soils have moderate permeability. The root zone is deep, available water capacity is high, and natural fertility is medium. The soils on the lowest terrace level are subject to infrequent flooding. Higher lying areas are above the flood level.

Nearly all the acreage is in permanent pasture and crops. Corn is the most commonly grown crop.

Representative profile of Hackers silt loam, 2 to 6 percent slopes, in the southeast quarter of sec. 15 in Belpre Township, 3/4 mile east of junction of Ohio State Highway 339 on Township Road 289, T. 2 N., R. 10 W.

Ap--0 to 5 inches, dark-brown (7.5YR 3/2) silt loam; brown (7.5YR 5/4) when dry; weak, coarse, subangular blocky structure parting to moderate, fine, granular; friable; many roots; strongly acid; clear, smooth boundary.

B1--5 to 12 inches, dark reddish-brown (5YR 3/4) silt loam; crushes to reddish brown (5YR 4/3); moderate, medium, subangular blocky structure; friable; many roots; strongly acid; abrupt, smooth boundary.

B2t--12 to 38 inches, reddish-brown (2.5YR 4/4) silty clay loam; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; firm; common roots; common fine and medium pores; thin patchy clay films; strongly acid; clear, smooth boundary.

B3--38 to 60 inches, dark reddish-brown (5YR 3/4) clay loam; weak, medium, subangular blocky structure; firm; few roots; few fine pores; thin patchy clay films; many, fine, black concretions; strongly acid; gradual, smooth boundary.

C1--60 to 106 inches, reddish-brown (5YR 4/4) heavy silt loam; massive; friable; medium acid.

C2--106 to 120 inches, dark reddish-brown (2.5YR 3/4) loam; massive; friable; strongly acid.

The solum is 30 to 60 inches thick. Depth to gravel or bedrock ranges from 48 to more than 100 inches. The Ap horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 2 to 4. An undisturbed soil has a dark-colored A1 horizon 1 to 2 inches thick.

The B horizon is clay loam, silty clay, or silt loam in hue of 2.5YR, 5YR, or 7.5YR and value and chroma of 3 or 4. It ranges from strongly acid to slightly acid. The C horizon is silt loam, loam, or sandy loam.

Hackers soils have a more strongly expressed profile than Moshannon soils on nearby flood plains. They are coarser textured than Vandalia soils on adjacent colluvial slopes. They are more reddish than Mentor soils, which are on low terraces.

HcA--Hackers silt loam, 0 to 2 percent slopes. This nearly level soil occupies low terraces and alluvial fans along most of the streams in the county. Areas range from 3 to 100 acres in size and are generally blocky. The surface is even to slightly convex.

Included with this soil in mapping are narrow bands of Moshannon soils along small drainageways, which are subject to flooding. Areas along the Ohio and Muskingum Rivers are underlain by sandy and gravelly glacial outwash.

This soil has good tilth and is easily worked. It is suited to intensive cropping and has no important limitations for most nonfarm uses. Runoff is slow, and erosion is not a hazard. Flooding is a hazard. Capability unit I-1; woodland suitability group 2o1.

HcB--Hackers silt loam, 2 to 6 percent slopes. This gently sloping soil is on low terraces and alluvial fans. Areas range from 3 to 60 acres in size and are generally blocky. Slopes are even to slightly convex. A profile of this soil was described as representative of the series.

Included with this soil in mapping are small areas of Moshannon soils on narrow flood plains and spots of gravelly soils. The included gravelly soils along the Ohio and Muskingum Rivers contain glacial outwash material.

Runoff is medium, and the erosion hazard is moderate in cultivated areas. The limitations for some nonfarm uses are slight to moderate. The lower parts of some areas are subject to infrequent floods. Along the smaller streams, this soil is often used for farmsteads and home sites.

This soil is used mostly for crops. It is suited to general farm crops and truck crops. In very narrow stream valleys, it is used mostly for pasture. Capability unit IIe-1; woodland suitability group 2o1.

HcC--Hackers silt loam, 6 to 12 percent slopes. This sloping soil is on low terraces and alluvial fans along streams. Areas range from 5 to 25 acres in size. The smaller areas are fan shaped. The larger areas are commonly long and narrow. Slopes are short and even to slightly convex. Included in mapping are a few small areas of gravelly soils, which are more droughty than the Hackers soils.

Runoff is rapid, and the erosion hazard is severe in cultivated areas. Maintaining good tilth is difficult if the soil is cultivated intensively. Slope is the main limitation for nonfarm use. Capability unit IIIe-1; woodland suitability group 2o1.

Hartshorn Series

The Hartshorn series consists of well-drained, nearly level soils on flood plains. These soils have a shallow to moderately deep root zone over loose sand or gravel. They occur on narrow flood plains along small streams throughout the county.

In a representative profile in a cultivated area the surface layer is dark-brown silt loam 8 inches thick. The subsoil is 11 inches of dark yellowish-brown silt loam. Below the subsoil is dark yellowish-brown very gravelly sandy loam that grades to loose sand and gravel below a depth of 24 inches. Siltstone bedrock is at a depth of 48 inches.

Permeability is moderately rapid. The available water capacity is moderate to low, depending on the depth to loose sand and gravel. The root zone is mostly moderately deep, and natural fertility is medium.

Hartshorn soils are used mainly for pasture and hay. Many of the broader areas are used for corn and small grain.

Representative profile of Hartshorn silt loam, 200 feet east of vacant house on Township Road 86, 3/4 mile northwest of U.S. Highway 21, southeast corner of sec. 32, Aurelius Township:

Ap--0 to 8 inches, dark-brown (10YR 3/3) silt loam; brown (10YR 4/3) when crushed; strong, medium, granular structure; firm; many roots; 5 percent small pebbles; slightly acid; abrupt, smooth boundary.

B--8 to 19 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky structure; firm; common roots; 5 percent small pebbles; slightly acid; abrupt, wavy boundary.

IIC1--19 to 24 inches, dark yellowish-brown (10YR 4/4) very gravelly sandy loam; single grained; friable; slightly acid; clear, smooth boundary.

IIC2--24 to 48 inches, poorly sorted loose sand and gravel; single grained; very friable; 65 percent siltstone fragments; slightly acid; clear, wavy boundary.

IIIR--48 inches, siltstone bedrock.

The solum is 15 to 30 inches thick. It ranges from medium acid to neutral unless limed. Depth to loose sand and gravel ranges from 16 to 30 inches. Depth to bedrock ranges from 3½ to 6 feet. Coarse fragments make up 5 to 30 percent of the upper 30 inches. The Ap horizon has hue of 10YR and 7.5YR, value of 3 or 4, and chroma of 2 or 3. When the soil is rubbed, value is higher than 3.5. An undisturbed soil has a dark A1 horizon, 1 inch to 2 inches thick, having value of 4 or 5 and chroma of 3 or 4 in 10YR hue. The B horizon is gravelly or nongravelly silt loam or loam that has hue of 10YR or 7.5YR and value and chroma of 3 or 4.

Hartshorn soils are not so red as Moshannon soils. They are shallower over sand and gravel and bedrock than Chagrin, Nolin, and Moshannon soils, which are on flood plains.

He--Hartshorn silt loam. This nearly level soil is in long narrow areas of bottom land, mainly in the upper parts of drainage basins. The surface is typically smooth, but some areas contain abandoned stream channels and gently sloping alluvial fans. Most areas of this soil range from 5 to 80 acres in size.

Included with this soil in mapping are a few small areas of poorly drained soils, commonly in narrow bands along the edge of the flood plain or in depressions. Also included are a few small gently sloping areas on alluvial fans below hillside drainageways. These alluvial fans contain more gravel in the upper soil layers and have a less severe hazard of flooding.

Many narrow areas are cut by the meandering stream. The coarse-textured substratum limits root growth and the available water capacity. This soil is subject to frequent flooding. Floodwater is swift and erosive and can result in severe damage, which limits the nonfarm use of this soil.

Much of the acreage is an isolated, steep, forested area that has potential for recreational use. Capability unit IIw-2; woodland suitability group 1o2.

Hayter Series

The Hayter series consists of deep, well-drained, gently sloping to very steep soils formed in colluvial material. These soils are on foot slopes mainly below long, very steep hillsides.

In a representative profile in a wooded area, the surface layer is dark-brown loam about 2 inches thick. The subsurface layer is brown loam 8 inches thick. The subsoil extends to a depth of 55 inches. It is brown and is more clayey than the surface layer. The upper 14 inches of the subsoil is loam, the next 28 inches is clay loam, and the lower 3 inches is channery clay loam. The substratum to a

depth of 80 inches is brown very stony loam that is 90 percent sandstone fragments.

Hayter soils have medium to rapid runoff, depending on the slope. Permeability is moderately rapid. The available water capacity is moderate, the root zone is deep, and natural fertility is medium.

Most of the acreage is woodland, the rest is mainly pasture. Some of the less steep areas are cropped.

Representative profile of Hayter loam, 18 to 25 percent slopes, in woodland, SW¼SE¼SW¼ sec. 1, Fairfield Township, T. 7 N., R. 11 W., along Township Road 53, 0.5 mile east of junction with Township Road 239, 100 feet north of the road:

A1--0 to 2 inches, dark-brown (10YR 4/3) loam; strong, very fine, granular structure; very friable; many roots; 5 percent sandstone fragments; strongly acid; abrupt, wavy boundary.

A2--2 to 10 inches, brown (7.5YR 4/4) loam; weak, very fine, granular structure; friable; many roots; 5 percent sandstone fragments; strongly acid; clear, smooth boundary.

B1--10 to 16 inches, brown (7.5YR 4/4) loam; weak, medium, subangular blocky structure; friable; many roots; common fine to coarse pores; 5 percent sandstone fragments; strongly acid; abrupt, wavy boundary.

B21t--16 to 24 inches, brown (7.5YR 5/4) heavy loam; weak, medium, angular and subangular blocky structure; firm; common roots; common fine and medium pores; thin, patchy, brown (7.5YR 4/4) clay films; 10 percent sandstone fragments; strongly acid; clear, smooth boundary.

B22t--24 to 52 inches, brown (7.5YR 4/4) clay loam; moderate, medium, angular blocky structure; firm; few roots; few fine pores; thin, patchy, brown (7.5YR 4/4) clay films; 10 percent sandstone fragments; strongly acid; gradual boundary.

B3t--52 to 55 inches, brown (7.5YR 4/4) channery clay loam; weak, medium, subangular blocky structure; firm; few roots; few fine pores; thin, very patchy, brown (7.5YR 4/4) clay films; 30 percent sandstone fragments; strongly acid; clear, wavy boundary.

C--55 to 80 inches, brown (7.5YR 4/4) very stony heavy loam; massive; friable; few roots; 90 percent sandstone fragments; strongly acid.

The solum is 40 to 60 inches thick. Depth to bedrock ranges from 7 to more than 10 feet. Content of coarse fragments ranges from 5 to 30 percent. Unless limed, the soil is strongly to medium acid throughout. The Ap horizon has 10YR hue, value of 4 and 5, and chroma of 3 or 4. In wooded areas the A1 horizon has value of 3 or 4 and chroma of 2 or 3. The 4- to 10-inch A2 horizon has value of 4 or 5 and chroma of 3 or 4.

The B and C horizons have hue of 10YR or 7.5YR. The B1 horizon, which occurs in some places, is loam, heavy sandy clay loam, or clay loam that has value of 4 or 5 and chroma of 4 to 6. The B2t horizon is clay loam, sandy clay loam, and loam having value of 4 or 5 and chroma of 4 to 8. Reddish, brownish, or yellowish mottles occur in places. In most places the C horizon is channery, stony, or bouldery loamy soil material.

Hayter soils are coarser textured than Brookside and Vandalia soils, which are other soils formed in colluvial material. They are deeper over bedrock than Summitville soils, which are on the nearby uplands. They do not have the reddish colors typical of Vandalia and Summitville soils.

HgB--Hayter loam, 2 to 6 percent slopes. This gently sloping soil is on foot slopes and alluvial fans in narrow valleys. The foot slopes are commonly convex at the lower edge and concave next to the hillsides. The alluvial fans have smooth, even slopes that are cut by a small drainageway. Individual areas range from about 5 to 60 acres in size. They are generally long and narrow, but a few are blocky. Included in mapping on alluvial fans, are small areas of Hartshorn soils, which are subject to flooding.

The erosion hazard is moderate in cultivated areas. Tilth is good, and runoff is medium. The hazard of flash flooding is the main limitation for farm and nonfarm uses. This soil provides many homesites because it is near roads. The many remote, confined locations preclude its use for all nonfarm purposes but recreational use.

This soil is used for crops and pasture and provides sites for farm buildings. Capability unit IIe-1; woodland suitability group 2o1.

HgC--Hayter loam, 6 to 12 percent slopes. This sloping soil is on foot slopes along valley walls. Slopes are smooth or slightly uneven and are cut every few hundred feet by shallow drainageways. Areas are mainly long and narrow and range from about 5 to 25 acres in size. Included in mapping are a few small areas of the clayey Brookside and Vandalia soils, which have slower permeability.

The erosion hazard is severe in cultivated areas. Tilth is good, and runoff is medium. Slope is a moderate limitation for many nonfarm purposes. Many houses are built on this soil because it is near roads and above flood levels in valleys where surrounding soils are steep.

This soil is used for crops, woodland, and pasture. Capability unit IIIe-2; woodland suitability group 2o1.

HgD--Hayter loam, 12 to 18 percent slopes. This moderately steep soil occupies foot slopes below very steep hillsides. A few areas are on lower benches separated from flood plains by steeper slopes. Slopes are mostly irregular,

and many are cut by small drainageways. Areas are generally long or oblong and range from about 5 to 25 acres in size.

Included with this soil in mapping are narrow, steeper bands of the shallower Dekalb and Gilpin soils. Also included are small areas of the clayey Brookside and Vandalia soils, which are unstable and subject to landslides. There are large flagstones and stones on the surface in some places.

The erosion hazard is severe in cultivated areas. Tilth is good, and runoff is rapid. The moderately steep slopes are a severe limitation for many nonfarm uses.

This soil is used for pasture and crops. Capability unit IVe-1; woodland suitability group 2r1.

HgE--Hayter loam, 18 to 25 percent slopes. This steep soil is on foot slopes below very steep valley walls. Slopes are irregular and are cut by drainageways every few hundred feet. Areas are mostly long and winding and range from 5 to 30 acres in size. A profile of this soil was described as representative of the series.

Included with this soil in mapping are a few narrow bands of shallower, very steep soils. Also included are a few small areas of somewhat poorly drained soils below springs and seep spots.

Runoff is very rapid. The erosion hazard is severe in cultivated areas. Steep slopes are a severe limitation for most nonfarm uses.

Most of the acreage is woodland. Wooded areas are predominantly yellow-poplar, ash, and beech and scattered black oak and white oak. Capability unit IVe-2; woodland suitability group 2r1.

HgF--Hayter loam, 25 to 35 percent slopes. This very steep soil is on the foot slopes of long hillsides. Some areas are along both sides of small streams in narrow valleys. The upper slopes are generally concave and the lower slopes are convex. All are cut by drainageways or deep ravines every few hundred feet. Areas range from about 10 to 30 acres in size. Most are long, narrow, and winding, following the valley walls. The profile of this soil has more sand and coarse fragments than the one described as representative of the series. The fragments make the soil more difficult to manage. Included in mapping are small areas of the clayey Vandalia and Brookside soils.

Runoff is very rapid, and the erosion hazard is very severe in cultivated areas. The deep ravines cutting through this soil limit the construction of logging roads. The very steep slopes severely limit all farm and nonfarm uses. The included Vandalia and Brookside soils are subject to landslides. Wooded areas are predominantly yellow-poplar, ash, and beech, and scattered black oak and white oak.

Most of the acreage is wooded. A small part is pastured. Capability unit VIe-1; woodland suitability group 2r1.

HhE--Hayter very stony soils, 18 to 30 percent slopes. These steep to very steep soils are mainly on foot slopes along valley walls. A few areas are on benches in midslope positions. Slopes are irregular, ranging from concave in center positions to convex near ravines and on interfluves. The surface is littered with stones and large boulders. There are drainageways and deep ravines every few hundred feet. Areas are mostly long and narrow along valley walls and broad on the lower parts of ravines. They range from about 5 to 60 acres in size.

A profile of these soils contains more stones and boulders and is slightly coarser textured than the one described as representative of the series. In places, there are bedrock outcrops and sandstone cliffs. The surface layer ranges from loam to sandy loam.

Runoff is rapid, and the erosion hazard is very severe if the plant cover is removed. These soils are too steep and bouldery for most nonfarm uses. Wooded areas are predominantly yellow-poplar, ash, and beech and scattered black oak and white oak.

The acreage is used for woodland and recreational purposes. Capability unit VIIs-1; woodland suitability group 2x1.

HkE--Hayter-Vandalia channery loams, 12 to 25 percent slopes. This moderately steep to steep mapping unit is on colluvial benches on foot slopes and on benches or in coves in hillsides. It is about 25 percent Hayter soil; 25 percent Vandalia soil; 25 percent a soil similar to Hayter soil, but underlain by red clay; and 25 percent included soils. The Hayter and Vandalia soils occur in such intricate, irregular patterns that it is not practical to map or manage them separately. The surface is generally hummocky, and most areas are cut by small drainageways. Areas are mainly long, narrow, and winding, but in some coves they are wide and blocky. They range from about 5 to 100 acres in size.

Included with these soils in mapping are areas of Gilpin and Upshur soils and spots of poorly drained soils. The shallower Gilpin and Upshur soils are generally near drainageways or on the lower part of hillside benches near slope breaks. The more poorly drained soils are in small concave areas or near seep spots.

In general, the Hayter soil is in the upper part of the mapped areas, and the Vandalia soil is in the lower part. In some areas the Hayter soil is redder than is typical. Both the Hayter and Vandalia soils have more rock fragments in their profiles than is typical.

Runoff is rapid, and the erosion hazard is very severe in cultivated areas. The Vandalia soil is subject to landslides. Nonfarm use is limited because slopes are unstable and steep.

This mapping unit is used mainly for pasture and woodland. Stones sometimes limit pasture management. Many areas in scenic wooded spots near cliffs and rocky slopes have potential for

recreational use. Capability unit IVe-2; woodland suitability group 2r1.

HkF--Hayter-Vandalia stony complex, 25 to 50 percent slopes. This very steep mapping unit is on foot slopes along the base of valley walls, in coves, and in narrow valleys choked by colluvial fill. It is about 25 percent Hayter soil; 25 percent Vandalia soil; 25 percent a soil similar to Hayter soil, but underlain by red clay; and 25 percent included soils. Hayter and Vandalia stony soils occur in such intricate patterns that it is not practical to map or manage them separately. The surface is irregular and hummocky. Areas range from about 10 to 60 acres in size. They are long and narrow along valley walls and blocky in coves near heads of drainageways. Slopes are commonly concave on the uphill side and convex on the downhill side and are cut by drainageways and ravines. The profiles of Hayter and Vandalia soils contain more stones than the ones described as representative of their series.

Included with these soils in mapping are areas of Gilpin, Upshur, and Hartshorn soils and small areas of rock outcrop and bouldery soils. The shallower Gilpin and Upshur soils are mainly on steeper narrow bands and near drainageways. The Hartshorn soil is on very narrow flood plains that are too narrow to delineate on the soil map.

Stones and the very steep slopes limit the use of the soils for farming and nonfarm uses. Also, landslides are a hazard. Timber harvesting machinery can be used in most areas.

This mapping unit is used mainly for woodland and some recreation. Wooded areas are predominantly yellow-poplar, ash, beech, sugar maple, and oak. Capability unit VIIs-1; woodland suitability group 2x1.

Huntington Series

The Huntington series consists of deep, dark-colored, nearly level soils that are medium textured and well drained. These soils are mainly on flood plains along the Ohio River.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 16 inches thick. The subsoil is brown silt loam that extends to a depth of 60 inches. The substratum to a depth of 84 inches is dark yellowish-brown silt loam.

These soils have moderate permeability and a high available water capacity. Natural fertility is high, and nutrients are readily available. The root zone is deep. The soils are subject to flooding, which limits certain kinds of farming and most nonfarm uses. Most of the acreage is used for row crops and small grain. Corn is the main crop. Some areas are under urban and industrial development. Extensive areas are used for highways and railroads.

Representative profile of Huntington silt loam in an alfalfa meadow in NE¼NE¼NE¼ sec. 36, Newport Township, T. 2 N., R. 7 W.; 500 feet southwest of house, 200 feet north of the Ohio River:

Ap--0 to 8 inches, dark-brown (10YR 3/3) silt loam; weak, fine and medium, granular structure in upper part, weak, fine and medium, subangular blocky structure in lower part; friable; many roots; slightly acid; abrupt, smooth boundary.

A1--8 to 16 inches, dark-brown (10YR 3/3) silt loam; weak, medium, subangular blocky structure; friable; many roots; slightly acid; clear, smooth boundary.

B21--16 to 27 inches, brown (10YR 4/3) silt loam; weak to moderate, medium, subangular blocky structure; friable; common roots; common fine and medium pores; slightly acid; clear, smooth boundary.

B22--27 to 36 inches, brown (10YR 4/3) silt loam; common, fine, faint, brown (10YR 5/3) mottles; weak to moderate, medium, subangular blocky structure; friable; common roots; common fine and medium pores; slightly acid; clear, wavy boundary.

B23--36 to 60 inches, brown (10YR 4/3) heavy silt loam; weak to moderate, medium, subangular blocky structure; friable; few roots; common fine and medium pores; slightly acid; gradual, wavy boundary.

C--60 to 84 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; common, medium, faint, light brownish-gray (10YR 6/2) mottles; weak, fine and medium, angular blocky structure; friable; few fine pores; slightly acid.

The solum is 40 to 65 inches thick. Reaction ranges from medium acid to mildly alkaline. The A1 or Ap horizon has 10YR or 7.5YR hue, value of 2 or 3, and chroma of 1 to 3. The B horizon has 10YR and 7.5YR hue, value of 4 or 5, and chroma of 3 or 4. It is silt loam or light silty clay loam. The C horizon is similar in color to the B horizon, but ranges from silt loam to sandy loam.

Similar soils on flood plains and low terraces are Ashton, Chagrin, Nolin, and Newark soils. Huntington soils have a thicker, darker surface layer than Nolin soils and are better drained than Newark soils. They contain less sand and have a darker A horizon than Chagrin soils. They have a less distinct profile than Ashton soils on low terraces.

Hu--Huntington silt loam. This nearly level soil is on undulating bottom land mainly along the Ohio River. Areas tend to be blocky or oblong and range from about 25 to 200 acres in size.

Included with this soil in mapping are small areas of loamy soils. In small depressions or in narrow bands along the edge of the mapped areas are small spots of poorly drained Newark soils. Newark soils require tile drainage if they are used for crops.

The lower areas of this soil are subject to frequent flooding and scouring. Runoff is slow. Erosion is not a hazard. Flooding is the main limitation for nonfarm uses. Capability unit IIw-2; woodland suitability group 1o2.

Keene Series

The Keene series consists of deep, gently sloping or sloping soils that are moderately well drained. The surface layer and the upper part of the subsoil formed in silty material. The clayey lower part of the subsoil formed in material weathered from acid shale and siltstone. These soils are on ridgetops and benches on hillsides.

In a representative profile in a pastured area, the surface layer is brown silt loam about 6 inches thick. It is underlain by 3 inches of pale-brown silt loam. The subsoil extends to a depth of 51 inches. The upper 13 inches is strong-brown silt loam and silty clay loam. The lower 29 inches is brown, strong-brown, and yellowish-brown silty clay loam, silty clay, and clay that is mottled with gray, yellowish red, reddish brown, and light gray. The substratum is dark yellowish-brown channery silty clay. Light olive-brown siltstone is at a depth of 54 inches.

Permeability is moderate in the upper part of the subsoil, but slow in the clayey lower part. Keene soils have a moderately deep root zone and moderate available water capacity above the clayey layers in the lower part of the subsoil. In wet periods, the water table is perched above these clayey layers. Deep-rooted legumes, such as alfalfa, are subject to frost heaving. The natural fertility is low.

Most of the acreage is cropped or pastured. Some areas in idle, brushy fields are reverting to forest.

Representative profile of Keene silt loam, 6 to 12 percent slopes, in a pasture, sec. 33, Wesley Township, T. 7 N., R. 11 W., 900 feet north of junction of Township Road 5 on Ohio State Highway 555, 300 feet northeast of road (see profile WS-15 under "Laboratory Data"):

Ap--0 to 6 inches, brown (10YR 4/3) silt loam; weak, thick, platy structure parting to weak, fine, subangular blocky; friable; many roots; strongly acid; abrupt, wavy boundary.

A2--6 to 9 inches, pale-brown (10YR 6/3) silt loam; weak, medium, subangular blocky structure; friable; many roots; common fine pores; very strongly acid; abrupt, wavy boundary.

B21t--9 to 15 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable; common roots; many fine pores; thin, patchy, brown (7.5YR 5/4) clay films; strongly acid; clear, smooth boundary.

B22t--15 to 22 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, angular and subangular blocky structure; friable; common roots; many fine pores; thin, continuous, brown (7.5YR 5/4) clay films; strongly acid; clear, wavy boundary.

IIB23t--22 to 29 inches, brown (7.5YR 5/4) silty clay loam; common, fine, distinct, gray (10YR 5/1) and yellowish-red (5YR 4/6) mottles; moderate, medium, angular blocky structure; firm; common roots; many fine pores; medium, continuous, brown (7.5YR 4/4) clay films; very strongly acid; abrupt, smooth boundary.

IIB24t--29 to 37 inches, brown (7.5YR 4/4) silty clay; common, fine, distinct, gray (10YR 5/1) and reddish-brown (5YR 4/4) mottles; weak, coarse, subangular blocky structure; firm, slightly sticky; few roots; common fine pores; thin, patchy, brown (7.5YR 4/4) clay films; very strongly acid; gradual, smooth boundary.

IIB25t--37 to 46 inches, strong-brown (7.5YR 5/6) clay; common, coarse, distinct, light-gray (N 7/0) mottles; weak, coarse, angular blocky structure; firm, slightly sticky; few roots; common fine pores; thin, patchy, brown (7.5YR 5/4) clay films; very strongly acid; clear, smooth boundary.

IIB3t--46 to 51 inches, yellowish-brown (10YR 5/6) silty clay; few, fine, distinct, light-gray (N 7/0) mottles; weak, medium, angular blocky structure; firm, slightly sticky; few roots; thin, patchy, brown (10YR 5/3) clay films; 5 percent siltstone fragments; very strongly acid; gradual boundary.

IIC--51 to 54 inches, dark yellowish-brown (10YR 4/4) channery silty clay; massive; 30 percent siltstone fragments; very strongly acid.

IIR--54 inches, light olive-brown (2.5Y 5/4) siltstone bedrock.

The solum is 30 to 60 inches thick. The lower part of the solum is 5 to 30 percent coarse fragments, but the upper part contains few or none. Depth to bedrock ranges from 40 to 72 inches. Unless limed, the solum is strongly acid to very strongly acid, and the C horizon is very strongly acid to slightly acid. The Ap horizon ranges from dark brown (10YR 4/3) to grayish brown (10YR 5/2). A dark-colored A1 horizon 1 to 2 inches thick and an A2 horizon 3 to 8 inches thick occur in places. The A2 horizon has 10YR hue, value of 4 to 6, and chroma of 2 to 4.

The B1 horizon, which occurs in some areas, and the upper B2t horizon are heavy silt loam or silty clay loam. Hue is 7.5YR or 10YR, value is 4 or 5, and chroma is 4 to 6. The

lower B2t horizon is clay through heavy silty clay loam. It has matrix colors in hue of 2.5Y to 7.5YR and value and chroma of 4 to 6. The C horizon is dominantly silty clay loam, clay loam, or silty clay.

Keene soils are in positions similar to those of Woodsfield and Upshur soils. Also nearby are Zanesville and Lowell soils. Keene soils do not have the reddish colors typical of Upshur and Woodsfield soils. In contrast with Zanesville soils, they are finer textured in the lower part of the solum and do not have a fragipan. They contain less clay in the upper part of the solum than Lowell soils.

KeB--Keene silt loam, 2 to 6 percent slopes. This gently sloping soil is on ridgetops that are gently rounded and grade to nearly level near the center. Most areas range from about 3 to 40 acres in size.

Included with this soil in mapping on some of the broader ridgetops are spots of somewhat poorly drained soils at the center and sloping soils along the edge. The wet spots in the center delay plowing in spring. The narrow bands of sloping soils at the edge are subject to a more serious erosion hazard.

The smooth, uniform slopes are well suited to the use of most kinds of farm machinery. Runoff is medium, and the erosion hazard is moderate in cultivated areas. Slow permeability and the clayey subsoil are limitations for some nonfarm uses. Capability unit IIe-3; woodland suitability group 2w2.

KeC--Keene silt loam, 6 to 12 percent slopes. This sloping soil is in saddles and on rounded ridgetops and hillside benches. Slopes are typically convex. They are dissected by a few shallow drainageways at the outer edges of the mapped areas. Areas are mainly long and winding and range from about 3 to 25 acres in size. Some are oval. Slopes are 100 to 200 feet long. A profile of this soil is the one described as representative of the series.

Included in mapping are small areas of shallower soils that in most places are more severely eroded and are clayey within a depth of 6 to 18 inches. These soils are commonly near ridge crests or along the outer edge of ridgetops and benches near slope breaks. Some areas on benches have spots of more poorly drained soils below seep spots.

In cultivated areas, runoff is rapid and the erosion hazard is severe. Many areas are too small or narrow to be managed separately for farming and are managed with the surrounding soils. Slow permeability and slope are severe limitations for some nonfarm uses. Capability unit IIIe-6; woodland suitability group 2w2.

Lakin Series

The Lakin series consists of deep, sandy, well-drained soils. These gently sloping to steep soils are on low, hummocky and undulating terraces and on rounded hills. They formed in thick deposits of sandy wind-deposited material.

In a representative profile in a wooded area that was formerly cultivated, the surface layer is brown loamy fine sand 7 inches thick. The subsoil is yellowish brown to a depth of 50 inches. The upper 15 inches is loamy fine sand, and the lower 28 inches is loamy fine sand and bands of fine sandy loam. The substratum to a depth of 60 inches is yellowish-brown loamy fine sand.

Lakin soils are rapidly permeable. They have a low available water capacity, a deep root zone, and low natural fertility.

These soils are mostly near Reno and Newport on west-facing sites that are east of segments of the Ohio River Valley.

Lakin soils are used for nursery and special crops and for woodland. They support excellent stands of yellow-poplar.

Representative profile of Lakin loamy fine sand, in an area of Duncannon-Lakin complex, 12 to 18 percent slopes, in a forested but formerly cultivated area near the crests of a hillside about 75 yards south of the honor camp, just east of Marietta State Forest Nursery, NE¼NE¼SE¼ sec. 8, Marietta Township, T. 2 N., R. 8 W.

Ap--0 to 7 inches, brown (10YR 4/3) loamy fine sand; weak, fine, granular structure; very friable; many roots; very strongly acid; abrupt, irregular boundary.

B1--7 to 22 inches, yellowish-brown (10YR 5/4) loamy fine sand; weak, fine, subangular blocky structure; very friable; common roots; strongly acid; gradual, smooth boundary.

C&B2t--22 to 50 inches, yellowish-brown (10YR 5/4) loamy fine sand and brown (7.5YR 4/4) fine sandy loam bands about ½-inch thick; total thickness of bands is 3½ inches; single grained; very friable when moist, loose when dry; few roots; medium acid; gradual, smooth boundary.

C--50 to 60 inches, yellowish-brown (10YR 5/4) loamy fine sand; single grained; loose; slightly acid.

The solum is 40 to 60 inches thick. Unless limed, it ranges from very strongly acid to medium acid. Depth to bedrock is ordinarily more than 6 feet, but in places is more than 20 feet. In places the soil contains a few small pebbles.

The Ap horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/4). An undisturbed

soil has a 1- to 4-inch dark-colored A1 horizon. The A2 horizon, which occurs in places and is 6 to 10 inches thick, has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The B1 horizon has 10YR or 7.5YR hue and ranges from 4 to 6 in value and 3 to 6 in chroma. The 1- to 5-inch bands in the B2t and C horizons are 3 or 4 in value and 4 to 6 in chroma. The B2t horizon ranges from sand or loamy fine sand in the matrix to sandy loam in the bands. The C horizon ranges from sand to loamy fine sand and is slightly acid or medium acid. Colors are yellowish brown (10YR 5/4) or pale brown (10YR 5/3).

Lakin soils have a lighter colored A horizon than the nearby Sparta soils. They contain more sand than Duncannon soils, which occur with the steeper Lakin soils.

LbC--Lakin loamy fine sand, 3 to 12 percent slopes. This gently sloping to sloping soil is on low terraces. Areas are uneven and slightly hummocky and range from 30 to 60 acres in size. Included in mapping are spots in which soil blowing has been so severe that productivity is low.

If this soil is cultivated, the erosion hazard is severe. Drought and soil blowing are also hazards. The moderate slope and rapid permeability are limiting factors for many nonfarm uses.

This soil is used for truck crops and nursery crops and for urban development. Capability unit IIIs-1; woodland suitability group 3s1.

LbD--Lakin loamy fine sand, 12 to 18 percent slopes. This moderately steep soil is on the tops and sides of knolls along the river valleys. Slopes are irregular. The upper slopes are cut by small ravines. Areas tend to be blocky but irregular in shape and range from about 3 to 25 acres in size. Included in mapping are small areas of the finer textured Duncannon soils.

The erosion hazard is very severe and runoff is medium to rapid if vegetation is removed. Soil blowing is a hazard. Moderately steep slopes are the main limitation for nonfarm uses.

This soil is used mainly for pasture and woodland. Capability unit IVe-1; woodland suitability group 3s1.

Licking Series

The Licking series consists of deep, moderately well drained, gently sloping to moderately steep soils formed in water-deposited material. These soils are on terraces mainly in the western parts of the county.

In a representative profile in a cultivated area, the surface layer is brown silt loam 8 inches thick. It is underlain by 4 inches of yellowish-brown silt loam. The subsoil extends to a depth of 60 inches. The upper 9 inches is yellowish-brown silty clay loam. The lower 39 inches is dark yellowish-brown silty clay and silty clay loam that is weakly laminated and has grayish-brown mottles. The substratum to a depth of 76 inches is dark yellowish-brown, laminated channery silty clay loam.

Permeability is slow in the lower part of the subsoil, and the water table is perched for several days during wet periods. The root zone is moderately deep, the available water capacity is moderate, and natural fertility is medium.

Most of the acreage is used for grain crops, hay, and pasture.

Representative profile of Licking silt loam, 2 to 6 percent slopes, 2½ miles south of Waterford, 250 feet east of Ohio State Highway 339, 100 feet north of farmhouse, Waterford Township (see profile WS-2 under "Laboratory Data"):

Ap--0 to 8 inches, brown (10YR 4/3) silt loam; weak, coarse, subangular blocky structure parting to weak, fine and medium, granular; friable; common roots; neutral; abrupt, smooth boundary.

B&A--8 to 12 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium and fine, subangular blocky structure; friable; common roots; common medium and fine pores; patchy, pale-brown (10YR 6/3) silty ped surfaces; slightly acid; clear, smooth boundary.

B21t--12 to 21 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, angular blocky structure; firm, slightly sticky; common roots; thin, patchy, brown (7.5YR 5/4) clay films; very strongly acid; clear, smooth boundary.

IIB22t--21 to 42 inches, dark yellowish-brown (10YR 4/4) silty clay; many, fine and medium, distinct grayish-brown (2.5Y 5/2) mottles; weak, coarse, prismatic and moderate, coarse, subangular blocky structure parting to strong, medium, angular blocky; firm, sticky; common roots; common fine to medium pores; medium, patchy, yellowish-brown (10YR 5/4) clay films; few, fine, black concretions; very strongly acid; clear, smooth boundary.

IIB31--42 to 51 inches, laminated dark yellowish-brown (10YR 4/4) silty clay loam that has thin layers of brown (7.5YR 4/4) sandy loam; common, fine, distinct, grayish-brown (2.5Y 5/2) mottles; moderate, medium and thin, platy structure (laminated); friable; common fine pores in sandy layers; medium, continuous, brown (10YR 5/3) clay films in pores and in laminae; very strongly acid; gradual boundary.

IIB32--51 to 60 inches, dark yellowish-brown (10YR 4/4) laminated silty clay that has medium, patchy, brown (10YR 5/3) clay films on laminae; neutral; abrupt, smooth boundary.

IIC--60 to 76 inches, dark yellowish-brown (10YR 4/4) channery silty clay loam; laminated lacustrine material mixed with fragments of local bedrock; neutral.

The solum is 40 to 70 inches thick. Unless limed, it ranges from very strongly acid to medium acid in the upper part to neutral or mildly alkaline in the lower part. Depth to neutral or mildly alkaline material ranges from 40 to 60 inches. An undisturbed soil has a 1- to 2-inch dark-colored A1 horizon. The A2 horizon has value of 4 to 6 and chroma of 3 or 4 in the 10YR hue. Hue in the B horizon is 7.5YR or 10YR, value is 4 or 5, and chroma is 4 to 6. Texture is clay, silty clay, or silty clay loam. The C horizon has 10YR or 7.5YR hue, value of 4 or 5, and chroma of 3 or 4. Texture is mainly heavy silty clay loam to clay and in some areas is channery.

Licking soils occur on the same landscape as Vincent and Otwell soils. They are finer textured than Otwell soils and do not have the fragipan typical of those soils. They have less red colors than Vincent soils. They differ from Markland soils, which are on lower lying terraces, in not having carbonates within a depth of 2 to 3 feet. They are better drained than McGary soils, which also are on lower lying terraces.

LcB--Licking silt loam, 2 to 6 percent slopes. This gently sloping soil is on remnants of high terraces. It occupies wide benches and ridgetops. It is slightly hummocky to undulating. Areas are long and range from about 5 to 25 acres in size. A profile of this soil is the one described as representative of the series.

Included with this soil in mapping are spots of somewhat poorly drained soils, commonly near the center of the larger areas, that require artificial drainage if they are to be cropped. Also included around the edge of this soil, near slope breaks, are narrow bands of severely eroded soils.

Runoff is medium and the erosion hazard is moderate in cultivated areas. Slow permeability and clayey texture are the main limitations for nonfarm uses.

This soil is mostly used for crops. Capability unit IIe-3; woodland suitability group 2c1.

LcC--Licking silt loam, 6 to 12 percent slopes. This sloping soil is on high terraces, mainly on wide benches and ridgetops. It is cut by shallow drainageways along the outer edges, but these channels do not seriously interfere with tillage. Areas are irregular and blocky in shape and range from about 3 to 80 acres in size. A profile of this soil commonly has a thinner surface layer and subsoil than the one described as representative of the series.

Included with this soil in mapping are small areas of Markland soils, which are mostly near slope breaks. Also included near the center of larger areas of this soil, in saddles and at the upper edge of benches, is 3 to 4 feet of medium-textured material overlying the clay; and near the crest of ridges and interfluves and near slope breaks are spots or bands of moderately eroded soils that have a surface layer of light or reddish silty clay loam that is hard to till and hard to protect against further erosion.

Runoff is rapid and the erosion hazard is severe if this soil is cultivated. The clayey subsoil and slow permeability are limitations for many nonfarm uses.

This soil is used for crops and pasture. Capability unit IIIe-6; woodland suitability group 2c1.

LcD--Licking silt loam, 12 to 18 percent slopes. This moderately steep soil is on remnants of high terraces, mainly on rounded knolls and ridgetops and on side slopes below the more gently sloping Licking soils. Areas are long and blocky in shape and range from about 5 to 30 acres in size. A profile of this soil has a thinner, finer textured surface layer than the one described for the series. Depth to the substratum is about 12 inches less than is typical.

Included with this soil in mapping are areas of Markland and Allegheny soils and spots of moderately or severely eroded soils, which have a lighter colored and finer textured surface layer and are more difficult to till.

Runoff is very rapid and the erosion hazard is very severe in cultivated areas. The moderately steep slopes and slow permeability are limitations for nonfarm uses.

This soil is used for pasture and crops. Capability unit IVe-5; woodland suitability group 2c2.

Lowell Series

The Lowell series consists of deep, well-drained, sloping to very steep soils formed in material weathered from layers of limestone, siltstone, and shale on uplands. These soils are on ridgetops and upper slope positions. Most areas are in the northern part of the county.

In a representative profile in a pasture, the surface layer is dark grayish-brown and brown silt loam 6 inches thick. The subsoil extends to a depth of 50 inches. The upper 11 inches is dark yellowish-brown silty clay loam, the next 7 inches is yellowish-brown clay, and the lower 26 inches is silty clay loam in variegated shades of brown. The substratum is weathered, neutral siltstone that has brown clay flows in fissures. Siltstone is at a depth of 60 inches.

Lowell soils have moderately slow permeability in the clayey part of the subsoil and

substratum. The root zone is deep, and available water capacity is moderate to high. Runoff is rapid to very rapid. These soils erode easily unless protected. Their natural fertility is medium. Many areas have good native stands of bluegrass pasture.

The Lowell soils in Washington County are mapped only with Upshur, Westmore, and Elba soils.

Representative profile of Lowell silt loam in pasture, from an area of Lowell-Upshur complex, 25 to 35 percent slopes, in Salem Township, 0.8 mile west of Warner, and 0.75 mile east of junction of County Road 8 on Ohio State Highway 530, 700 feet north of road:

Ap1--0 to 1 inch, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; very friable; many roots; medium acid; abrupt, smooth boundary.

Ap2--1 to 6 inches, brown (10YR 4/3) heavy silt loam; moderate, fine, subangular blocky structure; firm; many roots; medium acid; clear, smooth boundary.

B21t--6 to 17 inches, dark yellowish-brown (10YR 4/4) heavy silty clay loam; moderate, fine, subangular blocky structure; very firm; many roots; common fine pores; thin, patchy, brown (7.5YR 4/4) clay films; about 3 percent siltstone and hard limestone fragments; strongly acid; abrupt, smooth boundary.

B22t--17 to 24 inches, yellowish-brown (10YR 5/4) clay that has few, fine, faint, brown (10YR 5/3) mottles; moderate, medium, angular blocky structure; very firm; few roots; common fine pores; thin, patchy, brown (7.5YR 5/4) clay films; about 10 percent siltstone and hard limestone fragments; strongly acid; abrupt, smooth boundary.

B23t--24 to 37 inches, variegated pale-brown (10YR 6/3) and brown (7.5YR 5/4) heavy silty clay loam; weak, medium, subangular blocky structure; firm; few roots; few fine pores; thin, patchy, light brownish-gray (10YR 6/2) clay films; about 10 percent brownish-yellow (10YR 6/8) soft siltstone fragments; medium acid; abrupt, wavy boundary.

B3t--37 to 50 inches, variegated brown (10YR 4/3 and 7.5YR 5/4) and dark-brown (7.5YR 3/2) silty clay loam; weak, medium, subangular blocky structure; firm; thin, patchy, brown (10YR 5/3) clay films; 10 percent soft siltstone fragments; slightly acid; gradual, smooth boundary.

C--50 to 60 inches, soft, weathered siltstone that has brown (7.5YR 4/4) clay flows in fissures; neutral; abrupt, smooth boundary.

R--60 inches, siltstone bedrock.

The solum is 40 to 60 inches thick. In places it is as much as 15 percent coarse fragments. Depth to bedrock ranges from 40 to 72 inches. Unless limed, the B3 horizon is very strongly acid to medium acid. The B3 and C horizons are medium acid to mildly alkaline. Depth to carbonates or neutral soil is 35 to 60 inches.

The Ap horizon is dark grayish brown (10YR 4/2) to brown (7.5YR 4/4) silt loam and silty clay loam. In an undisturbed soil the 1- to 4-inch A1 horizon is 3 or 4 in value and 1 to 3 in chroma. The 4- to 8-inch A2 horizon, which occurs in places, is 4 or 5 in value and 2 to 4 in chroma. The Bt horizon ranges from heavy silty clay loam to clay. The upper part is 10YR or 7.5YR in hue, 4 or 5 in value, and 4 to 6 in chroma.

Nearby soils on uplands are the Upshur, Belpre, Elba, Keene, and Westmore soils. Lowell soils are shallower over bedrock than Brookside soils, which are on nearby colluvial foot slopes. They are finer textured than Westmore soils, are more acid than Elba soils, and contain more clay in the upper part of the solum than Keene soils. They do not have the reddish colors typical of Upshur and Belpre soils.

LoC--Lowell-Upshur complex, 6 to 12 percent slopes. This sloping mapping unit is on ridgetops. It is about 45 percent Lowell soil, 35 percent Upshur soil, and 20 percent included soils. Lowell and Upshur soils occur in such mixed intricate patterns that they were not mapped separately. Slopes are irregular and 100 to 200 feet long. The profile of the Lowell soil is deeper over clay than the one described as representative of the series. Included in mapping are areas of Westmore and Gilpin soils.

Runoff is rapid, and the erosion hazard is severe in cultivated areas. These soils have a moderate to high shrink-swell potential. Slope and moderately slow permeability limit their use for most nonfarm purposes. Bluegrass grows well in many areas. Capability unit IIIe-6; woodland suitability group 3c1.

LoD--Lowell-Upshur complex, 12 to 18 percent slopes. This moderately steep mapping unit occurs on narrow ridgetops and upper side slopes and on knolls and benches. Slopes are mainly smooth and convex, but are cut by shallow drainageways. Some on the upper part of the benches and near the drainageways are concave. Most areas are long and range from about 10 to 40 acres in size.

This mapping unit is about 45 percent Lowell soil, 35 percent Upshur soil, and 20 percent included soils. Lowell and Upshur soils occur in such mixed intricate patterns that they were not mapped separately. The Lowell soil is slightly deeper over bedrock, but otherwise has a profile similar to the one described as representative of the series.

Included with these soils in mapping are areas of Elba, Belpre, Summitville, and Gilpin soils. The Elba and Belpre soils are less acid than is typical. No lime is required for most crops. The Gilpin soil contains more stone fragments and is shallower over bedrock than is typical.

Tilth is poor, runoff is rapid, and the erosion hazard is very severe in cultivated areas. This mapping unit is subject to landslips. The moderately steep slope, high shrink-swell potential, moderately slow to slow permeability, and poor stability limits its use for nonfarm purposes.

This unit is used mainly for crops and pasture. Row crops can be grown occasionally. Bluegrass grows well on the Lowell soil. Capability unit IVe-5; woodland suitability group 3c2.

LoE--Lowell-Upshur complex, 18 to 25 percent slopes. This steep mapping unit is mainly on upper hillsides. Some benchlike areas are bounded above and below by steeper soils. Slopes are mostly concave and convex, but are cut by shallow drainageways every 300 to 500 feet. Most areas are long and winding. Concave areas are 10 to 60 acres in size. This unit is about 45 percent Lowell soil, 35 percent Upshur soil, and 20 percent included soils. Lowell and Upshur soils occur in such mixed patterns that they were not mapped separately. The profile of the Upshur soil is slightly thinner than the one described for the series.

Included in mapping are mainly Elba, Belpre, Summitville, and Gilpin soils. Gilpin and Summitville soils are coarser textured and easier to cultivate than Lowell and Upshur soils. The Gilpin soil is also shallower over bedrock. Elba and Belpre soils are less acid and do not require lime for most crops.

Tilth is poor, runoff is very rapid, and the erosion hazard is severe in cultivated areas. This mapping unit is subject to landslips. The steep slope, a high shrink-swell potential, moderately slow to slow permeability, and susceptibility to landslides limit its use for nonfarm purposes.

This mapping unit is used mostly for hay and pasture. It is too steep and too erodible for cultivation. Bluegrass grows well on the Lowell soil. Capability unit VIe-2; woodland suitability group 3c2.

LoF--Lowell-Upshur complex, 25 to 35 percent slopes. This very steep mapping unit is mainly on upper hillsides. Slopes are mostly long and irregular. Areas are long and narrow on the hillsides, are blocky in ravines, and range from about 10 to 150 acres in size. Most are cut by drainageways and ravines every 300 to 500 feet.

This mapping unit is about 45 percent Lowell soil, 35 percent Upshur soil, and 20 percent included soils. Lowell and Upshur soils are in such mixed intricate patterns that they were not mapped separately. The profile of the Lowell soil is the one described as representative of the series. The Upshur soil has a thinner profile than the one described.

Included with these soils in mapping are mainly Elba, Belpre, Summitville, Gilpin, and Dekalb soils. The Summitville, Gilpin, and Dekalb soils are coarser textured and contain more stones than is typical. In addition, Gilpin and Dekalb soils are shallower over bedrock. Elba and Belpre soils are less acid and have a finer textured surface layer than is typical.

Tilth is poor, runoff is very rapid, and the erosion hazard is severe if the plant cover is removed. Steep slope and a severe hazard of landslides limit nonfarm use of the soils.

These soils are used mainly for pasture and woodland. The very steep slopes are difficult to manage for pasture. Bluegrass grows well on the Lowell soil. Black walnut is prominent in wooded areas. Capability unit VIe-3; woodland suitability group 3c2.

Markland Series

The Markland series consists of deep, gently sloping to very steep, moderately well drained to well drained soils. These soils formed in clayey lacustrine material on stream terraces.

In a representative profile in a cultivated area, the surface layer is brown heavy silt loam 7 inches thick. The subsoil to a depth of 49 inches is yellowish brown or dark yellowish brown mottled with grayish and reddish colors. The upper 3 inches is silty clay; below this it is clay. The substratum to a depth of 64 inches is brown silty clay thinly stratified with very fine sandy loam that is mottled with grayish colors.

Markland soils have slow permeability in the clayey subsoil. They have a deep root zone, moderate available water capacity, and medium natural fertility. They are used mostly for crops and pasture.

Representative profile of Markland silt loam, 2 to 6 percent slopes, in a cultivated field in Waterford Township along West Branch Wolf Creek, 2,000 feet south of Waterford Township Road 103, 2,500 feet west of Cedar Hill Cemetery (see profile WS-3 under "Laboratory Data"):

Ap--0 to 7 inches, brown (10YR 4/3) heavy silt loam; weak, thick, platy structure parting to weak, fine, granular; friable; common roots; very strongly acid; abrupt, smooth boundary.

B21t--7 to 10 inches, yellowish-brown (10YR 5/4) silty clay; weak, medium, subangular blocky structure; friable; common roots; common fine pores; thin, continuous, yellowish-brown (10YR 5/4) clay films; very strongly acid; clear, smooth boundary.

B22t--10 to 17 inches, yellowish-brown (10YR 5/4) clay; moderate, medium and fine, angular blocky structure; firm; common roots; common fine pores; thin, continuous, dark yellowish-brown (10YR 4/4) clay films; very strongly acid; gradual, smooth boundary.

B23t--17 to 23 inches, dark yellowish-brown (10YR 4/4) clay; few, coarse, faint, gray (10YR 6/1) mottles; weak, very

coarse, prismatic structure parting to moderate, fine and medium, angular blocky; firm, slightly sticky; few fine roots; few fine pores; thin, continuous, yellowish-brown (10YR 5/4) clay films; very strongly acid; gradual, smooth boundary.

B24t--23 to 29 inches, yellowish-brown (10YR 5/4) clay; few, coarse, distinct, gray (5YR 5/1) and reddish-brown (5YR 4/4) mottles; weak, very coarse, subangular blocky structure parting to moderate, medium, angular and subangular blocky; firm, slightly sticky; few roots; few fine pores; medium, continuous, dark yellowish-brown (10YR 4/4) clay films and few black stains; very strongly acid; gradual, smooth boundary.

B25t--29 to 33 inches, dark yellowish-brown (10YR 4/4) clay; common, fine, faint, light brownish-gray (10YR 6/2) mottles; weak, medium, angular blocky structure; firm; few fine pores; medium, continuous, brown (10YR 4/3) and reddish-brown (5YR 5/4) clay films and common, fine, black stains; less than 1 percent pebbles; neutral; gradual, smooth boundary.

B3--33 to 49 inches, dark yellowish-brown (10YR 4/4) laminated clay, thin layers of brown (7.5YR 4/4) very fine sandy loam; few, coarse, prominent, weak-red (2.5YR 4/2) mottles; weak, coarse, subangular blocky structure parting to moderate, very thick, platy (laminae); firm; thick, patchy, grayish-brown (10YR 6/2) clay films and yellowish-brown (10YR 5/4) silty films on laminae and ped surfaces; calcareous; moderately alkaline; gradual, smooth boundary.

C--49 to 64 inches, brown (10YR 4/3) laminated silty clay, thin layers of very fine sandy loam and few, coarse, distinct, gray (10YR 5/1) mottles; massive; friable; light-gray (10YR 7/1) slickenside-like faces; calcareous, moderately alkaline.

Thickness of the solum ranges from 28 to 54 inches. Unless limed, the upper part of the Bt horizon is medium acid to very strongly acid and ranges to slightly acid or neutral in the lower part. Depth to carbonates ranges from 24 to 36 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. An undisturbed soil has a 1- to 2-inch, dark-colored A1 horizon and a 2- to 8-inch A2 horizon; value is 4 or 5 and chroma is 3 or 4 in the 10YR hue.

The upper part of the Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It ranges from silty clay loam to clay. The matrix hue in the lower part of the Bt horizon is 10YR or 7.5YR, value is 4 or 5, and chroma is 3 or 4. This horizon is silty clay or clay.

The Markland soils in Washington County have a thicker solum than Markland soils elsewhere. This difference, however, does not greatly influence use and management of these soils.

Markland soils are finer textured than the nearby Glenford soils. In contrast with Licking soils, which do not contain carbonates, they have carbonates within a depth of 2 or 3 feet. They are better drained than the nearby McGary soils.

MbB--Markland silt loam, 2 to 6 percent slopes. This gently sloping soil is on low terraces. The surface is even to slightly convex and in a few places is cut by shallow drainageways near the outer edge. Areas range from about 10 to 60 acres in size and are blocky. A profile of this soil is described as representative of the series.

Included with this soil in mapping are small areas of Mentor and McGary soils. The Mentor soils are more permeable than Markland soils. McGary soils are in low spots and require drainage if they are used for cultivated crops.

Runoff is medium, and the erosion hazard is moderate if this soil is cultivated. The soil is slow to dry out in spring because the subsoil is clayey. Plowing and planting are delayed in wet years. The clayey texture and slow permeability are limitations for some nonfarm uses.

This soil is used mostly for crops and is suited to the crops most commonly grown in the county. A small acreage is in pasture. Capability unit IIe-3; woodland suitability group 2c1.

MbC--Markland silt loam, 6 to 12 percent slopes. This sloping soil is on low terraces. The surface is mostly even to convex, appearing as sloping bands or slightly rounded interfluves that are separated by shallow drainageways. Most areas are in long narrow bands parallel to the stream, but the larger ones are blocky. Areas range from about 5 to 60 acres in size.

Included with this soil in mapping are small areas of gently sloping soils near the center of larger areas. Along the edges, near slope breaks, are narrow bands of severely eroded soils that have a light-colored, more clayey surface layer that is difficult to cultivate.

Runoff is rapid, and the erosion hazard is severe if this soil is cultivated. Slope, clayey texture, and slow permeability are limitations for some nonfarm uses.

This soil is used for crops and pasture. It is suited to cultivated crops if erosion is controlled. Capability unit IIIe-6; woodland suitability group 2c1.

MbD2--Markland silt loam, 12 to 18 percent slopes, moderately eroded. This moderately steep soil is on short slopes between low terrace levels or between terraces and lower lying bottom lands. The surface is irregular and is cut by small drainageways. Slopes are generally short, only 50 to 200 feet long. Most areas range from 10 to 30 acres in size. This soil has a thinner surface layer and subsoil than is typical and in most areas is less acid.

Included with this soil in mapping are a few areas of severely eroded soils and some gullies. The severely eroded soils have a light-colored, clayey surface layer that is difficult to till.

Tilth is poor, and runoff is very rapid. The erosion hazard is very severe, and the soil is difficult to manage if it is cultivated. Short, irregular, moderately steep slopes and slow permeability limit the use of the soil for farm and nonfarm uses.

This soil is used for pasture and crops. It is suited to occasional row crops and to pasture, hay crops, and woodland. Capability unit IVe-5; woodland suitability group 2c2.

MbG--Markland silt loam, 18 to 50 percent slopes. This steep to very steep soil is mainly on the sides of ravines and terrace escarpments. Other areas are on low terraces that are highly dissected by deep drainageways. The surface is irregular and is mostly convex between drainageways. Most areas are long and range from 15 to 40 acres in size.

This soil is shallower over carbonates than is typical.

Included with this soil in mapping are eroded, gullied soils; sloping Markland soils on interfluves; and small areas of Upshur and Gilpin soils. The included Upshur and Gilpin soils are shallower over bedrock and are more acid than Markland soils.

Tilth is poor, and runoff is very rapid if this soil is cultivated. The erosion hazard is very severe. The clayey subsoil provides poor traction for mechanized logging equipment during wet periods. The steep slope is a severe limitation for most nonfarm uses.

This soil is used mostly for woodland, but many areas are idle or are in nonproductive pasture. Capability unit VIIe-1; woodland suitability group 2c2.

McGary Series

The McGary series consists of deep, somewhat poorly drained soils formed in water-deposited material. These nearly level soils are in even to depressional positions on terraces along the larger streams.

In a representative profile in a cultivated area, the surface layer is dark-gray heavy silt loam 7 inches thick. The subsoil extends to a depth of 56 inches. The upper 6 inches is dark grayish-brown silty clay loam, and the lower 43 inches is yellowish-brown silty clay or silty clay loam that is mottled with grayish brown. The substratum to a depth of 81 inches is dark yellowish-brown silty clay laminated with reddish brown.

McGary soils have slow permeability. The root zone is deep except when it is limited by a seasonal high water table. The available water capacity is moderate. Tilth is poor, and natural fertility is low.

McGary soils are used mainly for crops and pasture.

Representative profile of McGary silt loam, 0 to 2 percent slopes, in a cultivated field in Waterford Township, about 0.3 mile west of the junction of Township Road 106 and County Road 174, 100 feet north and 30 feet east of barn:

Ap--0 to 7 inches, dark-gray (10YR 4/1) heavy silt loam; weak, medium, subangular blocky structure; friable; many roots; medium acid; abrupt, smooth boundary.

B21t--7 to 13 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, angular blocky structure; firm; common roots; common fine pores; thin, patchy, dark-gray (10YR 4/1) clay films; slightly acid; clear, smooth boundary.

B22t--13 to 30 inches, yellowish-brown (10YR 5/4) silty clay; many, medium, distinct, dark-gray (10YR 4/1) mottles and black concretions; moderate, medium, angular blocky structure; firm; common roots; common fine pores; thin, patchy, gray (10YR 5/1) clay films; slightly acid grading to neutral in the lower part; effervesces slightly at a depth of 22 inches; gradual, smooth boundary.

B23t--30 to 41 inches, yellowish-brown (10YR 5/6) heavy silty clay loam; many, coarse, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; few roots; few fine pores; thin, patchy, gray (10YR 5/1) clay films; calcareous, mildly alkaline; abrupt, smooth boundary.

B3t--41 to 56 inches, yellowish-brown (10YR 5/4) heavy silty clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure; firm; thin, very patchy, gray (10YR 5/1) clay films; mildly alkaline, calcareous; clear, smooth boundary.

C--56 to 81 inches, dark yellowish-brown (10YR 4/4) light silty clay laminae of reddish brown (5YR 5/4); firm; few vertical cracks that have gray (10YR 5/1) films and small gypsum crystals; mildly alkaline, calcareous.

The solum is 40 to 60 inches thick. Depth to carbonates ranges from 20 to 36 inches. Depth to bedrock is more than 6 feet and in most areas is more than 10 feet. An uncultivated soil has a dark-colored A1 horizon 1 to 3 inches thick.

The Ap horizon ranges from dark gray (10YR 4/1) to gray (10YR 5/1). In the Bt horizon brownish colors predominate in hue of 10YR, value of 4 or 5, and chroma of 3 to 6. Less than 40 percent of the soil mass is grayish colors in hue of 10YR to 2.5Y, value of 4 or 5,

and chroma of 0 to 2. The Bt horizon ranges from medium acid or slightly acid in the upper part to mildly alkaline and calcareous in the lower part. It is heavy silty clay loam to silty clay. The B3 horizon has hue of 10YR and 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is calcareous and laminated. The C horizon, which is also laminated, has value of 4 or 5 and chroma of 1 to 4 in hue of 10YR and 7.5YR. In places the soil contains thin silty and sandy layers.

Similar soils on nearby terraces are Licking, Markland, Glenford, Taggart, and Peoga soils. McGary soils are shallower over carbonates and are more poorly drained than Licking soils. They are more poorly drained than nearby Markland and Glenford soils. They have a finer textured B horizon than Taggart and Peoga soils.

McA--McGary silt loam, 0 to 2 percent slopes. This nearly level soil occupies low terraces. Areas are commonly long and narrow or oval in shape. They range from about 5 to 30 acres in size. Included in mapping are small poorly drained areas where water is ponded much of the year. Also included are areas having a silty clay loam surface layer.

Artificial drainage is needed if this soil is cropped. Tilth is poor, runoff is slow or ponded, and water stands on the surface for short periods. The seasonal high water table prevents good subsoil aeration. Seasonal wetness and slow permeability severely limit nonfarm uses of this soil.

This soil is used for crops and pasture. If drained, it is suited to pasture and intensive cropping. Capability unit IIw-1; woodland suitability group 2w1.

Melvin Series

The Melvin series consists of deep, nearly level soils that are poorly drained. These soils are on flood plains along all of the major streams in the county.

In a representative profile in a pasture, the surface layer is about 6 inches of mottled dark grayish-brown silt loam. The subsoil extends to a depth of 21 inches. It is dark-gray, grayish-brown, and light brownish-gray silt loam mottled with brownish colors. The substratum to a depth of 60 inches is light brownish-gray and gray silt loam that has many yellowish-brown and dark-brown mottles.

Melvin soils have moderate permeability. Runoff is slow or ponded, and internal drainage is poor. The root zone is only moderately deep because the water table is high. Natural fertility is medium, and the available water capacity is high. The soils are subject to flooding. In most places flooding occurs several times a year.

Most of the acreage is in pasture and idle fields. Some areas in the path of highway and urban development are used for urban purposes.

Representative profile of Melvin silt loam, NE¼SW¼SW¼ sec. 22, Barlow Township, 125 feet west of Township Road 39, 75 feet west of stream, T. 3 N., R. 10 W.

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; many, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, fine, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B21g--6 to 11 inches, dark-gray (10YR 4/1) silt loam; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; friable; many roots; few medium pores; slightly acid; clear, smooth boundary.

B22g--11 to 14 inches, grayish-brown (10YR 5/2) silt loam; many, medium, faint, very dark grayish-brown (10YR 3/2) mottles; weak, fine, subangular blocky structure; friable; common roots; medium acid; clear, smooth boundary.

B23g--14 to 21 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, distinct, yellowish-brown (10YR 5/4) and very dark grayish-brown (10YR 3/2) mottles; weak, fine, subangular blocky structure; friable; few roots; medium acid; clear, smooth boundary.

C1g--21 to 42 inches, light brownish-gray (10YR 6/2) silt loam; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles; massive; friable; medium acid; gradual, smooth boundary.

C2g--42 to 60 inches, gray (10YR 6/1) silt loam; many, coarse, distinct, dark-brown (7.5YR 4/4) mottles; massive; friable; common soft concretions; medium acid.

The solum is 18 to 40 inches thick. It ranges from medium acid to neutral.

The Ap horizon ranges from grayish brown (10YR 5/2) to dark gray (N 4/0). The B horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 and 2. It is silt loam to silty clay loam. The C horizon has the same range of color and texture as the B horizon.

Melvin soils are more poorly drained and have grayer colors than Nolin and Newark soils on nearby flood plains. Their horizons are not so well defined as those of Peoga soils, which are on low terraces.

Md--Melvin silt loam. This nearly level soil is on flood plains, mostly in slight depressions or in former stream channels and abandoned oxbows. Most areas are along smaller streams and occupy the entire flood plain. Other areas are adjacent to or surrounded by better drained soils on the flood plain.

Included with this soil in mapping are small areas of somewhat poorly drained Newark soils. Also included are areas of soils that have a dark-colored silty clay loam surface layer. Permanent wet spots are identified on the soil map by spot symbols.

Runoff is ponded, and erosion is not a hazard. Wetness and flooding are the major limitations.

This soil is used mostly for pasture. Drainage is needed if it is used for crops. A few areas are used for wetland wildlife. Capability unit IIIw-1; woodland suitability group 2w1.

Mentor Series

The Mentor series consists of deep, well-drained soils formed in alluvial material. These nearly level to sloping soils are on terraces along all the major streams in the county. Most terraces are 40 to 50 feet above the adjacent flood plains. The most extensive areas are along the Ohio and Muskingum Rivers.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 12 inches thick. The subsoil is brown silt loam that extends to a depth of 48 inches. The substratum is brown loam to a depth of 84 inches and stratified sand and gravel to a depth of 134 inches.

Mentor soils have medium natural fertility, moderate permeability, and a deep root zone. The available water capacity is high. If well managed, the soils are easily worked and highly productive. Most areas are above the highest flood level. A few lower lying areas are subject to infrequent flooding.

Nearly all areas of Mentor soils are cleared of trees and are intensively farmed, mainly to grain, hay, and vegetable crops. Also, several urban areas are on these soils.

Representative profile of Mentor silt loam, 2 to 6 percent slopes, in Muskingum Township on the north side of a gravel pit 3/4 mile northwest of Devola, 1/4 mile west of Masonic Park, 400 feet north of house, 520 feet east of Muskingum River:

Ap--0 to 12 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 4/3) when crushed; moderate, fine, granular structure; friable; many roots; medium acid; abrupt, smooth boundary.

B1--12 to 17 inches, brown (7.5YR 4/4) silt loam; weak, medium, subangular blocky structure; friable; common roots; medium acid; clear, smooth boundary.

B21t--17 to 34 inches, brown (7.5YR 4/4) heavy silt loam; moderate, medium, subangular blocky structure; friable; few roots; thin, patchy, reddish-brown (5YR 4/3) clay films; medium acid; clear, smooth boundary.

B22t--34 to 48 inches, brown (7.5YR 4/4) heavy silt loam; common, fine, faint, pale-brown (10YR 6/3) mottles; moderate, medium, subangular blocky structure; friable; thin, patchy, reddish-brown (5YR 4/3) clay films; medium acid; clear, smooth boundary.

C1--48 to 84 inches, brown (7.5YR 4/4) loam; common, fine, faint, pale-brown (10YR 6/3) mottles; massive; friable; thin, patchy, reddish-brown (5YR 4/3) clay films; medium acid; gradual, smooth boundary.

IIC2--84 to 134 inches, weathered stratified sand and gravel; medium acid grading to mildly alkaline at a depth of 132 inches.

The solum is 36 to 60 inches thick. Depth to loose sand and gravel ranges from 6 to 20 feet. Unless limed, the soil is slightly acid to strongly acid to a depth of 80 inches.

The Ap horizon ranges from dark brown (10YR 3/3) to brown (10YR 5/3). If the soil is rubbed, the value is higher than 3. The B1 horizon is a silt loam in hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. In most areas the B2 horizon is heavy silt loam and light silty clay loam, but in some places individual horizons are loam. The horizon is dominantly hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The C horizon ranges from silt loam or loam in the upper part to very fine sandy loam or sand and gravel in the lower part. It has 10YR or 7.5YR hue, value of 4 or 5, and chroma of 3 or 4.

Nearby soils on terraces are the Wheeling, Hackers, Ashton, Watertown, Chili, and Conotton soils. Mentor soils are deeper over sand and gravel than Wheeling soils. They are not so red as Hackers soils. They are generally more acid than Ashton soils, which are on low terraces and are sometimes flooded. They have a thinner solum and are mostly less acid than Allegheny soils.

MeA--Mentor silt loam, 0 to 2 percent slopes. This nearly level soil occurs as even to slightly convex areas on low terraces. Areas are blocky to long and narrow. They are 1/2 to 1 mile long, 500 to 4,000 feet wide, and 20 to 300 acres in size. The large size and even shape of most areas are an aid to farming.

Included with this soil in mapping are small areas of moderately well drained Glenford soils, mostly in narrow bands along the edge of this soil and adjacent to upland slopes.

This soil is suited to intensive cropping. Runoff is slow, and erosion is not a hazard. Except for infrequent flooding in a few low positions, this soil has no significant limitations for farm and nonfarm uses. It is used mostly for crops, truck crops, and urban development. Capability unit I-1; woodland suitability group 1o1.

MeB--Mentor silt loam, 2 to 6 percent slopes. This gently sloping soil occurs as even to convex areas on low terraces. Most areas range from 20 to 100 acres in size and are blocky to long and narrow. A profile of

this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of the moderately well drained Glenford soils, commonly near the center of broad areas. Glenford soils dry out more slowly than Mentor soils.

The erosion hazard is moderate if this soil is cultivated, and runoff is medium. The soil has few limitations for most nonfarm uses. It is used for general farm and truck crops and for urban development. Capability unit IIe-1; woodland suitability group 1o1.

MeC--Mentor silt loam, 6 to 12 percent slopes. This sloping soil is on low terraces. Areas are mostly long, narrow bands between terrace levels or between terraces and flood plains. A few blocky areas along shallow drainageways have irregular slopes on interfluves. Slopes are commonly only 100 to 200 feet long. Most areas range from 5 to 50 acres in size. A profile of this soil differs from the one described as representative of the series in having a lighter colored surface layer.

Included with this soil in mapping are narrow areas of steeper soils along drainageways and near slope breaks. Also included are small spots of less well-drained soils in narrow drainageways.

If this soil is used for row crops, the erosion hazard is severe. Tilth is medium, and runoff is rapid. The slope limits some nonfarm uses. The soil is used mostly for crops and pasture. Capability unit IIIe-1; woodland suitability group 1o1.

Moshannon Series

The Moshannon series consists of deep, well-drained, nearly level soils on flood plains. These soils formed in alluvium washed from uplands dominated by the reddish Upshur soils. They are subject to flooding of short duration.

In a representative profile in a pasture, the surface layer is reddish-brown silt loam 6 inches thick. The subsoil extends to a depth of 38 inches. The upper 21 inches is dark reddish-brown silt loam, and the lower 11 inches is reddish-brown silt loam. The substratum to a depth of 60 inches is reddish-brown silt loam.

Moshannon soils have moderate permeability. They are easily worked. Natural fertility is medium. The root zone is deep, and the available water capacity is high. Most of the acreage is flooded one or more times per year.

Most areas are used for crops or meadow. Corn is the main crop.

Representative profile of Moshannon silt loam, SE¼NE¼ sec. 9, Belpre Township, T. 2 N., R. 10 W., along Township Road 289, one-half mile northeast of junction with Township Road 97:

Ap--0 to 6 inches, reddish-brown (5YR 4/3) silt loam; weak, medium, granular structure; friable; common roots; slightly acid; abrupt, smooth boundary.

B21--6 to 27 inches, dark reddish-brown (5YR 3/4) silt loam; weak, medium, subangular blocky structure; friable; few roots; medium acid; clear, smooth boundary.

B22--27 to 38 inches, reddish-brown (5YR 4/4) silt loam; weak, medium, subangular blocky structure; friable; few roots; slightly acid; gradual, smooth boundary.

C--38 to 60 inches, reddish-brown (5YR 4/3) silt loam; massive; friable; slightly acid.

The solum is 32 to 48 inches thick. Unless limed, the B and C horizons are slightly or medium acid.

The Ap horizon has 5YR or 7.5YR hue, value of 4 or 5, and chroma of 3 or 4. An undisturbed soil has a 1- to 2-inch, dark-colored A1 horizon and a 6- to 10-inch A2 horizon that has a color range the same as in the Ap horizon. The B horizon has 5YR or 2.5YR hue and value and chroma of 3 to 5. It is silt loam or light silty clay loam.

Moshannon soils are more reddish than Nolin, Hartshorn, and Chagrin soils on the flood plain. They are deeper than Hartshorn soils. Their horizons are not so well defined as those of Hackers soils, which are on nearby alluvial fans and terraces.

Mp--Moshannon silt loam. This nearly level soil is on bottom land mostly along the larger streams in the central and western parts of the county. Most areas range from 50 to 500 acres in size.

Included with this soil in mapping are small areas of somewhat poorly drained soils in abandoned stream channels and low spots in which water is slower to drain. Most of the larger wet spots are identified by spot symbols on the soil map.

Tilth is medium, runoff is slow, and erosion is not a hazard. This soil is subject to flooding, which does not seriously interfere with farming but severely limits nonfarm uses.

This soil is used mostly for crops, and it can be cropped intensively. Corn is the principal crop. Capability unit IIw-2; woodland suitability group 1o2.

Newark Series

The Newark series consists of deep, nearly level soils that are somewhat poorly drained. These soils formed in recent alluvium on flood plains throughout the county.

In a representative profile in a cultivated area, the surface layer is brown silt loam 6 inches thick. The subsoil extends to a depth of 40 inches. The upper 3 inches is yellowish-brown silt loam, the next 5 inches is brown silt loam, and the lower 26 inches is light brownish-gray silt loam. The substratum to a depth of 60 inches is brown silt loam. Gray and brown mottles occur throughout the profile.

The water table rises to near the surface during wet seasons. Runoff is very slow, and permeability is moderate. These soils are subject to flooding, mostly late in winter and in spring or in summer as a result of thunderstorms. The root zone is deep unless restricted by a seasonal high water table. Natural fertility is medium, and the available water capacity is high.

Most areas of Newark soils are in meadow or permanent pasture. A few areas are in row crops or are parts of areas under urban or industrial development.

Representative profile of Newark silt loam, SE¼NW¼SW¼ sec. 22, Barlow Township, T. 3 N., R. 10 W., 300 feet northeast of Township Road 39, 100 feet west of stream:

Ap--0 to 6 inches, brown (10YR 5/3) silt loam; many, fine, distinct, brown (7.5YR 4/4) mottles; weak, very fine, granular structure; friable; many roots; medium acid; abrupt, smooth boundary.

B21--6 to 9 inches, yellowish-brown (10YR 5/4) silt loam; many, fine, distinct, brown (7.5YR 4/4) mottles; weak, medium and coarse, subangular blocky structure; friable; common roots; medium acid; clear, smooth boundary.

B22--9 to 14 inches, brown (10YR 5/3) silt loam; many, medium, distinct, brown (7.5YR 4/4) and light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; friable; few roots; medium acid; gradual, smooth boundary.

B23g--14 to 40 inches, light brownish-gray (2.5Y 6/2) silt loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; slightly acid; gradual, smooth boundary.

C--40 to 60 inches, brown (7.5YR 4/4) silt loam; many, coarse, distinct, light brownish-gray (10YR 6/2) mottles; massive; friable; many dark-brown (7.5YR 3/2) iron cemented zones; medium acid.

The solum is 20 to 40 inches thick. Unless limed, the profile is medium acid to neutral throughout. Depth to coarse sand and gravel ranges from 4 to 10 feet.

The Ap horizon ranges from brown (10YR 5/3) to dark grayish brown (10YR 4/2). An undisturbed soil has a dark-colored A1 horizon 1 to 2 inches thick. The A2 horizon, 6 to 10 inches thick, has value of 4 and chroma of 2 to 4. The B horizon has hue of 10YR to 2.5Y, value of 4 to 6, and chroma of 2 to 4. Some stratification commonly occurs in places in the lower horizons. In most areas the solum is mainly silt loam or silty clay loam, but individual horizons are loam.

Newark soils are more poorly drained than Nolin and Huntington soils. They are better drained than Melvin soils. They are not so well defined as Peoga soils on low terraces.

Nn--Newark silt loam. This nearly level soil is in depressions in flood plains. It generally is next to the valley walls or terraces in slight depressions or abandoned stream channels. It has a slightly depressional or concave surface and receives seepage or runoff from the adjacent slopes. It is ponded following heavy rains. Most areas are long or oblong in shape and range from about 5 to 50 acres in size. Included in mapping are small areas of poorly drained Melvin soils, which are wet most of the year.

Wetness is a hazard. The soil has to be artificially drained if used for crops. Flooding and wetness limit its use for most purposes. Runoff is slow or ponded, and erosion is not a hazard. Capability unit IIw-1; woodland suitability group 2w1.

Nolin Series

The Nolin series consists of deep, well-drained, nearly level soils formed in recent alluvium. These soils are on flood plains and are subject to flooding.

In a representative profile in a cultivated field, the surface layer is dark-brown silt loam 8 inches thick. The subsoil is dark yellowish-brown heavy silt loam that extends to a depth of 42 inches. The substratum to a depth of 60 inches is dark yellowish-brown heavy silt loam mottled with grayish brown.

Nolin soils are moderately permeable. They have a deep root zone and a high available water capacity. The water table is below a depth of 3 feet. Reaction is neutral to medium acid. No lime is needed for most crops. Flooding is of short duration and is generally not damaging to crops. Natural fertility is high.

Nolin soils are used chiefly for general farm crops and truck crops.

Representative profile of Nolin silt loam in a cultivated field along the Muskingum River, 1.8 miles southeast of Coal Run and 300 feet southwest of Ohio State Highway 60:

Ap--0 to 8 inches, dark-brown (10YR 3/3) heavy silt loam, brown (10YR 4/3) when rubbed; moderate, medium, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B21--8 to 34 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; weak, medium, subangular blocky structure; friable; common roots; many coarse tubules; brown

(10YR 4/3) organic coatings on all peds; slightly acid; clear, smooth boundary.

B22--34 to 42 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; weak, medium, subangular blocky structure; friable; few roots; thin, patchy, brown (10YR 5/3) coatings on peds; slightly acid; gradual, smooth boundary.

C--42 to 60 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; few, coarse, grayish-brown (10YR 5/2) mottles; massive; friable; slightly acid.

The solum is 40 to 50 inches thick. Unless limed, it is medium acid to neutral throughout.

The Ap horizon is 3 to 5 in value and 2 or 3 in chroma in 10YR hue. An undisturbed soil has a 1- to 3-inch, dark-colored A1 horizon and an A2 horizon that has value of 4 or 5 and chroma of 3 or 4 in 10YR hue. If the soil is rubbed, the value is higher than 3.5. The B horizon is in hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or light silty clay loam. In most areas the C horizon is silt loam or light silty clay loam.

Other associated soils on the flood plain are Chagrin, Tioga, Huntington, Moshannon, Newark, Melvin, and Hartshorn soils. Nolin soils have a thinner and lighter colored A horizon than Huntington soils and are browner than the reddish Moshannon soils. They contain more silt and less sand than Chagrin and Tioga soils. In contrast with Hartshorn soils, they are deeper over bedrock. They are better drained than nearby Newark and Melvin soils.

No--Nolin silt loam. This nearly level soil is on long meandering strips of bottom land. In most places it occupies the entire flood plain. In some it is adjacent to more poorly drained soils. Areas range from 10 to 200 acres in size.

Included in mapping are small areas of the somewhat poorly drained Newark soils. These soils are commonly in slight depressions or are in narrow bands adjacent to hillsides.

Tilth is good, runoff is slow, and erosion is not a hazard. Flooding severely limits nonfarm uses. Most flooding is in winter and early spring and is not a serious hazard for farm crops.

This soil is used mostly for grain, hay, and vegetables. It is suited to intensive cropping. Capability unit IIw-2; woodland suitability group 1o2.

Otwell Series

The Otwell series consists of deep, gently sloping to sloping, moderately well drained soils on high terraces. These soils formed in alluvial and lacustrine material deposited in wide preglacial valleys and on some ridgetops. They occur in all parts of the county, but are more common in the western part.

In a representative profile in a meadow, the surface layer is brown silt loam 8 inches thick. The subsoil extends to a depth of 63 inches. The upper 17 inches is yellowish-brown silt loam mottled with grayish brown and strong brown. The lower 38 inches is a hard, compact fragipan. It is yellowish-brown silty clay loam and loam that is mottled with gray and yellowish brown. The substratum to a depth of 80 inches is yellowish-brown sandy loam mottled with light gray.

The available water capacity is moderate, and the root zone is moderately deep over the fragipan. Permeability is moderate above the fragipan, but slow in the pan. Internal drainage is restricted, and the water table is perched above the pan. Tilth is medium. Natural fertility is medium.

Representative profile of Otwell silt loam, 2 to 6 percent slopes, Waterford Township, 3½ miles west of Waterford, 25 feet north of Township Road 103, and 125 feet east of junction with Township Road 104:

Ap--0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; strongly acid; abrupt, smooth boundary.

B21t--8 to 22 inches, yellowish-brown (10YR 5/6) silt loam; moderate, fine, angular blocky structure; friable; common roots; few fine and medium pores; thin, very patchy, brown (7.5YR 4/4) clay films; strongly acid; clear, wavy boundary.

B22t--22 to 25 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) and strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; friable; few roots; few fine pores; thin, patchy, brown (7.5YR 4/4) clay films; common, fine, black concretions; strongly acid; clear, wavy boundary.

Bx1--25 to 45 inches, yellowish-brown (10YR 5/4) light silty clay loam; many, coarse, distinct, grayish-brown (10YR 5/2) mottles and few, coarse, black stains; weak, very coarse, prismatic structure parting to moderate, fine, angular blocky; very firm, brittle; few fine pores; thick, patchy, brown (10YR 5/3) clay films; patchy light brownish-gray (10YR 6/2) silty coatings; few, coarse, black stains; strongly acid; gradual, smooth boundary

Bx2--45 to 63 inches, yellowish-brown (10YR 5/6) loam; many, coarse, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; very firm, brittle; few fine and medium pores; thin patchy brown (10YR 5/3) clay films; strongly acid; abrupt, wavy boundary.

IIC--63 to 80 inches, yellowish-brown (10YR 5/6) sandy loam; many, coarse, distinct, light-gray (10YR 7/2) mottles; massive; 10 percent small pebbles; medium acid.

The solum is 40 to 80 inches or more thick. Unless limed, the upper part is very strongly acid to medium acid, and the lower part is very strongly acid to neutral. Depth to the fragipan ranges from 20 to 32 inches.

The Ap horizon has 10YR hue, value of 4 or 5, and chroma of 2 to 4. An undisturbed profile has a 1- to 3-inch, dark-colored A1 horizon and a 4- to 10-inch A2 horizon that has value of 4 or 5 and chroma of 3 or 4. In some places this soil has a B1 horizon. The B2t horizon has 10YR or 7.5YR hue, value of 4 or 5, and chroma of 3 to 6. It is silt loam or silty clay loam. The Bx horizon is silty clay loam, silt loam, or loam. The B3 horizon, which occurs in places, and the C horizon are stratified. Pebbles make up less than 5 percent of the solum. Most are weathered so that they crush easily.

Otwell soils, formed in water-deposited material, are deeper over bedrock than Zanesville soils on nearby uplands. They have a fragipan, which the Allegheny, Gallia, Licking, Vincent, and Glenford soils on nearby terraces do not have. They are coarser textured than Licking and Vincent soils.

OtB--Otwell silt loam, 2 to 6 percent slopes. This gently sloping soil is on high terraces. Slopes are mainly smooth, but are slightly convex near heads of drainageways and at the edges of mapped areas. Areas range from 5 to 200 acres in size. Most are blocky and irregular in shape, but some on ridge spurs are long and narrow. A profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of Allegheny, Licking, Gallia, and Vincent soils and spots of somewhat poorly drained soils. Allegheny and Gallia soils dry out more readily than Otwell soils. Licking and Vincent soils are more clayey and have poor tilth.

The erosion hazard is moderate, and runoff is medium to slow. Tilth is generally good, but a crust forms at the surface if the soil is cultivated too often. The upper part tends to remain wet for a few days after periods of prolonged rainfall.

Almost all the acreage is used for general farm crops. The soil is suited to this use. Capability unit IIe-2; woodland suitability group 3o1.

OtC--Otwell silt loam, 6 to 12 percent slopes. This sloping soil is on high terraces. It occurs on broad interfluves between shallow drainageways that cross every few hundred feet. Slopes are mostly convex. Areas are long and irregular and range from 5 to 100 acres in size. The larger areas are in the western part of the county. A profile of this soil has a lighter colored, thinner surface layer than the one described as representative of the series. The original surface layer has been mixed with material from the upper part of the subsoil. Included in mapping are small areas of somewhat poorly drained soils, commonly near the center of larger areas and at the heads of drainageways.

The erosion hazard is severe, tilth is medium, and runoff is rapid if this soil is cultivated. Slope and slow permeability limit many urban and nonfarm uses.

This soil is mostly used for crops, but a significant acreage is in pasture. It is suited to these uses. Capability unit IIIe-3; woodland suitability group 3o1.

OvB--Otwell-Vincent silt loams, 2 to 6 percent slopes. This gently sloping mapping unit is on crests of high terraces, benches, and ridgetops mantled with lacustrine material. Slopes are even to complex and 300 to 700 feet long. Areas are mostly blocky, but many are long and rather narrow.

This unit is about 40 percent Otwell soil, 30 percent Vincent soil, and 30 percent included soils. Otwell and Vincent soils occur in such intricate patterns that it is not practical to map or manage them separately. Otwell soils are generally at higher elevations near the center of the areas. Vincent soils are in saddles and shallow drainageways and along the edge of the mapped areas.

Included with this unit in mapping are areas of Allegheny and Licking soils and small areas near the center of this unit of somewhat poorly drained soils. Allegheny and Licking soils require similar management to Otwell and Vincent soils. If managed intensively, the somewhat poorly drained areas require tile drainage.

The erosion hazard is moderate, tilth is medium, and runoff is medium in cultivated areas. Slow permeability and the clayey texture of Vincent soils moderately limit nonfarm uses.

Almost all the acreage is cropped. The soils are suited to grain and hay crops. Capability unit IIe-2; woodland suitability group 3o1.

OvC--Otwell-Vincent silt loams, 6 to 12 percent slopes. This sloping mapping unit is at the margins of high terraces, on benches, and on ridgetops mantled with lacustrine material. Slopes are even to slightly convex. Areas range from 20 to 150 acres in size. They are long and winding at the margins of terraces and are cut by shallow drainageways. On ridgetops they are irregular and blocky.

This unit is about 40 percent Otwell soil, 30 percent Vincent soil, and 30 percent included soils. Otwell soils are mainly at the higher elevations. Vincent soils are in lower lying saddles, in shallow drainageways, and at the margins of mapped areas. Both soils occur in such an intricate pattern that it is not practical to map or manage them separately.

Included with this unit in mapping are areas of Licking and Allegheny soils, some areas of somewhat poorly drained soils, and spots of

severely eroded soils along drainageways. Allegheny and Licking soils are managed similarly to Otwell and Vincent soils. The somewhat poorly drained soils require drainage if they are cropped. Special management to increase fertility and prevent further erosion is needed in severely eroded areas.

Runoff is rapid, and the erosion hazard is severe. Tilth is poor in cultivated areas. The main limitations for nonfarm uses are slow permeability and slope.

This unit is used intensively for crops. A small acreage is pastured. Capability unit IIIe-3; woodland suitability group 3o1.

Peoga Series

The Peoga series consists of deep, poorly drained soils formed in water-deposited material. These are nearly level or depressional soils on low terraces along the rivers and large streams in the county.

In a representative profile in a cultivated field, the surface layer is mottled dark grayish-brown silt loam 9 inches thick. The subsoil extends to a depth of 63 inches. The upper 38 inches is gray, light brownish-gray, and grayish-brown light silty clay loam, and the lower 16 inches is variegated light brownish-gray silty clay loam and dark yellowish-brown silt loam. The substratum to a depth of 93 inches is mottled yellowish-brown, stratified silt loam and loam.

Permeability is slow. Peoga soils have a high water table much of the year and are subject to frequent ponding. A few of the lower lying areas are subject to occasional flooding. The available water capacity is high. Because of the high water table, the root zone is only moderately deep. Tilth is poor. Natural fertility is medium.

Peoga soils are used mostly for pasture. A few areas are cultivated along with better drained soils nearby.

Representative profile of Peoga silt loam in a cultivated field, SE¼NE¼NE¼ sec. 36, Newport Township, T. 2 N., R. 7 W., 0.8 mile northeast of junction with County Road 333 on County Road 544, 400 feet east of road:

Ap--0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; many, fine, distinct, brown (7.5YR 4/4) mottles; moderate, fine, granular and moderate, fine, angular blocky structure; friable; many roots; very strongly acid; abrupt, smooth boundary.

B21tg--9 to 13 inches, gray (10YR 5/1) light silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, prismatic structure parting to weak, medium, subangular blocky; firm; common roots; common fine pores; thin, continuous, gray (10YR 5/1) clay films; very strongly acid; abrupt, smooth boundary.

B22tg--13 to 21 inches, light brownish-gray (10YR 6/2) light silty clay loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, prismatic structure parting to weak, fine, subangular blocky; firm; common roots; common medium pores; thin, patchy, gray (10YR 6/1) clay films and silty coatings in pores; common dark concretions; very strongly acid; clear, smooth boundary.

B23tg--21 to 47 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure parting to weak, fine, angular blocky; firm; few roots; common medium pores; thin, very patchy, grayish-brown (10YR 5/2) clay films in pores; patchy black stains on ped faces; common, fine, dark concretions; very strongly acid; gradual, smooth boundary.

B3--47 to 63 inches, variegated light brownish-gray (10YR 6/2) silty clay loam and dark yellowish-brown (10YR 4/4) silt loam; weak, fine, subangular blocky structure; firm; thin, very patchy, grayish-brown (10YR 5/2) clay films in pores, patchy black stains on peds; common medium and fine concretions; very strongly acid; gradual, smooth boundary.

C--63 to 93 inches, yellowish-brown (10YR 5/4) stratified silt loam and loam; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; massive; friable; very strongly acid.

The solum is 40 to 65 inches thick. It is very strongly acid to medium acid. Depth to bedrock ranges from 6 to more than 10 feet.

The Ap horizon has value of 4 or 5 and chroma of 1 or 2 in 10YR hue. An undisturbed soil has a 1- to 3-inch, dark-colored A1 horizon and a 4- to 10-inch A2 horizon having value of 4 to 6 and chroma of 1 or 2 in 10YR hue. A thin B1 horizon occurs in places. The Bt horizon has value of 4 to 6 and chroma of 1 or 2 in 10YR hue. In some places the B3 horizon is absent. In most areas the C horizon is silt loam, light silty clay loam, or heavy loam. Coarse fragments are generally absent in the upper 40 inches, but thin layers of sand and gravel are in some places below this depth.

Peoga soils are the poorly drained members of the drainage sequence that includes the well drained Mentor soils, the moderately well drained Glenford soils, and the somewhat poorly drained Taggart soils.

Peoga soils have a B2t horizon that is lacking in Melvin and Newark soils, which are on flood plains. They have a coarser textured B horizon than McGary soils, which are on low terraces.

Pe--Peoga silt loam. This nearly level soil is in depressional areas 5 to 50 acres in size.

The smaller areas are oval in shape. The larger areas are long and narrow. Included in mapping are small areas of dark-colored, very poorly drained soils.

This soil is subject to frequent ponding. A few low lying areas are occasionally flooded. Erosion is not a hazard. Wetness is a severe limitation for most farm and nonfarm uses.

This soil is used for crops, pasture, and woodland. It is best suited as woodland, pasture, and habitat for wetland wildlife. Most areas provide good sites for dugout ponds. A few small areas are in urban use. Capability unit IIIw-1; woodland suitability group 3w1.

Sparta Series

The Sparta series consists of deep, sandy, well-drained, nearly level to gently sloping soils that have a dark surface layer. These soils formed in thick deposits of wind- or water-laid material. They are on low terraces that have a smooth, undulating surface.

In a representative profile in a cultivated area, the surface layer is very dark grayish-brown loamy sand 11 inches thick. The subsoil is brown loamy sand that extends to a depth of 43 inches. The substratum to a depth of 90 inches is loose brown sand.

Sparta soils are very rapidly permeable, have a low available water capacity, and have a deep root zone. Natural fertility is medium.

These soils are used mostly for nursery crops (fig. 9) and for urban and industrial uses.

Representative profile of Sparta loamy sand, 0 to 6 percent slopes, in forest tree nursery near Reno, 700 feet east of Ohio State Highway 7, 75 feet south of main nursery road, NW¼NW¼ SE¼ sec. 8, Marietta Township, T. 2 N., R. 8 W.

Ap--0 to 11 inches, very dark grayish-brown (10YR 3/2) loamy sand, (10YR 3/3) when rubbed, (10YR 5/2) when dry; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

B--11 to 43 inches, brown (7.5YR 4/4) loamy sand; massive; very friable; very patchy clay films bridging sand grains and on a few pebbles in lower part; medium acid; clear, smooth boundary.

C--43 to 90 inches, brown (10YR 5/3) sand; single grained; loose; 15 percent pebbles; medium acid.

The solum is 30 to 45 inches thick. Depth to bedrock is more than 6 feet.

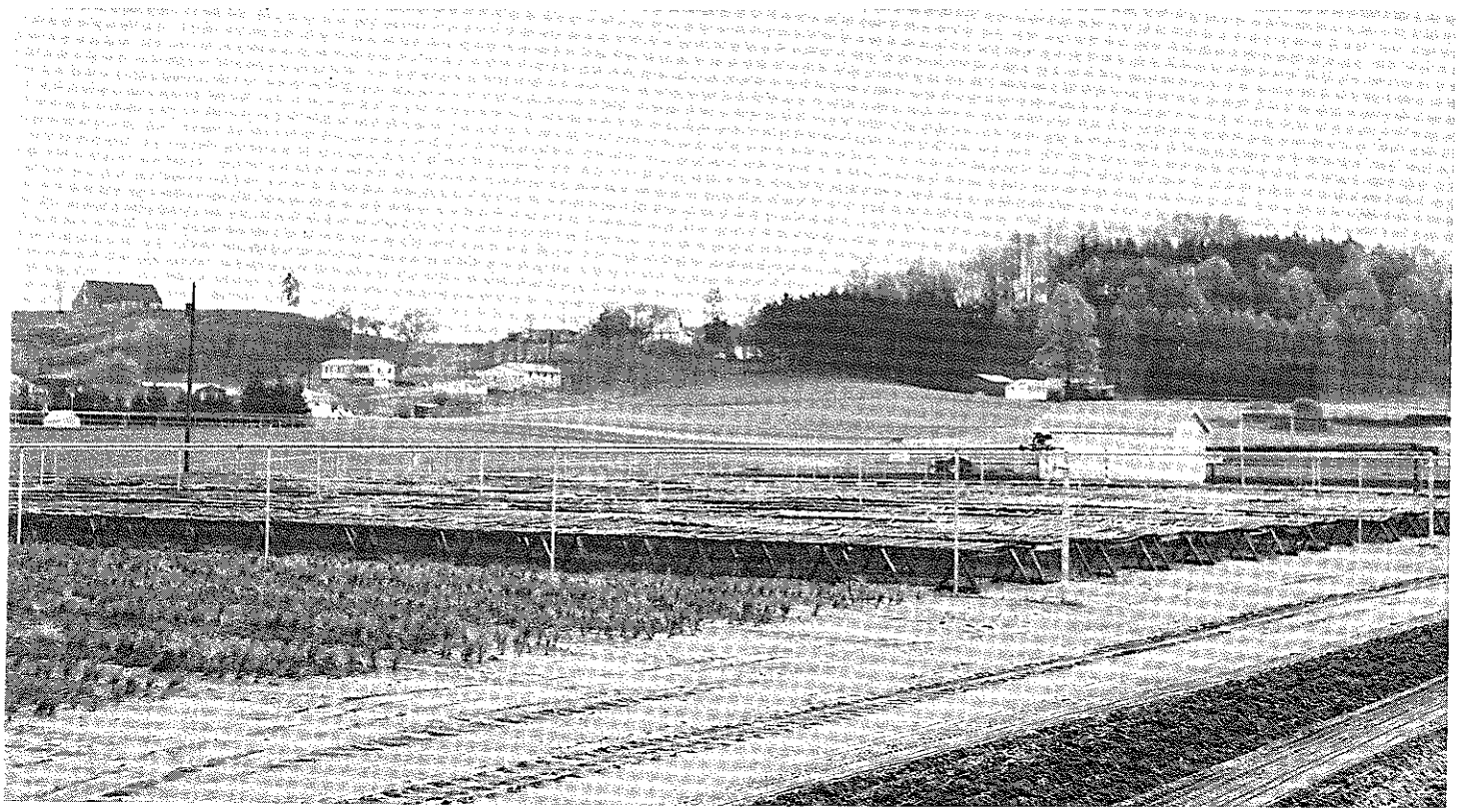

Figure 9.--Productive forest nursery on Sparta soil. This soil is well suited to many kinds of special crops.

The dark-colored A horizon is 10 to 15 inches thick. Unless limed, the soils are medium to strongly acid throughout. The Ap or A1 horizon has hue of 10YR and 7.5YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 7.5YR and value and chroma of 4, 5, or 6. It is sand, fine sand, loamy sand, or loamy fine sand. The C horizon has hue of 10YR and 7.5YR, value of 4 to 6, and chroma of 3 through 6.

The Sparta soils in this county have a slightly thicker solum than Sparta soils elsewhere, but this difference does not affect use and management.

Sparta soils have a darker colored A horizon than the nearby Lakin and Watertown soils.

SaB--Sparta loamy sand, 0 to 6 percent slopes. This nearly level to gently sloping soil is smooth or gently undulating. Areas range from 40 to 80 acres in size.

Included with this soil in mapping are small areas having a light-colored surface layer and areas in which the dark-colored surface layer is only 5 to 9 inches thick. Also included are gravelly soils that have a dark-colored surface layer. These included soils require a higher level of management than this Sparta soil.

Soil blowing is a moderate hazard in cultivated areas. Infiltration is rapid, runoff is slow, and the hazard of water erosion is slight. This soil has loose tilth and is subject to drought. It is suited to irrigation. It has no serious limitations for most nonfarm uses.

This soil is suited to nursery and truck crops. Some areas are home and industrial sites. Capability unit IIIs-1; woodland suitability group 3s1.

Strip Mine Spoil

SM--Strip mine spoil, calcareous, is on the tops and sides of ridges. It is a high wall on the uphill side, graded spoil material on narrow benches below and parallel to the high wall, and very steep spoil on outer slopes below the benches. On ridgetops it occurs as broad areas of graded spoil and very steep outer slopes. Slopes of this spoil are 100 to 600 feet long. Areas range from 30 to 150 acres in size.

This spoil is excavated rock and soil 5 to 20 feet thick. It is dominantly fine textured, but in places is medium textured. The coarse fraction consists of limestone, shale, siltstone, mudstone, and sandstone. The soil material is yellowish brown, reddish brown, grayish brown, and olive. It is about 25 percent rock fragments. Reaction is neutral to mildly alkaline.

On the sides of ridges about 50 percent is undulating and gently rolling and has slopes of 2 to 12 percent, 15 percent is high walls, and 35 percent, on the downslope side, is very steep and very stony spoil.

On ridgetops about 80 percent is graded spoil. Slopes are undulating to gently rolling and dominantly 2 to 12 percent. The outer edges are very stony and very steep.

Included in mapping are small areas of toxic spoil that commonly appears more yellowish and moist on the surface. Also included are deep gullies and many landslide scars on the outer slopes. These areas have not been stabilized and will not support good stands of vegetation.

Tilth is poor. If the plant cover is removed, the erosion hazard is very severe. Runoff is very rapid on the outer slopes.

This spoil contains large masses of material that is easy to manipulate. On stable ridgetops it can be graded and used as building sites. Legumes, grasses, and trees grow in the stable areas. Areas that have a good cover of legumes and grasses can be used for grazing. Capability unit and woodland suitability group not assigned.

SP--Strip mine spoil, acidic (toxic), is on the tops and sides of ridges. It is a high wall on the uphill side, graded spoil on narrow benches below the high wall, and very steep spoil on the downhill side. On ridgetops it occurs as broad areas of graded spoil and very steep slopes along the outer edge. Slopes are 100 to 500 feet long. On the outer edge there are many deep gullies, large boulders, and landslide scars. Areas on ridgetops are blocky; those on the sides of ridges are long and narrow. All range from 5 to 150 acres in size. About 40 percent of this spoil is very strongly or extremely acid and is not toxic.

This spoil is broken rock and soil 5 to 20 feet thick. It is very stony and channery loam or sandy loam and is dark grayish brown; yellowish brown, brown, and olive brown. It is about 35 to 60 percent sandstone fragments, including many that are stone and boulder size. Reaction is extremely acid; pH readings are below 3.8.

On the sides of ridges, about 50 percent is undulating and gently rolling and has slopes of 2 to 12 percent, about 15 percent is high walls, and 35 percent is very steep slopes along the downslope side. On ridgetops about 80 percent is graded spoil. Most areas are undulating to gently rolling and have slopes of 2 to 12 percent. The rest is very steep outer slopes. Where the spoil has been graded, most of the larger stones and boulders have been buried.

Included in mapping are small areas of coaly spoil, mine waste, and bouldery areas.

This spoil is highly toxic and will not support vegetation. The erosion hazard is very severe, landslides are active, and large quantities of sediment are being eroded and deposited on adjacent lower slopes, bottom land, and stream channels. Tilth is poor, and

runoff is very rapid. Stabilization and revegetation of this spoil would be very difficult and costly. Capability unit and woodland suitability group not assigned.

Summitville Series

The Summitville series consists of deep, well-drained soils on uplands. These soils formed in mixed material weathered from shale, siltstone, and sandstone.

In a representative profile in a wooded area, the surface layer is very dark grayish-brown silt loam 1 inch thick over 5 inches of yellowish-brown silt loam. The subsoil, in sequence from the top, is 4 inches of brown silt loam, 6 inches of strong-brown silty clay loam, 19 inches of reddish-brown channery silty clay loam, and 6 inches of reddish-brown very channery silty clay loam. Fractured siltstone bedrock is at a depth of 41 inches.

Summitville soils have moderately slow permeability and a deep root zone. The available water capacity is moderate. Natural fertility is medium.

The steep and very steep soils are mostly in woodland. The sloping and moderately steep soils are mostly in crops and pasture.

Representative profile of Summitville silt loam in an area of Gilpin-Summitville-Upshur complex, 18 to 25 percent slopes, SE¼SW¼SE¼ sec. 26, Grandview Township, T. 2 N., R. 5 W., 400 feet northwest of the junction of County Road 138 on Ohio State Highway 260, 150 feet north of the road:

A1--0 to 1 inch, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; very friable; many roots; 5 percent sandstone fragments; strongly acid; abrupt, smooth boundary.

A2--1 to 6 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure parting to weak, very fine, granular; friable; many roots; 8 percent sandstone fragments; strongly acid; abrupt, smooth boundary.

B21t--6 to 10 inches, brown (7.5YR 5/4) silt loam; moderate, fine, angular blocky structure; friable; many roots; thin, very patchy, reddish-brown (5YR 4/4) clay films; 15 percent sandstone fragments; very strongly acid; clear, smooth boundary.

B22t--10 to 16 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, fine, angular blocky structure; friable; common roots; thin, patchy, reddish-brown (5YR 5/4) clay films; 15 percent sandstone fragments; very strongly acid; clear, smooth boundary.

B23t--16 to 35 inches, reddish-brown (5YR 4/4) channery silty clay loam; strong, medium, angular blocky structure; firm; common roots; thin, continuous, reddish-brown (5YR 4/4) clay films; 20 percent sandstone fragments; many, fine, black stains and concretions; thick, patchy, brown (7.5YR 5/4) silty coatings on vertical ped faces; very strongly acid; clear, smooth boundary.

B3t--35 to 41 inches, reddish-brown (5YR 4/4) very channery silty clay loam; weak, fine, angular blocky structure; firm; thin, continuous, reddish-brown (5YR 4/4) clay films; 75 percent soft siltstone fragments; strongly acid; clear, smooth boundary.

IIR--41 inches, fractured siltstone bedrock.

The solum ranges from 35 to 45 inches in thickness. Depth to bedrock ranges from 3½ to 6 feet. Unless limed, it is strongly to very strongly acid in the upper part and very strongly to slightly acid in the lower part. Coarse fragments range from 5 to 10 percent in the upper part of the profile to 75 percent just above the bedrock.

The A1 horizon is 1 to 2 inches thick. It has value of 2 or 3 and chroma of 1 to 3 in 10YR hue. The A2 horizon has value of 4 or 5 and chroma of 3 or 4 in 10YR and 7.5YR hue. The Bt horizon is 2.5YR to 5YR hue; value is 4 or 5 and chroma is 4 to 6. In places the upper part of the Bt horizon is 7.5YR hue. Texture of the upper 10 to 15 inches of the Bt horizon is heavy silt loam, clay loam, or light silty clay loam. The lower part is silty clay loam, silty clay, or clay. The underlying bedrock ranges from yellow siltstone or sandstone to red clay shale.

Summitville soils are associated with Gilpin, Upshur, and Hayter soils. They are deeper over bedrock and are more reddish than Gilpin soils. They have a coarser textured B horizon and contain more coarse fragments than Upshur soils. They are redder than Hayter soils and are shallower over bedrock.

SuD--Summitville silt loam, 10 to 20 percent slopes. This moderately steep soil is on benches, on side slopes, and in narrow bands on foot slopes. Many benches are in cove positions. Slopes are mostly smooth to slightly concave. Foot slopes and coves are cut by shallow drainageways that are 200 to 400 feet apart. Areas are mostly long and narrow, but the larger ones are blocky. They range from 5 to 40 acres in size.

Included with this soil in mapping are small areas of clayey Upshur and Vandalia soils, which are difficult to plow. Also included are small spots of somewhat poorly drained soils below seep spots and along small drainageways.

Runoff is rapid, and the erosion hazard is severe if this soil is used for grain crops. The steep slope and susceptibility to slips limit the use of this soil for nonfarm purposes.

This soil is suited to crops and pasture and is used for crops, pasture, and woodland. Many areas formerly used for grain crops and later

abandoned have reverted to woodland. Coves and benches commonly support good stands of yellow-poplar. Capability unit IVe-1; woodland suitability group 3r1.

Taggart Series

The Taggart series consists of deep, somewhat poorly drained soils formed in alluvial material on low terraces along major streams in the county. These soils are nearly level to depressional.

In a representative profile in a meadow, the surface layer is dark grayish-brown silt loam 8 inches thick. The subsurface layer is 5 inches of mottled grayish-brown silt loam. The subsoil extends to a depth of 45 inches. The upper 8 inches is mottled yellowish-brown silt loam, and the lower 24 inches is mottled light brownish-gray silty clay loam. The substratum to a depth of 60 inches is mottled yellowish-brown silt loam.

Taggart soils have moderately slow permeability and slow runoff. They commonly receive runoff from higher adjacent slopes. If adequately drained, they have a deep root zone. The available water capacity is high, and natural fertility is medium.

Most areas are used for crops and pasture, but a few areas are under urban development.

Representative profile of Taggart silt loam, 0 to 2 percent slopes, in a meadow in Ludlow Township, SW¼SW¼ sec. 4, T. 3 N., R. 6 W.

Ap--0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) when rubbed; moderate, medium, granular structure; friable; many roots; many fine and medium pores; medium acid; abrupt, smooth boundary.

A2--8 to 13 inches, grayish-brown (10YR 5/2) silt loam; few, fine, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, platy structure; friable; many roots; few fine pores; strongly acid; clear, smooth boundary.

B21t--13 to 21 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; common roots; few fine and medium pores; thin, patchy, brown (10YR 5/3) clay films; strongly acid; clear, smooth boundary.

B22t--21 to 45 inches, light brownish-gray (10YR 6/2) silty clay loam; common, coarse, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; few roots; few fine and medium pores; thin, patchy, brown (10YR 5/3) clay films; strongly acid; clear, smooth boundary.

C--45 to 60 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; friable; strongly acid.

The solum is 40 to 60 inches thick. Unless limed, it is strongly acid or very strongly acid and the C horizon is strongly acid to neutral.

The Ap horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The A2 horizon is silt loam or silty clay loam in hue of 10YR, value of 5 or 6, and chroma of 1 or 2. The Bt horizon is mainly silt loam or light silty clay loam, but some parts are loam. Hue is 10YR or 2.5Y, value is 5 or 6, and chroma is 2 to 4. The C horizon is silt loam or loam.

Soils that are mapped adjacent to the somewhat poorly drained Taggart soils are the well drained Mentor soils, the moderately well drained Glenford soils, and the poorly drained Peoga soils. Taggart soils are coarser textured than the nearby McGary soils.

TaA--Taggart silt loam, 0 to 2 percent slopes. This nearly level soil is on terraces that are fairly low but mainly above the flood level. Individual areas range from 10 to 60 acres in size. Most are long and narrow. A few are more blocky in shape.

Included with this soil in mapping are small areas of poorly drained Peoga soils, which are commonly in shallow depressions and in narrow bands near foot slopes along valley sides.

Wetness is a moderate seasonal hazard if this Taggart soil is used for farming. Seasonal wetness limits many nonfarm uses. Erosion is not a hazard. In some areas diversions are needed to intercept water from adjacent slopes. Capability unit IIw-1; woodland suitability group 2w2.

Tioga Series

The Tioga series consists of deep, well-drained, nearly level soils on flood plains. These soils formed in recent alluvium that is slightly acid or neutral in reaction.

In a representative profile in a cultivated area, the surface layer is brown fine sandy loam 10 inches thick. The subsoil extends to a depth of 38 inches. The upper 10 inches is dark yellowish-brown loam and loamy fine sand, and the lower 18 inches is dark yellowish-brown fine sandy loam. The substratum to a depth of 60 inches is dark yellowish-brown fine sandy loam, loam, and loamy fine sand.

Tioga soils have moderately rapid permeability. The root zone is deep, but the available water capacity is moderate to low because of the high sand content. Natural fertility is medium. Tioga soils are subject to flooding. Floods occur mainly in winter and spring.

Tioga soils are used mostly for row crops, small grain, special crops, and hay. Corn is the principal crop. The soils are well suited to early season crops because they drain readily and warm up quickly in spring. They are well suited to irrigation.

Representative profile of Tioga fine sandy loam, 2 miles northwest of Lowell in Adams Township, 75 feet west of Township Road 32, about 0.2 mile south of its junction with Township Road 123:

Ap--0 to 10 inches, brown (10YR 4/3) fine sandy loam; weak, very fine, granular structure; friable; common roots; neutral; abrupt, smooth boundary.
B21--10 to 20 inches, dark yellowish-brown (10YR 4/4) loam and loamy fine sand; weak, coarse, subangular blocky structure; friable; few roots; neutral; gradual, smooth boundary.
B22--20 to 38 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; weak, coarse, subangular blocky structure; friable; few roots; neutral; gradual, smooth boundary.
C--38 to 60 inches, layers of dark yellowish-brown (10YR 4/4) fine sandy loam, loamy fine sand, and light loam; massive; friable; neutral.

The solum is 24 to 40 inches thick. Depth to strongly contrasting material or bedrock is more than 40 inches. Reaction is slightly acid or neutral throughout. Coarse fragments are few or absent.

The Ap horizon has 10YR hue, value of 3 to 5, and chroma of 3 or 4. An undisturbed profile has a 1- to 2-inch dark-colored A1 horizon and a 5- to 12-inch A2 horizon that has value of 4 or 5 and chroma of 3 or 4 in 10YR hue. The B horizon has 10YR or 7.5YR hue, value of 3 to 5, and chroma of 3 or 4. It is dominantly fine sandy loam or loam, but some parts are loamy sand. The C horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is sandy loam, loamy sand, or loam and in some areas is stratified.

The Tioga soils in Washington County have a slightly higher soil reaction than Tioga soils mapped elsewhere. This difference does not alter their use or management.

Tioga soils are coarser textured than Chagrin and Nolin soils, which are on flood plains.

Tg--Tioga fine sandy loam. This soil is on flood plains mainly along the Muskingum and Ohio Rivers. Slopes are mostly even, but there are some swales. Areas range from about 5 to 30 acres in size. Most are long.

Included with this soil in mapping are a few spots of somewhat poorly drained soils, mostly in depressions where water accumulates for short periods. Crop yields are lower in these spots. Runoff is slow, and erosion is not a hazard. Capability unit IIw-2; woodland suitability group 1o2.

Upshur Series

The Upshur series consists of deep, well-drained, gently sloping to very steep soils formed in material weathered from red clay shale. These soils are on ridges, benches, and side slopes in all parts of the county. They are intermingled with Gilpin, Lowell, and Summitville soils and are mapped with those soils.

In a representative profile in a cultivated area, the surface layer is reddish-brown silty clay loam 6 inches thick. The subsoil to a depth of 40 inches is reddish-brown and dark reddish-brown silty clay and shaly silty clay loam. The substratum is dark reddish-brown very shaly silty clay loam. Dusky red shale bedrock is at a depth of 50 inches.

Upshur soils have slow permeability, rapid runoff, and a moderate available water capacity. The root zone, which is restricted by the clayey subsoil, is moderately deep. Tilth is poor. Farming these soils requires careful management. Unlimed soils are commonly very strongly acid in the root zone. Natural fertility is medium. Steep soils are unstable and subject to landslips. They tend to dry out slowly and crack on the surface.

Representative profile of Upshur silty clay loam, in an area of Gilpin-Summitville-Upshur complex, 12 to 18 percent slopes, SW¼SW¼SW¼ sec. 34, Lawrence Township, 20 feet east of County Road 17 (see profile WS-25 under "Laboratory Data"):

Ap--0 to 6 inches, reddish-brown (5YR 4/3) silty clay loam; moderate, fine, angular blocky structure; friable; many roots; very strongly acid; abrupt, wavy boundary.
B21t--6 to 9 inches, reddish-brown (5YR 4/4) silty clay; moderate, fine and medium, angular blocky structure; firm; common roots; many fine pores; thin, continuous, reddish-brown (5YR 4/3) clay films; very strongly acid; clear, smooth boundary.
B22t--9 to 25 inches, reddish-brown (2.5YR 4/4) silty clay; strong, medium, angular blocky structure; firm; common roots; common fine pores; thin, continuous, weak red (10R 4/3) clay films; very strongly acid; gradual, smooth boundary.
B23t--25 to 35 inches, dark reddish-brown (2.5YR 3/4) silty clay; moderate, medium, angular blocky structure; firm; few roots; common fine pores; thin, continuous, dusky red (10R 3/3) clay films; 5 percent soft, dusky red (10R 3/3) shale chips; very strongly acid; gradual, smooth boundary.
B3t--35 to 40 inches, dark reddish-brown (2.5YR 3/4) shaly silty clay loam; weak, fine,

subangular blocky structure; firm; few roots; few fine pores; thin, patchy, dusky red (10R 3/3) clay films; 20 percent soft, dusky red (10YR 3/3) shale chips; very strongly acid; clear, smooth boundary.

C--40 to 50 inches, dark reddish-brown (2.5YR 3/4) very shaly silty clay loam; massive; 80 percent dusky red (10R 3/3) shale chips; strongly acid; gradual, smooth boundary.

R--50 inches, dusky red (10R 3/3) shale.

The solum is 26 to 44 inches thick. It is 0 to 5 percent coarse fragments in the upper part and 5 to 20 percent in the lower part. Unless limed, it ranges from very strongly acid to medium acid. The C horizon ranges from strongly acid to neutral. Depth to bedrock is 42 to 60 inches.

The A horizon is silty clay loam and clay. The Ap horizon is 4 to 8 inches thick and has value of 4 and chroma of 3 or 4 in 7.5YR and 5YR hue. An undisturbed profile has a 1- to 2-inch, dark-colored A1 horizon and an A2 horizon the same color as the Ap horizon. The B horizon is 5YR, 2.5YR, or 10R hue. Color value and chroma are 3 to 4. The B2 horizon is clay or silty clay. The C horizon has hue of 10R to 5YR, value of 3 to 5, and chroma of 4 to 6.

Nearby are the Woodsfield, Keene, Summitville, Belpre, and Elba soils on uplands; Vincent soils on terraces; and Vandalia soils on colluvial foot slopes. Upshur soils have a finer textured A horizon and upper part of the B horizon than Woodsfield, Keene, and Summitville soils. They are redder and more acid than Elba soils. They are also redder than Lowell soils and more acid than Belpre soils. They are shallower over bedrock than Vincent and Vandalia soils.

UpB--Upshur silty clay loam, 2 to 6 percent slopes. This gently sloping soil is on narrow ridgetops and spurs. Slopes are smooth and convex and are less than 100 feet long. Areas are oval in shape and 2 to 10 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer and the subsoil are a few inches thicker.

Included in mapping are small areas of Summitville, Gilpin, and Woodsfield soils. These included soils have a coarser textured surface layer and are easier to cultivate than the Upshur soil.

Runoff is medium and the erosion hazard is moderate if this Upshur soil is cultivated. Slopes are favorable for limited cultivation. The high shrink-swell potential and the clayey texture limit some nonfarm uses.

This soil is used for crops, pasture, and woodland. It is suited to these uses. Capability unit IIIe-3; woodland suitability group 3c1.

UpC--Upshur silty clay loam, 6 to 12 percent slopes. This sloping soil is on gently rolling ridgetops and spurs and on the upper parts of side slopes. Slopes are convex and are cut by a few shallow drainageways about 400 to 800 feet apart. Areas are long and winding on narrow ridgetops and on side slopes and are blocky on the broader ridgetops. They range from 5 to 60 acres in size.

Included in mapping are small areas of Woodsfield, Summitville, and Gilpin soils. These included soils have a coarser textured surface layer and are more easily managed for farming than the Upshur soil.

This soil has poor tilth and is difficult to manage for grain crops. It is well suited to hay and pasture. The erosion hazard is severe in cultivated areas. Runoff is rapid. The slope, the high shrink-swell potential, the clayey texture, and the slow permeability limit the use of this soil for most nonfarm purposes.

This soil is used for crops and pasture. If protected against excessive erosion, it is suited to crops. Many small areas are idle and are reverting to woodland. Capability unit IIIe-6; woodland suitability group 3c1.

UpD--Upshur silty clay loam, 12 to 18 percent slopes. This moderately steep soil is on rolling ridgetops, on upper side slopes and benches, and in areas around the heads of ravines. Slopes are mostly convex. Around the heads of ravines and on side slopes, the soil is cut by shallow drainageways every 200 to 300 feet. Areas are blocky on broad ridgetops and around the heads of ravines and are long and winding on side slopes and narrow ridgetops. They range from 5 to 80 acres in size.

Included in mapping are small areas of Summitville, Gilpin, and Dekalb soils; small areas on concave slopes of the deeper Vandalia soils; a few spots where the soil is severely eroded and has a reddish clayey surface layer; and a few areas where shallow gullies have formed.

In cultivated areas the erosion hazard is severe, tilth is poor, and runoff is very rapid. The slope, the high shrink-swell potention, and the texture of this soil severely limit its use for nonfarm purposes. The soil is subject to landslides.

This soil is used for crops, pasture, and woodland. It is suited to grasses. Many areas of this soil are in fields of less sloping soils and are cultivated along with those soils. Capability unit IVe-5; woodland suitability group 3c2.

UpE--Upshur silty clay loam, 18 to 25 percent slopes. This steep soil is mainly on upper hillsides, on wide benches at midslope, and in broad hilly areas. Slopes are mostly convex, but in large areas around the heads of ravines, they are concave. Areas are cut by drainageways every 200 to 300 feet. They range

from 10 to 100 acres in size. Most are long and winding, but the larger areas are broad and irregular or somewhat blocky.

The Upshur soil makes up about 70 percent of this mapping unit. It is slightly shallower over bedrock, but otherwise has a profile similar to the one described as representative of the series. Included in mapping are small areas of Summitville and Gilpin soils, both of which are easier to manage for farming than the Upshur soil. Also included are areas of the deeper Vandalia soils on benches and concave slopes.

In cultivated areas the erosion hazard is severe, tilth is poor, and runoff is very rapid. The deep ravines cut fields into small areas that are inconvenient for machinery. The slope and the susceptibility to landslides severely limit the use of this soil for nonfarm purposes.

This soil is used for meadow and woodland and is suited to both. A small grain crop can be grown to reseed a long-term meadow. Capability unit VIe-2; woodland suitability group 3c2.

UrD3--Upshur clay, 12 to 18 percent slopes, severely eroded. This moderately steep soil is on upper side slopes, around the heads of ravines, and on rolling ridgetops. It has been severely eroded by intensive use. Slopes are 100 to 400 feet long. Areas range from 5 to 50 acres in size. The larger areas are blocky, and the smaller ones on side slopes curving around ridgetops are long and narrow.

This soil has a red clay surface layer. The original surface layer has been removed by erosion. In a few spots, weathered shale or siltstone bedrock is exposed. In most places, shallow rills and shallow gullies are numerous.

Included in mapping are a few areas of less sloping soils and small areas of severely eroded Summitville and Gilpin soils. In some of these areas numerous sandstone fragments are on the surface.

This soil is difficult to manage for farming. The erosion hazard is severe if plant cover is lacking. Tilth is poor, and runoff is very rapid. Some areas are scarred by landslips. Logging roads do not support traffic during wet periods. The moderately steep slopes, the high shrink-swell potential, the hazard of slips, and the clayey texture of this soil severely limit most farm and nonfarm uses.

This soil is used mostly for woodland and is suited to this purpose. Large areas of idle brushland are reverting to forest. In areas that have been reforested, most of the gullies have been healed by forest cover. Capability unit VIe-2; woodland suitability group 3c2.

UrE3--Upshur clay, 18 to 25 percent slopes, severely eroded. This steep soil is on upper side slopes, around the heads of ravines, and on hilly ridgetops. The surface is truncated by erosion, and many gullies have formed. Slopes are 300 to 900 feet long. Areas are long and winding and blocky in shape and 10 to 30 acres in size.

This soil has a red clay surface layer. Erosion has removed the original surface layer. Spots of weathered shale and siltstone bedrock are exposed, mostly in gullies. Fieldwork is difficult.

Included in mapping are small areas of severely eroded Summitville, Gilpin, and Belpre soils. Also included are small areas of moderately eroded soils and a few rocky escarpments.

The erosion hazard is very severe where plant cover is lacking. Tilth is poor, and runoff is very rapid. The soil is subject to landslides. Logging roads do not support traffic during wet periods. The steep slope, the hazard of landslides, and the clayey texture of this soil severely limit its use for nonfarm purposes.

This soil is suited to trees. Idle areas are brushy and are reverting to woodland. Most of the gullied areas are covered by pine forest, and the gullies are no longer active. Capability unit VIIe-1; woodland suitability group 3c2.

UsF--Upshur-Gilpin complex, 25 to 35 percent slopes. This very steep mapping unit occurs throughout the county. Around the heads of drainage basins and in some wide areas where there is no bottom land, it covers the entire basin between ridgetops. Slopes are mostly convex and in most areas are cut by shallow drainageways or deep ravines every 200 to 500 feet. Areas range from 25 to 200 acres in size. Most are very long and winding, but the larger areas, which include entire valleys, are blocky.

This mapping unit is about 50 percent Upshur soil and 20 percent Gilpin soil. These soils occur as alternating bands and consequently were not mapped separately. They are slightly shallower over bedrock than is typical and also contain more stone fragments. Included in mapping are areas of Summitville and Vandalia soils and small areas of very stony and severely eroded soils.

The erosion hazard is severe if the soil is bare of vegetation. Tilth is poor and runoff is very rapid. The Upshur soil and the included Vandalia soil are subject to landslides. Smooth slopes can be managed for pasture, but the very steep and rough slopes severely limit most farm and nonfarm uses.

Most areas are used for woodland and pasture. Much of the acreage formerly cultivated, but now abandoned, is reverting to brush and woodland.

Wooded areas on southern exposures are predominantly white oak, lesser amounts of black oak, and scattered hickory. Northern exposures are also dominated by white oak, but have more black oak and scattered chestnut oak, hickory, and other trees requiring only a medium amount of moisture. Capability unit VIe-3; woodland suitability group 3c2.

UsF3--Upshur-Gilpin complex, 25 to 35 percent slopes, severely eroded. This mapping unit is on upper side slopes and around the heads of ravines. Slopes are concave and convex and are truncated by erosion and gullied. Most areas range from 5 to 40 acres in size. Large areas are broad and irregular in shape. Small areas are long and narrow.

This mapping unit is about 50 percent Upshur soil and 20 percent Gilpin soil. These soils occur as alternating bands and were not mapped separately. Both have a thinner surface layer than is typical. In most areas the Upshur soil has a red clay surface layer, and weathered shale and siltstone bedrock is exposed in the gullies. Included in mapping are small areas of Summitville, Belpre, and Vandalia soils.

This mapping unit is very difficult to manage for farming. The erosion hazard is very severe if vegetative cover is lacking. Tilth is poor, and runoff is very rapid. In most areas the fertility level is very low.

This mapping unit is subject to landslides, especially in the Upshur and Vandalia areas. Logging roads do not support traffic during wet periods. The very steep slopes, the susceptibility to landslides, and the clayey texture severely limit this mapping unit for most nonfarm uses.

This mapping unit is suited to trees and is dominantly wooded, chiefly with Virginia pine, which is marketed for pulpwood. Some pine, such as pitch and shortleaf, grows to sawlog size. Idle areas are in weeds, brush, Virginia pine, and other yellow pines that have seeded naturally. Most gullies are covered by pine forest and are no longer active. Capability unit VIIe-2; woodland suitability group 3c2.

UTG--Upshur association, very stony, 25 to 70 percent slopes. This very steep mapping unit is on hillsides. In places it occurs as a band around hillsides and is bordered above and below by less steep soils. In other places it occupies the entire hillside and the gorges. The surface is uneven, has many large stones and boulders, and is cut by several drainageways. Near drainage heads there are deep ravines. Areas are mostly long and winding and range from 50 to 1,000 acres in size. The Upshur soil is about 12 inches thinner over bedrock than is typical.

This mapping unit is about 55 percent Upshur and other fine textured soils and 30 percent Gilpin, Dekalb, and Summitville soils. Included in mapping are very narrow areas of bottom land, rock cliffs, and small areas of Vandalia and Hayter soils. Gilpin and Dekalb soils commonly are on the steeper parts of uneven slopes and near rock outcrop. The deep Vandalia and Hayter soils are in narrow bands on foot slopes.

The erosion hazard is very severe if the plant cover is removed. Runoff is very rapid. Landslides are a hazard. The stoniness, steepness of slope, and hazard of landslides limit most nonfarm uses.

This mapping unit is suited to trees. Most of the acreage is wooded. All exposures are dominated by black oak and have lesser amounts of sugar maple, white oak, and hickory. Capability unit VIIs-1; woodland suitability group 3x1.

Urban Land

UX--Urban land consists of areas under commercial and industrial development. It is more than 50 percent buildings, parking lots, roads, streets, and industrial sites. The rest has been disturbed by cutting and by filling with soil or nonsoil material. Nonsoil fill commonly consists of stone, gravel, brick, cinders, industrial waste, and trash. The surface is generally filled or graded to nearly level or to gentle slopes. Most of the drainage is carried by sewers. Capability unit and woodland suitability group not assigned.

Vandalia Series

The Vandalia series consists of deep, sloping to very steep, well-drained soils on foot slopes and benches below very steep soils. Vandalia soils formed in thick colluvial deposits of mixed soil and rock material.

In a representative profile in a pasture, the surface layer is brown silty clay loam 4 inches thick. The subsurface layer is 9 inches of reddish-brown silty clay loam. The subsoil extends to a depth of 57 inches. The upper 17 inches is reddish-brown and dark reddish-brown silty clay; the lower 27 inches is dark reddish-brown and dusky red channery silty clay. The substratum to a depth of 83 inches is dark reddish-brown channery silty clay.

Vandalia soils have a deep root zone, a moderate available water capacity, and medium natural fertility. They have slow permeability and dry out slowly in spring. They receive runoff and seepage from higher adjacent slopes. They are subject to landslips, particularly during prolonged or seasonal wet periods. Crops respond well to lime and fertilizer.

Vandalia soils are wooded and pastured. A small acreage is cropped (fig. 10).

Representative profile of Vandalia silty clay loam, 18 to 25 percent slopes, 300 feet north of Ohio State Highway 7, SE¼SE¼ sec. 1, of Marietta Township, T. 2 N., R. 8 W. (see profile WS-14 under "Laboratory Data"):

Ap--0 to 4 inches, brown (7.5YR 4/2) silty clay loam; moderate, fine, granular structure; friable; many fine and medium roots; many fine and medium pores; 5 percent siltstone fragments; slightly acid; abrupt, smooth boundary.

Figure 10.--Sloping Vandalia soil is well suited to hay. The hummocky surface is evidence of the unstable nature of the soil.

A2--4 to 13 inches, reddish-brown (5YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; friable; common fine and medium roots; 5 percent siltstone fragments; medium acid; clear, smooth boundary.

B21t--13 to 22 inches, reddish-brown (2.5YR 4/4) silty clay; moderate, medium, angular blocky structure; firm; few roots; common fine and medium pores; thin, continuous, reddish-brown (2.5YR 4/4) clay films on horizontal and vertical ped faces; 5 percent siltstone fragments; very strongly acid; gradual, smooth boundary.

B22t--22 to 30 inches, dark reddish-brown (2.5YR 3/4) silty clay; weak, medium, subangular blocky structure; firm; common fine and medium pores; thin, continuous, reddish-brown (2.5YR 4/4) clay films; 5 percent siltstone fragments; very strongly acid; clear, smooth boundary.

B31t--30 to 48 inches, dark reddish-brown (2.5YR 3/4) channery silty clay; weak, coarse, subangular blocky structure; firm; few fine and medium pores; thin, patchy, reddish-brown (2.5YR 4/4) clay films; 15 percent siltstone fragments; strongly acid; clear, smooth boundary.

B32t--48 to 57 inches, dusky red (10R 3/3) channery silty clay; moderate, medium, subangular blocky structure; firm; few fine pores; thin, patchy, dark reddish-brown (2.5YR 3/4) clay films; 15 percent siltstone fragments; neutral; gradual, smooth boundary.

C--57 to 83 inches, dark reddish-brown (2.5YR 3/4) channery silty clay; massive; firm; thin, very patchy, dark reddish-brown (2.5YR 3/4) clay films; 40 percent siltstone and shale fragments; neutral.

The solum is 40 to 70 inches thick. It is 5 to 35 percent coarse material. Depth to bedrock ranges from 7 to more than 30 feet. The B2t horizon is very strongly acid to medium acid, and the B3t horizon is strongly acid to neutral.

The Ap horizon has hue of 7.5YR and 10YR, value of 3 or 4, and chroma of 2 or 3. If the soil is rubbed, value is more than 3.5. An undisturbed profile has a 1- to 3-inch, dark-colored A1 horizon underlain by an A2 horizon that has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4.

The Bt and C horizons are of 5YR, 2.5YR, and 10R hue, value of 3 or 4, and chroma of 3 or 4. The Bt horizon is heavy silty clay loam, clay loam, and either silty clay or channery silty clay. The C horizon is heavy silty clay loam, clay loam, and clay. It is 15 to 45 percent coarse fragments.

Vandalia soils are similar to Brookside and Hayter soils on colluvial benches and slopes. They are near Hackers, Upshur, and Vincent soils. They are redder than Brookside and Hayter soils and are finer textured than Hayter soils. Also they are finer textured than Hackers soils, which are on low terraces. They are deeper than Upshur soils, which are on uplands, and contain more fragments than Vincent soils, which are on nearby terraces.

VaC--Vandalia silty clay loam, 6 to 12 percent slopes. This sloping soil is on colluvial benches below steep soils on uplands. Slopes are mostly convex. Some are hummocky as a result of small landslips. Most areas are cut by a few shallow drainageways. All are long and winding and 5 to 20 acres in size.

Included with this soil in mapping are wet spots, areas of stony soils, and narrow bottom lands occupied by Hartshorn and Moshannon soils. The wet spots and stony areas limit fieldwork.

Most areas receive some runoff from adjacent higher slopes. The erosion hazard is severe if the soil is cultivated. Runoff is rapid. Slow permeability and the hazard of landslips are limitations for most nonfarm uses.

This soil is used for crops and pasture. In most areas it is suited to these purposes. Capability unit IIIe-6; woodland suitability group 2c1.

VaD--Vandalia silty clay loam, 12 to 18 percent slopes. This moderately steep soil is on colluvial benches or foot slopes below very steep soils on hillsides. It is dissected by shallow drainageways at intervals of 300 to 500 feet. Slopes are generally concave and hummocky. Landslips are in some areas. Areas are long and winding along valley sides and are blocky where they extend across colluvium-filled valleys. They are 5 to 40 acres in size.

Included with this soil in mapping are small areas of well drained Brookside soils; areas where the surface layer is loamy; wet spots; areas where slopes are narrow and very steep; and areas where stones and boulders are on the surface. The spots of Brookside soil are slightly more productive than the Vandalia soil. Stones, irregular slopes, and wet spots make management difficult.

The erosion hazard is very severe if this soil is cultivated. Runoff is rapid. The moderately steep slopes, the high shrink-swell potential, and the susceptibility to landslips limit the use of this soil for most nonfarm purposes.

This soil is best suited to grass crops and trees. Most of the acreage is used for this purpose. Areas that have a uniform, nonstony surface are suitable for cultivation. Capability unit IVe-5; woodland suitability group 2c2.

VaE--Vandalia silty clay loam, 18 to 25 percent slopes. This steep soil is on colluvial benches and foot slopes along stream valleys and below very steep soils on valley sides. Slopes are mostly irregular as a result of small landslips and shallow drainageways. In places stones and a few boulders are on the surface. Areas are commonly long and narrow and are 10 to 60 acres in size. The soil has the profile described as representative of the series.

Included in mapping are small areas of bottom land, seep spots, gullied land, and spots of Brookside soils. Brookside soils are more productive than the Vandalia soil. Active landslips and gullied areas are identified by spot symbols on the soil map.

The erosion hazard is very severe if the plant cover is removed. Runoff is very rapid. Landslips, steep slopes, the clayey texture, and slow permeability limit most nonfarm uses.

This soil is suited to pasture and trees. Many areas are wooded. Stands are chiefly sugar maple, sycamore, and yellow-poplar, and scattered oak and hickory. Capability unit VIe-2; woodland suitability group 2c2.

VaF--Vandalia silty clay loam, 25 to 35 percent slopes. This very steep soil is on colluvial benches, on foot slopes, and on large dissected colluvial deposits in valleys. Slopes are irregular, are bouldery in places, and are dissected by drainageways and ravines. Areas are commonly long and winding and 10 to 100 acres in size. Except for a thinner surface layer and a higher content of rock fragments, this soil has a profile similar to the one described as representative of the series.

Included in mapping are spots of the coarser textured Hayter soils, stony soils, and bedrock outcrop. Stones, boulders, and very steep and uneven slopes limit pasture management.

If the plant cover is removed, the erosion hazard is very severe, runoff is very rapid, and tilth is poor. The soil is highly unstable, and the hazard of landslips is very severe. The very steep slope, the clayey texture, and the poor stability severely limit most nonfarm uses.

This soil is suited to woodland and pasture. Wooded areas are dominantly sugar maple, yellow-poplar, and sycamore, and scattered oak and hickory. Capability unit VIe-3; woodland suitability group 2c2.

The Vincent series consists of deep, well-drained, gently sloping to moderately steep soils on old stream terraces that are about 150 to 300 feet above present streams. Vincent soils formed in lacustrine material.

In a representative profile in a cultivated field, the surface layer is brown silt loam 8 inches thick. The subsoil extends to a depth of 54 inches. The upper 5 inches is brown silty clay loam; the lower 41 inches is reddish-brown and dark reddish-brown silty clay loam and silty clay. The underlying material is dark reddish-brown silty clay to a depth of 74 inches and red silty clay loam to a depth of 104 inches.

Vincent soils have a high available water capacity, medium natural fertility, and a deep root zone. They have slow permeability and tend to dry out slowly in spring.

Vincent soils are used chiefly for crops and pasture. A few areas are wooded.

Representative profile of Vincent silt loam, 2 to 6 percent slopes, in a cultivated field, NE¼NW¼SW¼ sec. 3, Barlow Township, T. 3 N., R. 10 W., 300 feet east of farm lane and 1,000 feet south of U.S. Route 50A:

Ap--0 to 8 inches, brown (7.5YR 4/2) heavy silt loam; weak, medium, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

B21t--8 to 13 inches, brown (7.5YR 5/4) silty clay loam; moderate, fine, angular blocky structure; friable; many fine roots; few fine and medium pores; thin, patchy, dark-brown (7.5YR 4/4) clay films; very strongly acid; clear, wavy boundary.

IIB22t--13 to 23 inches, reddish-brown (5YR 4/4) heavy silty clay loam; moderate, fine and medium, angular blocky structure; firm; common fine roots; few fine pores; thin, patchy, reddish-brown (5YR 4/3) clay films; medium, patchy, light brown (7.5YR 6/4) silt coatings on vertical ped faces; very strongly acid; gradual, smooth boundary.

IIB23t--23 to 34 inches, reddish-brown (2.5YR 4/4) silty clay; weak, coarse, prismatic structure parting to strong, medium, angular blocky; firm; common fine roots; few fine pores; medium, continuous, weak red (2.5YR 4/2) clay films; strongly acid; gradual, smooth boundary.

IIB24t--34 to 46 inches, reddish-brown (2.5YR 4/4) silty clay; weak, coarse, prismatic structure parting to moderate, medium, angular blocky; firm; few fine pores; medium, continuous, weak red (2.5YR 4/2) clay films; slightly acid; abrupt, wavy boundary.

IIB3--46 to 54 inches, dark reddish-brown (2.5YR 3/4) silty clay loam; very weak, coarse, subangular blocky structure; firm; few fine pores; medium, patchy, reddish-brown (2.5YR 4/4) clay films; common, fine, black concretions; slightly acid; clear, smooth boundary.

IIC1--54 to 74 inches, dark reddish-brown (2.5YR 3/4) silty clay; massive; firm; ¼- to ½-inch pockets of reddish-brown (5YR 5/4) calcareous material at 60 to 74 inches; mildly alkaline; gradual, smooth boundary.

IIC2--74 to 104 inches, red (2.5YR 5/6) heavy silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; massive; firm; common, fine, black concretions; mildly alkaline.

The solum is 40 to 70 inches thick. It is free or nearly free of coarse fragments. Depth to bedrock is 6 feet to more than 10 feet. Unless limed, the A and Bt horizons are very strongly acid to slightly acid. The B3 horizon is strongly acid to neutral, and the C horizon is neutral to mildly alkaline.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4 in 7.5YR and 10YR hue. An undisturbed profile has a 1- to 6-inch A1 horizon that is 10YR or 7.5YR hue, has value of 3 or 4, and chroma of 1 to 3. The A2 horizon is 4 to 8 inches thick in unplowed areas and is 7.5YR or 10YR hue, value of 4 or 5, and chroma of 3 or 4. In areas having a thin silt cap, the upper part of the B horizon is 10YR or 7.5YR hue, value of 4 or 5, and chroma of 4 to 6. It is light silty clay loam or silt loam. The B2t horizon is hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 4 to 6. It is silty clay loam, silty clay, or clay. The C horizon is laminated lacustrine sediments of silty clay, silty clay loam, and clay.

Closely associated are Gallia, Licking, Otwell, Upshur, Vandalia, and Woodsfield soils. Vincent soils are finer textured than Gallia and Otwell soils. Also, they differ from Otwell soils in not having a fragipan. They are redder than Licking soils, are deeper over bedrock than Woodsfield and Upshur soils, and contain fewer coarse fragments than Vandalia soils.

VtB--Vincent silt loam, 2 to 6 percent slopes. This gently sloping soil is on wide benches on high terraces. Slopes are gently undulating and predominantly convex. Areas are somewhat irregular in shape, but mostly long and winding. They range from 5 to 80 acres in size.

This soil has the profile described as representative of the series. Included in mapping are small areas of Allegheny, Gallia, and Otwell soils and some areas where the subsoil is less clayey than is typical.

The erosion hazard is moderate if this soil is cultivated. Runoff is medium. A high shrink-swell potential and slow permeability limit most nonfarm uses.

Most of the acreage is cropped. A small acreage is pastured or wooded. The soil is suited to these uses. Capability unit IIe-3; woodland suitability group 2c1.

VtC--Vincent silt loam, 6 to 12 percent slopes. This sloping soil is on high terraces, some of which are on ridgetops. Slopes are slightly convex. Shallow drainageways commonly begin near the outer edge of mapped areas of this soil and are 200 to 700 feet apart. Areas are irregular and range from about 5 to 150 acres in size. The larger areas are long and winding. The smaller areas are rectangular or blocky.

Included in mapping are spots of the coarser textured Allegheny and Gallia soils, small areas of gently sloping soil near the center of ridgetops, narrow bands of moderately steep soil along drainageways, and areas where the soil is moderately eroded.

The erosion hazard is severe if this soil is cultivated. The slope and the slow permeability limit many nonfarm uses.

Most of the acreage is cropped. A smaller acreage is used for pasture. If well managed, this soil is suited to crops. Capability unit IIIe-6; woodland suitability group 2c1.

VtD--Vincent silt loam, 12 to 18 percent slopes. This moderately steep soil is on the sides of high terraces, on benches, and on dissected slopes and low rounded knolls. Shallow drainageways commonly occur at intervals of 100 to 300 feet. Between the drainageways, slopes are convex. Areas range from about 5 to 120 acres in size. The benches are long and winding; other areas are irregular or blocky.

Included in mapping are spots of Gallia, Allegheny, and Upshur soils. The Gallia and Allegheny soils are more easily tilled than the Vincent soils. The Upshur soil has a clayey surface layer and is more difficult to till.

If this soil is cultivated, runoff is very rapid and the erosion hazard is severe. The slope and the slow permeability limit many nonfarm uses.

This soil is used for crops and pasture. It is suited to pasture, hay, and limited cropping. Capability unit IVe-5; woodland suitability group 2c2.

Watertown Series

The Watertown series consists of deep, nearly level to sloping, well-drained soils. These soils formed in sandy glacial outwash on low terraces along the Ohio and Muskingum Rivers.

In a representative profile in a cultivated field, the surface layer is dark-brown sandy loam 13 inches thick. The subsoil extends to a depth of 44 inches. The upper 22 inches is brown loamy coarse sand; the lower 9 inches is brown very gravelly loamy sand. The underlying material is dark yellowish-brown very gravelly and gravelly coarse sand to a depth of 84 inches and yellowish-brown sand to a depth of 110 inches.

Watertown soils have rapid permeability and slow runoff. They have a deep root zone, but the available water capacity is low. Natural fertility is medium, and tilth is good. The soils warm up early in spring and are suited to early season specialized crops.

About a third of the acreage of Watertown soils provides sites for urban development, particularly in the Belpre and Beverly area. The rest is used chiefly for grain and vegetable crops.

Representative profile of Watertown sandy loam, 0 to 2 percent slopes, in a cultivated field in Waterford Township, 200 feet north of barn at junction of Township Roads 32 and 104, 4 miles northwest of Beverly (see profile WS-17 under "Laboratory Data"):

Ap--0 to 13 inches, dark-brown (10YR 4/3) sandy loam; weak, coarse, angular blocky structure parting to weak, very fine, granular; friable; many roots; common coarse to fine pores; dark brown (7.5YR 3/4) coatings on granular surfaces; 1 percent small pebbles; neutral; abrupt, wavy boundary.

B21t--13 to 22 inches, brown (7.5YR 4/4) loamy coarse sand; weak, very coarse, angular blocky structure parting to very weak, medium, subangular blocky; friable, hard; common roots; many, medium, fine pores; strong clay bridging between sand grains; 3 percent small pebbles; slightly acid; gradual, smooth boundary.

B22t--22 to 35 inches, brown (7.5YR 4/4) loamy coarse sand; very weak, coarse, subangular blocky structure; very friable, hard; few roots; weak clay bridging between sand grains; 5 percent small pebbles; medium acid; clear, smooth boundary.

IIB3--35 to 44 inches, brown (7.5YR 4/4) very gravelly loamy sand; weak, very coarse and medium, subangular blocky structure; loose when moist, hard when dry; few roots; weak clay bridging between sand grains; 50 percent small pebbles; medium acid; abrupt, smooth boundary.

IIC1--44 to 61 inches, dark yellowish-brown (10YR 4/4) very gravelly coarse sand; single grained; loose; 50 percent small pebbles; medium acid; abrupt, smooth boundary.

IIC2--61 to 84 inches, dark yellowish-brown (10YR 4/4) gravelly coarse sand; single grained; loose; about 20 percent small pebbles; slightly acid; abrupt, smooth boundary.

IIIC3--84 to 110 inches, yellowish-brown (10YR 5/4) sand with irregular-sized and irregular-shaped chunks of brown (7.5YR 4/4) sand; single grained; loose; slightly acid.

The solum is 25 to 60 inches thick. Unless limed, it ranges from strongly acid to slightly acid. It is 0 to 50 percent pebbles in the upper part and 0 to 75 percent in the lower part and in the C horizon. An undisturbed profile has a 1- to 3-inch, dark-colored A1 horizon. The A horizon ranges from sandy loam to gravelly loamy sand. The Ap horizon is 10YR hue, value of 4 or 5, and chroma of 2 or 3. If the soil is rubbed, value is 4 or 5 and chroma is 3 or 4. The B2t horizon ranges from gravelly loamy sand to sandy loam. The sandy loam layer, if it occurs, is thin. The B2t horizon is 10YR to 7.5YR hue, value of 4 and 5, and chroma of 3 or 4. The B3 horizon is sand or loamy sand and in places is gravelly or very gravelly. It is 10YR to 7.5YR hue, value of 4 or 5, and chroma of 3 to 5. The C horizon ranges from loamy sand to very gravelly sand. It is 10YR or 7.5YR hue, value of 4 or 5, and chroma of 3 or 4.

Similar soils on terraces are Chili, Conotton, Mentor, Sparta, and Wheeling soils. Watertown soils contain more sand than any of those soils except Sparta soils. They have a lighter colored A horizon than Sparta soils.

WaB--Watertown gravelly loamy sand, 2 to 6 percent slopes. This gently sloping soil is on terraces. In most areas slopes are smooth and uniform. Except for a gravelly surface layer and subsoil, this soil has a profile similar to the one described as representative of the series. Included in mapping are small areas of Watertown sandy loam, which is managed similarly to this soil.

This soil is suited to irrigation. Droughtiness is a severe hazard. Runoff is slow, but erosion is a hazard if this soil is cultivated. The slope is a moderate limitation for some urban and other nonfarm uses.

This soil is used for general farming and specialized crops and for urban development. It is suited to these uses. Capability unit IIIs-1; woodland suitability group 3s1.

WbA--Watertown sandy loam, 0 to 2 percent slopes. This nearly level soil is on broad terrace flats. Areas are 30 to 150 acres in size. The larger areas are blocky, and the smaller areas are long and narrow. This soil has the profile described as representative of the series. Small areas of the coarser textured Lakin soils are included in mapping.

The erosion hazard is slight, and runoff is slow. Soil blowing is a moderate hazard when this soil is bare of vegetation. The soil is suited to irrigation. It has few limitations for most nonfarm uses.

This soil is used for general farming and specialized crops and for urban development. It is suited to these uses. Capability unit IIs-1; woodland suitability group 3s1.

WbB--Watertown sandy loam, 2 to 6 percent slopes. This gently sloping soil is on the higher parts of terraces. Slopes are mostly convex and short and are 50 to 200 feet long. Areas are 20 to 150 acres in size. The larger areas are blocky, and the smaller areas are long and narrow. Included in mapping are spots of Lakin loamy sand, which has a looser consistence than the Watertown soil.

This soil is suited to irrigation and to specialized crops. It is subject to soil blowing when it is bare of plant cover. It has few limitations for most nonfarm uses. The hazard of droughtiness is severe.

This soil is used for general farming and specialized crops and for urban development. It is suited to these uses. Capability unit IIIs-1; woodland suitability group 3s1.

WbC--Watertown sandy loam, 6 to 12 percent slopes. This sloping soil occurs as narrow strips between broad terrace levels. Slopes are smooth and uniform and are generally short. Most areas are long and narrow in shape and 20 to 40 acres in size. The surface layer is about 6 inches thick and is a mixture of the original surface soil and some of the upper part of the subsoil. It is lighter in color than the surface layer described in the representative profile. Included in mapping are small areas of Lakin soils and areas where this soil is severely eroded. The eroded areas are lower in productivity.

The erosion hazard is severe if this soil is cultivated. Runoff is medium. Soil blowing is a hazard if this soil is bare of plant cover. The slope is the main limitation for most nonfarm uses.

This soil is used for urban development and for general farming and specialized crops. Capability unit IIIe-5; woodland suitability group 3s1.

Wellston Series

The Wellston series consists of deep, well-drained, gently sloping to moderately steep soils on uplands. These soils formed in material weathered from sandstone, siltstone, or shale. They occur as small areas throughout the county, mostly on ridgetops.

In a representative profile in a wooded area, the surface layer is very dark brown silt loam 2 inches thick. The subsurface layer is pale-brown silt loam 5 inches thick. The subsoil extends to a depth of 36 inches. The upper 18 inches is yellowish-brown and brown silt loam and silty clay loam. The lower part of the subsoil and the substratum are strong-brown channery loam and very channery loam. Fine-grained sandstone bedrock is at a depth of 45 inches.

Wellston soils have moderate permeability and moderate available water capacity. The root zone is deep. Natural fertility is medium.

Nearly all areas of Wellston soils are cropped or pastured. A few small areas are brushy and idle or are wooded.

Representative profile of Wellston silt loam, 6 to 12 percent slopes, in a wooded area, SE¼SE¼SW¼ sec. 8, Watertown Township, T. 4 N., R. 10 W., 0.85 mile south of State Route 676 on County Road 2,100 feet north of junction of road and field lane (see profile WS-5 under "Laboratory Data"):

A1--0 to 2 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; many fine roots; very strongly acid; abrupt, wavy boundary.

A2--2 to 7 inches, pale-brown (10YR 6/3) silt loam; weak, coarse, subangular blocky structure parting to weak, fine, granular; friable; many fine roots; many fine to coarse pores; very strongly acid; clear, wavy boundary.

B1t--7 to 10 inches, yellowish-brown (10YR 5/6) silt loam; weak, medium, subangular blocky structure; friable; many fine roots; many fine to medium pores; thin, very patchy, dark yellowish-brown (10YR 4/4) clay films; brown (10YR 5/3) silty coatings of variable thickness, mostly less than 1 millimeter, on more than 50 percent of vertical surfaces; very strongly acid; clear, smooth boundary.

B21t--10 to 15 inches, brown (7.5YR 5/4) silt loam; moderate, fine and medium, subangular blocky structure; firm; common fine roots; few coarse pores; thin, continuous, brown (7.5YR 4/4) clay films; very strongly acid; gradual, wavy boundary.

B22t--15 to 21 inches, brown (7.5YR 5/4) silt loam; moderate, fine and medium, subangular blocky structure; firm; common fine roots; few coarse pores; thin, continuous, brown (7.5YR 4/4) clay films; strongly acid; abrupt, wavy boundary.

B23t--21 to 25 inches, brown (7.5YR 5/4) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; common fine roots; few fine pores; thin, patchy, brown (7.5YR 4/4) clay films; 3 percent sandstone fragments; very strongly acid; clear, smooth boundary.

IIB3t--25 to 36 inches, strong-brown (7.5YR 5/6) channery loam; weak, medium, subangular blocky structure; firm; slight brittleness; few fine roots; few fine pores; thin, very patchy, pale-brown (10YR 6/3) clay films and few, thin, gray (10YR 5/1) silty coatings in lower part; 20 percent sandstone and siltstone fragments; very strongly acid; abrupt, wavy boundary.

IIC--36 to 45 inches, strong-brown (7.5YR 5/6) very channery loam; many, medium, light brownish-gray (10YR 6/2) mottles or variegations; massive; firm; few roots; few fine pores; 80 percent siltstone fragments increasing to 90 percent in the lower part; strongly acid; abrupt, irregular boundary.

R--45 inches, light olive-brown (2.5Y 5/6), acid fine-grained sandstone; fractured; strong-brown (7.5YR 5/6) loam in cracks 2 millimeters wide that extend to about 52 inches; rock layers grade to hard and compact below 52 inches.

The solum is 32 to 50 inches thick. Unless limed, it is strongly acid to very strongly acid throughout. Depth to bedrock is 3½ to 5 feet.

The Ap horizon is 10YR hue, value of 4 or 5, and chroma of 2 or 3. An undisturbed profile has a 1- to 2-inch, dark-colored A1 horizon. The A2 horizon is 10YR hue, value of 5 or 6, and chroma of 3 or 4. The B horizon is 10YR or 7.5YR hue, value of 4 to 6, and chroma of 3 to 6. It is ordinarily silty clay loam or silt loam, but in places is light clay loam or loam. It is 0 to 20 percent coarse fragments. The C horizon is silt loam, clay loam, and loam. It is 7.5YR and 10YR hue, value of 4 or 5, and chroma of 3 to 6. In places it is as much as 90 percent coarse fragments.

Wellston soils are associated with Alford, Allegheny, Clymer, Dekalb, Gilpin, Woodsfield, and Zanesville soils. They are deeper over bedrock than Gilpin and Dekalb soils. They are coarser textured than Woodsfield soils, which are red in the lower part of the solum. They differ from Zanesville soils in not having a fragipan. They have a lower content of sand than Clymer soils. They differ from Allegheny soils in not having stratified underlying material. They differ from Alford soils in having coarse fragments in the lower part of the solum.

WhB--Wellston silt loam, 2 to 6 percent slopes. This gently sloping soil is on broad ridgetops. Slopes are uniform and mostly slightly convex. The areas are blocky to long in shape and 5 to 10 acres in size. The surface layer and subsoil in a profile of this soil are slightly thicker than those in the representative profile.

Included with this soil in mapping are small areas of Zanesville soils and areas of nearly level Wellston soils. These included soils are in the center of the wider ridgetops and have slower drainage then the surrounding soils. Also included are areas of Clymer soils, which are more loamy than the Wellston soil.

The erosion hazard is moderate if this soil is cultivated. Tilth is medium, and runoff is slow. Except for depth to bedrock, this soil has few limitations for most nonfarm uses.

This soil is used for crops and pasture and is suited to these uses. Ridgetops having good air drainage are suited to fruit and vegetable crops. Capability unit IIe-1; woodland suitability group 2o1.

WhC--Wellston silt loam, 6 to 12 percent slopes. This sloping soil is on ridgetops and upper side slopes bordering gently sloping soils on broad ridgetops. Slopes are smooth and convex. The areas on the entire ridgetop are blocky and on the upper side slopes are long and winding. They are 5 to 40 acres in size. This soil has the profile described as representative of the series.

Small areas of the shallower Gilpin soils and the moderately well drained Zanesville soils are included with this Wellston soil in mapping. Gilpin soils are commonly near slope breaks, and Zanesville soils are near the center of the wider ridges.

The erosion hazard is severe if this soil is cultivated. Tilth and runoff are medium. The slope and the depth to bedrock are limitations for many nonfarm uses.

This soil is used mainly for crops , but also for pasture. It is suited to these uses. Ridgetops are well suited to orchards. Capability unit IIIe-2; woodland suitability group 2o1.

WhD--Wellston silt loam, 12 to 18 percent slopes. This moderately steep soil is on upper side slopes, on knolls and in saddles on ridgetops, and on hillside benches. Slopes are smooth and are mostly convex. Areas are 10 to 30 acres in size. Those on side slopes are commonly long and narrow, and those on ridgetops are blocky. This soil has a profile similar to the one described as representative of the series, but the depth to bedrock is slightly less and the surface layer and subsoil are slightly thinner. Small areas of Gilpin and Dekalb soils near slope breaks are included with this Wellston soil in mapping. These included soils are shallower over bedrock and less productive than the Wellston soil.

If this soil is cultivated, the erosion hazard is very severe. Tilth is medium, and runoff is rapid. The slope and the depth to bedrock are limitations for many nonfarm uses.

This soil is used for crops and pasture. It is suited to grass and hay and to row crops occasionally. Capability unit IVe-1; woodland suitability group 2r1.

Westmore Series

The Westmore series consists of deep, well-drained, steep to very steep soils formed in mixed material weathered from interbedded limestone, shale, siltstone, and sandstone. These soils are in the northern and eastern parts of the county.

In a representative profile in a pasture, the surface layer is dark yellowish-brown silt loam 6 inches thick. The subsoil extends to a depth of 54 inches. The upper 16 inches is brown light silty clay loam; the lower 32 inches is brown clay. The underlying material to a depth of 72 inches is weak red clay.

Westmore soils have moderate permeability in the upper part of the subsoil and slow permeability in the clayey lower part. They have a deep root zone and a high available water capacity. Natural fertility is high.

Westmore soils are used for hay, pasture, and woodland.

Representative profile of Westmore silt loam in an area of Westmore-Lowell-Elba complex, 35 to 70 percent slopes, ¼ mile west of junction of Township Roads 74 and 75, 500 feet south of large oak along Township Road 75, section 20, Aurelius Township, T. 5 N., R. 8 W.

Ap--0 to 6 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, very fine, angular blocky structure; friable; many roots; 2 percent sandstone fragments; medium acid; abrupt, wavy boundary.

B21t--6 to 22 inches, brown (7.5YR 5/4) light silty clay loam; moderate, medium, subangular blocky and angular blocky structure; firm; common roots; many fine and medium pores; thin, patchy, brown (7.5YR 4/4) clay films and few yellowish-brown (10YR 5/4) silty coatings; 1 percent fragments; strongly acid; clear, smooth boundary.

IIB22t--22 to 44 inches, brown (7.5YR 5/4) light clay grading to heavy clay in lower part; moderate, medium, angular blocky structure grading to weak, fine, angular blocky in lower part; firm; few roots; thin, continuous, reddish-brown (5YR 4/3) and brown (7.5YR 4/4) clay films; common, fine, black stains; 5 percent sandstone fragments; strongly acid grading to slighty acid in lower part; clear, smooth boundary.

IIB23t--44 to 54 inches, brown (7.5YR 4/4) clay; few, fine, prominent, white (N 8/0) and light brownish-gray (2.5Y 6/2) mottles; weak, coarse, subangular blocky structure; firm, sticky; few roots; thin, patchy, brown (7.5YR 4/4) clay films; 20 percent sandstone fragments, mostly large flagstones; neutral; abrupt, smooth boundary.

IIIC--54 to 72 inches, weak red (10R 4/3) heavy clay; massive in place, parting to weak, coarse, angular blocky structure; neutral.

The solum is 40 to 60 inches thick. It is less than 5 percent coarse fragments in the upper part. Unless limed, it ranges from strongly acid to medium acid in the upper part and from medium acid to mildly alkaline in the lower part. Depth to bedrock is 4 to 7 feet.

The Ap horizon has value and chroma of 3 or 4 in 10YR or 7.5YR hue. An undisturbed profile has a 1- to 2-inch, dark-colored A1 horizon. The B horizon is 4 or 5 in value and 4 to 6 in chroma in 7.5YR or 10YR hue. It is silt loam or silty clay loam in the upper part and clay or silty clay in the lower part. Depth to bedrock is 4 to 7 feet.

Westmore soils are geographically associated with Lowell, Elba, and Brookside soils. They have less clay in the upper layers than Lowell and Elba soils and are more acid than Elba soils. They contain less coarse fragments than Brookside soils, which formed in thick colluvium on foot slopes.

WkF--Westmore-Lowell-Elba complex, 25 to 35 percent slopes. This very steep mapping unit is on side slopes. Slopes are generally smooth and convex, but in places there are slips, hummocks, gullies, and drainageways. Areas are long, narrow, and winding and range from 15 to 30 acres in size.

The Westmore and the Lowell soil each make up about 30 percent of this unit, the Elba soil about 20 percent, and Belpre, Upshur, Gilpin, and Dekalb soils 20 percent. The soils occur in such a mixed and intricate pattern that they cannot be mapped or managed separately.

Small areas of severely eroded and gullied soils are included with these soils in mapping. Special erosion control is needed on these included soils.

If the plant cover is removed, runoff is very rapid and the erosion hazard is severe. Using machinery is difficult on these very steep soils. Nonfarm use of the soils is severely limited by the very steep slope and the susceptibility to landslides.

This mapping unit is used for pasture and woodland and is suited to both. It is productive of pasture grasses. Black walnut grows naturally. Capability unit VIe-3; woodland suitability group 3c2.

WkG--Westmore-Lowell-Elba complex, 35 to 70 percent slopes. This very steep mapping unit is on side slopes. Slopes are irregular and are cut by drainageways every 200 to 500 feet. Areas are long and winding along valley sides and range from about 10 to 100 acres in size.

The Westmore and the Lowell soil each make up about 30 percent of this unit, the Elba soil about 20 percent, and Brookside, Hartshorn, Belpre, and Gilpin soils 20 percent. These soils occur in such a mixed and intricate pattern that it is not practical to map them separately.

Small severely eroded areas, escarpments, and stony soils are included with these soils in mapping. Prominent escarpments are identified by spot symbols on the soil map.

The profile described as representative of the Westmore series is in an area of this mapping unit.

The erosion hazard is very severe if the soil is bare of vegetative cover. The main limitations for most nonfarm uses are the very steep slopes and the susceptibility to landslides.

This mapping unit is used for pasture and woodland. It is too steep for the machinery needed in improving pasture. It is suited to woodland. Walnut grows well. Capability unit VIIe-1; woodland suitability group 3c3.

WlF--Westmore-Lowell-Elba complex, 25 to 35 percent slopes, benched. This very steep mapping unit is on side slopes where one or more benches occur. The benches are sloping or moderately steep and are less than 150 feet wide. Slopes are irregular and are cut by ravines every 200 to 400 feet. Slips are common. Areas are long and winding and range from about 30 to 40 acres in size.

The Westmore and the Lowell soil each make up about 30 percent of this unit, the Elba soil about 20 percent, and Brookside, Belpre, and Gilpin soils 20 percent. These soils occur in such a mixed and intricate pattern that it is not practical to map or manage them separately. Management is about the same for all but the Gilpin soil, which is coarser textured and more easily managed. Seep spots and small gullied areas are included in mapping. Some are identified by spot symbols on the soil map.

If the plant cover is removed, runoff is very rapid and the erosion hazard is very severe. The benches can be managed as pasture. Some can be used for crops. Nonfarm use of this mapping unit is severely limited by the steep slopes and the hazard of landslides.

This mapping unit is suited to woodland, pasture, and hay. It is used chiefly for woodland. Walnut grows well. Capability unit VIe-2; woodland suitability group 3c2.

WlG--Westmore-Lowell-Elba complex, 35 to 70 percent slopes, benched. This very steep mapping unit is on side slopes where benches occur mostly at midslope and the lower levels. Slopes are irregular and are cut by ravines every 200 to 400 feet. The dominant overall slope is very steep, but the steeper slopes are broken by one or more benches that are too narrow to delineate on the soil map. The benches are moderately steep to steep and about 20 to 150 feet wide.

Areas range from 30 to 200 acres in size. They are typically long and winding, but some are broad and include entire valleys.

The Westmore and the Lowell soil each make up about 30 percent of this unit, the Elba soil about 20 percent, and Brookside, Hartshorn, Belpre, and Gilpin soils 20 percent. These soils occur in such a mixed and intricate pattern that it is not practical to map or manage them separately. The Lowell soil occurs mostly on the benches. Westmore and Elba soils are steeper and are shallower over rock than is typical. Management is about the same for all but the Hartshorn soil, which is on narrow strips of bottom land and is subject to flooding.

Small severely eroded areas, escarpments, seep spots, and stony soils are included in mapping. Some are identified by spot symbols on the soil map.

If the plant cover is removed, runoff is very rapid and the erosion hazard is very severe. The very steep slopes and the hazard

of landslides limit most nonfarm uses. The benches can be used as logging roads. Some are wide enough to be managed as pasture.

This mapping unit is used for pasture and woodland. It is suited to woodland. Walnut grows well. The wider benches are particularly suited to pasture. Capability unit VIIe-2; woodland suitability group 3c3.

Wheeling Series

The Wheeling series consists of deep, well-drained soils formed in material deposited by glacial melt water. These soils are mainly on low terraces along the Ohio and Muskingum Rivers. They are nearly level to very steep.

In a representative profile in a cultivated area, the surface layer is brown silt loam 8 inches thick. The subsoil extends to a depth of 43 inches. In sequence downward, it is 22 inches of brown loam, 6 inches of brown sandy clay loam, and 7 inches of dark yellowish-brown very gravelly sandy loam. The underlying material to a depth of 120 inches is layers of brown loose sandy loam, gravel, and sand.

Wheeling soils have moderate permeability. Water is absorbed readily, and runoff is slow to rapid depending on slope. These soils have good tilth, a high available water capacity, and a deep root zone. Natural fertility is medium.

Nearly all areas of Wheeling soils are in crops or under urban development (fig. 11). Urban uses of these soils are increasing. Gravel and sand are commonly mined.

Figure 11.--Wheeling soils on terraces along the Ohio River. These soils are well suited to most farm and nonfarm uses.

Representative profile of Wheeling silt loam, 2 to 6 percent slopes, in a cultivated area, 2 miles east of Beverly, 3/4 mile east of crossing of railroad and Township Road 32:

Ap--0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; neutral; clear, smooth boundary.
B21t--8 to 20 inches, brown (7.5YR 4/4) loam; weak, medium, subangular blocky structure; friable becoming firm in lower part; many roots; few pores; thin, very patchy, reddish-brown (5YR 4/3) clay films; 2 percent pebbles; medium acid; clear, smooth boundary.
B22t--20 to 30 inches, brown (7.5YR 4/4) loam; moderate, fine, angular blocky structure; firm; few roots; few pores; thin, patchy, reddish-brown (5YR 4/3) clay films; medium acid; abrupt, smooth boundary.
B23t--30 to 36 inches, brown (7.5YR 4/4) light sandy clay loam; moderate, medium, angular blocky structure; firm; few pores; thin, patchy, reddish-brown (5YR 4/3) clay films; 4 percent pebbles; common fine black concretions; medium acid; gradual, smooth boundary.
IIB3--36 to 43 inches, dark yellowish-brown (10YR 4/4) very gravelly sandy loam; very weak, fine, subangular blocky structure; friable; very patchy reddish-brown (5YR 4/3) clay films on pebbles; 60 percent pebbles; medium acid; gradual, smooth boundary.
IIC--43 to 120 inches, layers of brown (10YR 4/3) sandy loam, gravel, and sand; single grained; loose; medium acid.

The solum is 40 to 60 inches thick. Depth to loose sand and gravel ranges from 3½ to 6 feet. Unless limed, the soil is medium acid to very strongly acid throughout.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. An undisturbed profile has a dark-colored A1 horizon. The B horizon has hue of 7.5YR or 10YR and value and chroma of 4 or 5. The B2 horizon is light silty clay loam, light sandy clay loam, loam, or silt loam in the upper part, and gravelly or very gravelly loam, clay loam, or sandy clay loam in the lower part. The C horizon is stratified material that has a high content of gravel and sand.

Wheeling soils occupy about the same position on terraces as Mentor, Chili, and Conotton soils. They are near Allegheny and Watertown soils. They are thinner over gravel and sand than Mentor soils, and they have less sand and gravel in the upper part of the solum than Chili and Conotton soils. They generally have a thinner solum and are less acid than Allegheny soils. They are finer textured than Watertown soils.

WrA--Wheeling silt loam, 0 to 2 percent slopes. This nearly level soil is on low terraces. It is typically smooth and uniform. Areas are commonly blocky in shape and range from 25 to 80 acres in size.

Included with this soil in mapping are small areas of Wheeling fine sandy loam, which has a lower available water capacity than Wheeling silt loam.

Runoff is slow, and erosion is not a hazard. This soil has no serious limitations for intensive cropping or for most nonfarm use.

This soil is used mostly for urban development, but some areas are still farmed. A few areas are excavated for gravel. This soil is easily farmed and is suitable for growing early truck and specialized crops that require clean cultivation. It is one of the most productive soils in the county. Capability unit I-1; woodland suitability group 1o1.

WrB--Wheeling silt loam, 2 to 6 percent slopes. This gently sloping soil is on low terraces. Slopes are smooth or slightly convex. The areas are commonly long and narrow and range from about 50 to 200 acres in size. This soil has the profile described as representative of the series. Included in mapping are small areas of Wheeling fine sandy loam, which has a lower available water capacity than this Wheeling silt loam.

The erosion hazard is moderate if this soil is cultivated. Runoff is slow to medium. Except for gentle slopes, this soil has few limitations for most nonfarm uses. It is well suited to farming, but erosion control is needed.

This soil is used for truck and grain crops. It is also suited to other specialized crops. Large areas are used for urban development. Capability unit IIe-1; woodland suitability group 1o1.

WrC--Wheeling silt loam, 6 to 12 percent slopes. This sloping soil is on low terraces, commonly between terrace levels and bottom land. Slopes are smooth to slightly convex and in places are cut by shallow drainageways. Areas are commonly long and narrow and range from 20 to 30 acres in size. The profile of this soil contains more sand than the one described as representative of the series. The surface layer is lighter colored, and the depth to sandy and gravelly material is slightly less. Included in mapping are spots of the more sandy Watertown soils and the more silty Mentor soils.

Runoff is rapid and the erosion hazard is severe if this soil is cultivated. Slope is the main limitation for most nonfarm uses.

This soil is used for crops, pasture, and urban development. It is suited to these uses. Capability unit IIIe-1; woodland suitability group 1o1.

WrD--Wheeling silt loam, 12 to 18 percent slopes. This moderately steep soil is on terrace remnants at the base of valley sides and between terraces and bottom land or between terrace levels. Slopes are convex, and are cut by drainageways. Areas are mostly long and narrow, but on foot slopes they are blocky. They range from 5 to 25 acres in size. This soil is shallower over sand and gravel than is typical.

Included with this soil in mapping are spots of Chili, Watertown, and Duncannon soils. The Chili and Watertown soils are more droughty than the Wheeling soils.

The erosion hazard is severe if this soil is cropped. Runoff is rapid. Slope is a severe limitation for most nonfarm uses.

This soil is used for urban development, woodland, and pasture. It is suitable for trees and grasses. Capability unit IVe-1; woodland suitability group 1r1.

WrF--Wheeling silt loam, 18 to 35 percent slopes. This steep to very steep soil is on escarpments between low terraces and bottom land. The surface is very irregular and in many places is cut by deep ravines. Areas are very long and very narrow, generally only 100 to 200 feet wide, and range from 10 to 30 acres in size. This soil contains more sand and is shallower over sand and gravel than is typical. Included in mapping are areas of Conotton, Chili, Watertown, and Mentor soils.

The erosion hazard is severe if this soil is bare of vegetation. Runoff is rapid. The steep and very steep slopes severely limit most nonfarm uses.

This soil is used for woodland and pasture and is suited to these uses. Capability unit VIe-1; woodland suitability group 1r1.

Woodsfield Series

The Woodsfield series consists of deep, well-drained soils on uplands. These soils are on ridgetops and benches. They are widely distributed and are extensive in the eastern part of the county. They are gently sloping to moderately steep.

In a representative profile in a cultivated area, the surface layer is brown silt loam 7 inches thick. The subsoil extends to a depth of 50 inches. The upper 14 inches is brown silt loam and silty clay loam. The lower 29 inches is dark-red and dark reddish-brown silty clay and clay. The underlying material to a depth of 63 inches is dark reddish-brown clay and shaly silty clay loam.

Woodsfield soils are moderately permeable in the upper part and slowly permeable in the clayey lower part. The available water capacity is moderate. These soils have medium natural fertility and medium to poor tilth. The root zone is restricted by the clayey subsoil and is only moderately deep. Woodsfield soils are used for crops and pasture.

Representative profile of Woodsfield silt loam, 6 to 12 percent slopes, in meadow 2 miles northwest of Cutler, SE¼SE¼SW¼ sec. 26, Wesley Township, 250 feet south of State Route 555 and 300 feet west of Township Road 359.

Ap--0 to 7 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; 5 percent inclusions of B horizon material; medium acid; abrupt, smooth boundary.

B21t--7 to 10 inches, brown (7.5YR 4/4) heavy silt loam; moderate, medium, angular blocky structure; friable; common roots; thin, very patchy, brown (7.5YR 4/4) clay films; thin brown (10YR 4/3) organic coatings in root channels; strongly acid; clear, smooth boundary.

B22t--10 to 16 inches, brown (7/5YR 5/4) light silty clay loam; moderate, fine, angular blocky structure; friable; few roots; thin, very patchy, brown (7.5YR 4/4) clay films; patchy pale-brown (10YR 6/3) silty coatings; very strongly acid; abrupt, wavy boundary.

B23t--16 to 21 inches, brown (7.5YR 5/4) silty clay loam; strong, fine, angular blocky structure; friable; few roots; thin, patchy, reddish-brown (5YR 4/4) clay films; patchy pale-brown (10YR 6/3) silty coatings; very strongly acid; clear, wavy boundary.

IIB24t--21 to 27 inches, dark-red (2.5YR 3/6) heavy silty clay; moderate, medium, angular blocky structure parting to strong, fine, angular blocky; firm; thin, continuous, dark-red (2.5YR 3/6) clay films; common slickensides; very strongly acid; gradual, smooth boundary.

IIB3t--27 to 50 inches, dark reddish-brown (2.5YR 3/4) clay; weak, coarse, angular blocky structure; firm; thin, continuous, dark reddish-brown (2.5YR 3/4) clay films; few fine dark concretions; medium acid; gradual, wavy boundary.

IIC1--50 to 58 inches, dark reddish-brown (2.5YR 3/4) clay; massive; firm; 5 percent small soft shale fragments; slightly acid; gradual, smooth boundary.

IIC2--58 to 63 inches, dark reddish-brown (2.5YR 3/4) shaly silty clay loam; many black stains; massive; firm; 30 percent soft shale fragments; neutral.

The solum is 40 to 60 inches thick. Depth to bedrock ranges from 40 to 72 inches. The silty mantle is 14 to 26 inches thick. Unless limed, the solum is strongly acid or very strongly acid in the upper part and grades with increasing depth to medium acid to mildly alkaline in the C horizon.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. An undisturbed

profile has a 1- to 2-inch, dark-colored A1 horizon and a 2- to 6-inch A2 horizon in value of 4 or 5 and chroma of 3 or 4 in 10YR and 7.5YR hue. The upper part of the Bt horizon is silt loam or silty clay loam. Hue is 7.5YR or 5YR, value 4 or 5, and chroma 4 to 6. The lower part of the Bt horizon is silty clay or clay in hue of 10R to 5YR, value of 3 to 5, and chroma of 3 to 6. The C horizon ranges from silty clay loam to clay in hue of 2.5YR to 10YR and value and chroma of 3 to 5.

Woodsfield soils are associated with Upshur, Wellston, Zanesville, and Keene soils on uplands and with Vincent soils on nearby terraces. They are coarser textured in the upper part of the solum than Upshur soils. They are finer textured and redder in the lower part of the solum than Wellston and Zanesville soils. They are redder in the lower part of the solum than Keene soils. They are shallower over bedrock than Vincent soils and do not have the laminated substratum that is characteristic of those soils.

WtB--Woodsfield silt loam, 2 to 6 percent slopes. This gently sloping soil is on ridgetops and high benches. Slopes are smooth to slightly undulating in the center of the areas and convex at the margin. Areas range from about 5 to 50 acres in size. The larger areas are typically long. The smaller areas tend to be blocky.

Included with this soil in mapping are small areas of Upshur soils, generally around the edge of ridgetops near slope breaks. Upshur soils have a fine-textured surface layer and are more difficult to till.

The heavy clay in the lower part of the subsoil restricts internal drainage and retards drying out of the soil in spring. It sometimes delays cultivation in wet seasons. Deep-rooted legumes are subject to some frost heaving. If this soil is cultivated, the erosion hazard is moderate and runoff is medium. The main limitation to nonfarm uses is the heavy clay in the lower part of the subsoil, which has low strength and is slowly permeable.

This soil is used mostly for crops. Small acreages are used for pasture or are idle. Capability unit IIe-3; woodland suitability group 2o1.

WtC--Woodsfield silt loam, 6 to 12 percent slopes. This sloping soil is on rounded ridgetops and in bands along the edges of the wider ridgetops. Slopes are smooth or slightly convex. Areas range from 10 to 60 acres in size. They are mostly long and rather narrow, but smaller areas tend to be blocky. This soil has the profile described as representative of the series.

Included in mapping are small areas of Upshur soils, which have a more reddish, finer textured surface layer, are more erosive, and are difficult to till. The smooth surface of this Woodsfield soil favors the use of farm machinery. Deep-rooted legumes are subject to frost heaving. If this soil is cultivated, runoff is rapid and the erosion hazard is severe. Slope and the slow permeability of the subsoil limit most nonfarm uses. The soil is used for general crops and pasture. Capability unit IIIe-6; woodland suitability group 2o1.

WtD--Woodsfield silt loam, 12 to 18 percent slopes. This moderately steep soil is on benches and saddles and rolling, rounded ridgetops. Ridgetops are convex, and the saddles and benches are generally concave. Some benches are cut by shallow drainageways. Areas range from 5 to 40 acres in size. They are typically long and narrow. Larger areas on ridgetops are broad.

Included with this soil in mapping are spots of severely eroded clayey soils, areas of medium-textured Summitville and Gilpin soils, and areas of more poorly drained soils in wet spots on benches.

If this Woodsfield soil is cultivated, the erosion hazard is severe and runoff is rapid to very rapid. Moderately steep slopes and slow permeability limit most nonfarm uses.

This soil is used for pasture and crops. A pasture-crop rotation and long-term meadow are needed for erosion control. Capability unit IVe-5; woodland suitability group 2r1.

WzB--Woodsfield-Zanesville silt loams, 2 to 6 percent slopes. This gently sloping mapping unit is on ridgetops and narrow spurs. It is smooth and convex except for narrow, nearly level spots in the center. Areas range from 5 to 100 acres in size. Large areas are long and broad. Small areas are blocky. The Woodsfield and Zanesville soils occur in such an irregular pattern that it is not practical to map or manage each soil separately. The Woodsfield soil makes up about 50 percent of this unit, and the Zanesville soil about 30 percent. The Zanesville soil is mostly in the smoother areas. The Woodsfield soil occupies low knolls, saddles, and bands around the edge of the ridgetops and, in places, is in alternating bands.

Included with this unit in mapping are small areas of Gilpin and Upshur soils. Also included are soils that resemble Zanesville soils in having a red clay substratum.

This mapping unit is somewhat slow to dry out in spring, and cultivation is delayed in wet years. Deep-rooted legumes are subject to frost heaving. In cultivated areas the erosion hazard is moderate and runoff is slow. The main limitations to nonfarm use are slow permeability and the clayey subsoil of the Woodsfield soil.

Most of the acreage is in crops or pasture. Only a small acreage is in woodland. Capability unit IIe-3; woodland suitability group 2o1.

WzC--Woodsfield-Zanesville silt loams, 6 to 12 percent slopes. This sloping mapping unit is on ridgetops, benches, and spurs. It is typically smooth and convex, but in places it is concave in saddles or it forms low knolls. Areas range from 40 to 150 acres in size and are mostly long and narrow. The Woodsfield

and Zanesville soils occur in such an irregular pattern that it is not practical to map or manage them separately. The Woodsfield soil makes up about 50 percent of most areas, and the Zanesville soils about 30 percent.

Included with this unit in mapping are small areas of Wellston, Gilpin, and Upshur soils and spots of severely eroded soils. Also included are areas of soils that resemble Zanesville soils in having a red clay substratum.

The smooth surface of this mapping unit favors the use of farm machinery. Sometimes wetness delays cultivation. Deep-rooted legumes are subject to damage by frost heaving. In cultivated areas, runoff is rapid and the erosion hazard is severe. Slope and slow permeability limit many nonfarm uses.

This mapping unit is used for crops and pasture. Capability unit IIIe-6; woodland suitability group 2o1.

WzD--Woodsfield-Zanesville silt loams, 12 to 18 percent slopes. This moderately steep mapping unit is on upper side slopes, benches, and low spurs. It is smooth and convex, but in places is cut by drainageways that are not crossable with farm machinery. Areas are commonly long and winding and range from about 5 to 50 acres in size. The Woodsfield and Zanesville soils occur in such an irregular pattern that it is not practical to map or manage them separately. The Woodsfield soil makes up about 40 percent of this unit, and the Zanesville soil about 30 percent. The rest is small areas of Upshur, Gilpin, and Wellston soils and spots of severely eroded soils, all of which were included in mapping. Woodsfield and Zanesville soils have thinner profiles than described as representative of the series.

In cultivated areas, runoff is very rapid and the erosion hazard is severe. Moderately steep slopes and slow permeability limit most nonfarm uses of these soils.

This mapping unit is used for pasture, crops, and woodland. Capability unit IVe-5; woodland suitability group 2r1.

Zanesville Series

The Zanesville series consists of deep, well-drained soils that occupy broad ridgetops and benches on uplands. These soils have a fragipan in the lower part of the subsoil and are underlain by sandstone, siltstone, and shale. They are gently sloping to moderately steep.

In a representative profile in a meadow, the surface layer is brown silt loam 8 inches thick. The subsoil extends to a depth of 58 inches. The upper 13 inches is yellowish-brown silt loam, the next 7 inches is yellowish-brown silty clay loam, and the lower 30 inches is a yellowish-brown, firm, compact loam and clay loam fragipan. The underlying material is 8 inches of yellowish-brown clay loam over 11 inches of yellowish-brown sandy loam in rock fractures. Weathered shale bedrock is at a depth of 77 inches.

Zanesville soils have moderate permeability above the fragipan and slow permeability in the pan. The water table is perched above the pan late in winter and early in spring. Natural fertility is medium. The root zone is moderately deep, and the available water capacity is moderate.

Most areas of Zanesville soils are in crops or are idle. A few areas are wooded.

Representative profile of Zanesville silt loam, 2 to 6 percent slopes, 0.8 mile south of Layman and Township Road 17, 225 feet west of road, 325 feet north of farmhouse; NW¼SE¼ sec. 3, Fairfield Township T. 7 N., R. 11 W. (see profile WS-24 under "Laboratory Data"):

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

B1--8 to 14 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, subangular blocky structure; friable; common fine roots; many medium pores; common, thin, dark yellowish-brown (10YR 4/4) organic coatings; medium acid; clear, wavy boundary.

B21t--14 to 21 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, fine and medium, subangular blocky structure; friable; common fine roots; few medium pores; thin, patchy, yellowish-brown (10YR 5/4) clay films; very strongly acid; clear, wavy boundary.

B22t--21 to 28 inches, yellowish-brown (10YR 5/4) silty clay loam; common, fine, faint, brown (7.5YR 4/4) mottles; moderate, medium, angular blocky structure; firm, slightly brittle; common fine roots; few medium pores; thin, patchy, yellowish-brown (10YR 5/4) clay films; very strongly acid; abrupt, wavy boundary.

IIBx1--28 to 44 inches, yellowish-brown (10YR 5/4) heavy loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles and many, medium, distinct, pale-brown (10YR 6/3) mottles; weakly developed polygons 3 to 4 inches in diameter; very firm, compact and brittle; few fine roots; common fine pores; thick grayish-brown (10YR 5/2) clay films on vertical polygons; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on plates and blocky peds; few fine concretions; very strongly acid; clear, smooth boundary.

IIBx2--44 to 58 inches, yellowish-brown (10YR 5/4) clay loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, thick, platy structure; firm, compact and brittle; few fine pores; thin, patchy, dark yellowish-brown (10YR 4/4) clay films; strongly acid; gradual, smooth boundary.

IIC1--58 to 66 inches, yellowish-brown (10YR 5/4) clay loam; few, fine, distinct,

strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; thin, patchy, dark yellowish-brown (10YR 4/4) and thin, very patchy, grayish-brown (10YR 5/2) clay films; about 15 percent micaceous sandstone fragments; strongly acid; clear, smooth boundary.

IIC2--66 to 77 inches, yellowish-brown (10YR 5/4) sandy loam in rock fractures; massive; friable; 85 percent yellowish-brown (10YR 5/6) fractured micaceous sandstone; medium acid grading to slightly acid in the lower part.

IIR--77 inches, weathered shale bedrock.

The solum is 34 to 60 inches thick. Depth to the fragipan ranges from 24 to 32 inches. Depth to bedrock ranges from 42 to 80 inches. Coarse fragments make up 0 to 15 percent of the solum and 15 to 85 percent of the substratum. Reaction ranges from medium acid to very strongly acid in the upper part of the solum unless the surface layer is limed. The lower part of the solum is strongly acid or very strongly acid.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 to 4. An undisturbed profile has a 1- to 2-inch dark-colored A1 horizon. The A2 horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The upper part of the B horizon, above the fragipan, has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The B horizon is silt loam or silty clay loam in the upper part and clay loam or loam in the fragipan. The fragipan is 12 to 30 inches thick. It has the same color range as the upper part of the B horizon and it is mottled. The C horizon has the same color range as the fragipan. It is light silty clay loam to sandy loam.

Zanesville soils are associated with Alford, Clymer, Gilpin, Wellston, and Woodsfield soils on uplands. They differ from those soils in having a fragipan. Also they are coarser textured and less reddish than Woodsfield soils and are deeper over bedrock than Gilpin soils. They contain less sand than Clymer soils. They are near Otwell soils, which formed in thick, water-deposited material on terraces.

ZnB--Zanesville silt loam, 2 to 6 percent slopes. This gently sloping soil is near the center of ridgetops. Slopes are uniform and slightly convex. Areas are long, mostly broad, and irregular and range from 15 to 300 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are strips that are nearly level. The broader areas include small areas of somewhat poorly drained soils in the center and at the heads of shallow drainageways. These poorly drained spots delay tillage in spring. Small areas of well-drained Wellston, Gilpin, and Clymer soils are near the outer borders of broad areas.

This Zanesville soil has properties that are generally favorable for cultivation, but a perched water table above the fragipan sometimes delays cultivation during wet periods. Runoff is slow and the erosion hazard is moderate if this soil is cultivated. Slow permeability limits some nonfarm uses.

This soil is used mostly for crops or pasture. A few areas are abandoned and are reverting to forest. The gentle slopes are well suited to farming. Capability unit IIe-2; woodland suitability group 3o1.

ZnC--Zanesville silt loam, 6 to 12 percent slopes. This sloping soil is on ridgetops. Slopes are mostly smooth and convex, but in places are cut by a few shallow drainageways. Areas are mostly long and narrow, but range to broad and irregular and from 10 to 60 acres in size.

This soil has a thinner surface layer and a subsoil that contains more rock fragments than is typical. The depth to weathered bedrock is commonly about 54 inches.

Included with this soil in mapping are small areas of Wellston, Gilpin, and Keene soils. These soils are commonly near slope breaks at the outer margin of the areas.

If this Zanesville soil is cultivated, runoff is medium to rapid and the erosion hazard is severe. Slope and slow permeability limit most nonfarm uses.

This soil is used mostly for crops or pasture. The slopes favor the use of most farm machinery. Capability unit IIIe-3; woodland suitability group 3o1.

ZnD--Zanesville silt loam, 12 to 18 percent slopes. This moderately steep soil is on ridgetops and at the heads of ravines. Slopes range from convex to concave and in places are cut by drainageways. Areas are mostly long, narrow, and irregular and range from 5 to 25 acres in size. The profile of this soil differs from the one that is representative of the series in that plowing has mixed the surface layer with the upper part of the subsoil and the subsoil contains more rock fragments. Depth to bedrock is only about 3½ to 4 feet.

Small areas of Wellston, Gilpin, and Clymer soils are included with this soil in mapping. These soils are mostly near the outer edge of the areas.

If this Zanesville soil is cultivated, the erosion hazard is severe and runoff is rapid. Moderately steep slopes and slow permeability limit most nonfarm uses.

This soil is used mostly for pasture or for crops. It is suited to rotation crops, meadows, or pasture. Capability unit IVe-1; woodland suitability group 3r1.

Formation and Classification of the Soils

This section describes the factors and processes of soil formation and explains how they have affected the soils in Washington County. It defines the current system of soil classification and classifies the soils according to that system. This part of the survey also shows laboratory data for selected soils.

Factors of Soil Formation

Soil forms through the actions of weathering and biotic activity on rock and on unconsolidated soil material that has been deposited or accumulated through geologic activity. The characteristics of the soil at any given point depend on the interrelationships of five factors: (1) the physical and mineral composition of the parent material; (2) the climate under which the parent material has accumulated and formed into soil; (3) living organisms in and on the soil; (4) the topography, or relief, of the area; and (5) the time required for the changing of parent material into a soil profile.

Parent Material

Parent material is the unconsolidated mass of material from which a soil forms. The kinds of parent material in Washington County are defined in the paragraphs that follow.

In about 72 percent of the county, the soils formed in residuum from interbedded sedimentary rocks. For example, Upshur soils formed in the residuum of red clay shale, Gilpin soils in residuum of siltstone, and Dekalb soils in the residuum of sandstone. Lowell and Elba soils dominantly formed in limestone residuum. Other soils are in areas of thin interbedded rock, and the residuum is a mixture from several types of bedrock. Summitville soils, for example, formed in residuum from both siltstone and red clay shale.

In about 10 percent of the county, the soils formed in unconsolidated parent material transported by water, gravity, or wind. Most low-lying valley areas have thick layers of silt, sand, gravel, and clay deposited by glacial meltwater or by more recent floodwaters. Chagrin, Hartshorn, Moshannon, Nolin and Huntington are examples of soils formed in material deposited by floodwater or the more recent alluvium. Ashton, Mentor, Glenford, Markland, and Hackers soils are on the loamy or clayey, low-level terraces. Chili, Watertown, and Conotton soils are on the sandy and gravelly, low-level terraces.

In about 8 percent of the county, at higher levels in former preglacial stream valleys, is other water deposited material. Thick layers of silt, clay, and sand were laid down by water during the ponding and changes in drainage of early glacial times. This material is referred to as Minford Silts (12,13). It is mostly in the western and central parts of the county. Minford Silts consists of four layers. In sequence from the top, they are brown loamy alluvium, lacustrine gray clay, lacustrine red clay, and reddish sand. The soils associated with these layers are Otwell or Allegheny, Licking, Vincent, and Gallia. All four layers seldom occur at any one place.

In about 9 percent of Washington County, the parent material is colluvium, a gravity deposit at the base of steep slopes. This material was deposited by downslope movement of soil and rock. Vandalia, Hayter, and Brookside soils formed in colluvium.

In about 1 percent of the county, the soils formed in loess. Wind-deposited silts and fine sands that commonly exceed 3 feet in thickness occur on a few west-facing slopes along the Ohio and Muskingum River Valleys. Lakin soils formed in fine sandy loess. Duncannon and Alford soils formed in silty loess.

Some soils in the county formed in more than one type of parent material. The upper layers of Woodsfield soil, for example, formed in loess. The lower layers formed in residuum of red clay shale.

Climate

The present climate of Washington County is of the humid, temperate, continental type. The effect of such a climate is evident in the soils. Rainfall and temperature have been conducive to plant growth, and as a result, all of the soils have a surface layer that contains a measurable amount of organic matter. The frequency of rainfall has favored the movement of clay from the surface layer to the subsoil. Gilpin and Woodsfield are among the soils that have clay films in the subsoil, which is evidence of such movement. The structure in most of the soils is at least partly the result of freezing and thawing.

In an area the size of a county, climate is fairly uniform. It can differ only locally, as a result of differences in topography or aspect. Consequently, the soils in Washington County differ mainly as a result of differences in parent material, relief, or topography, and time.

Additional information about the climate is given in the section "General Nature of the County."

Living Organisms

Hardwood forest has been the dominant vegetation in Washington County. Most of the soils on uplands, such as Keene, Gilpin, Wellston, and Zanesville soils, are characteristic of soils that formed under hardwoods. They have light-colored surface and subsurface layers. Ashton, Belpre, Huntington, and Sparta soils have a higher organic-matter content, commonly 4 to 7 percent in uneroded areas, and thus have a dark-colored surface layer. The high lime content and the moderately fine texture appear to be important factors in this larger accumulation of organic matter.

Some of the native hardwoods are deep rooted. They take up minerals from lower horizons in the soil and later deposit these minerals on the soil surface, mainly in leaf litter. Yellow-poplar and basswood, for example, mine nutrients, or bases, from the soil and return them to the surface in leaves and other litter. Under yellow-poplars, an A1 horizon is commonly slightly acid to neutral, even in acid soils, such as Gilpin and Wellston.

Insects, worms, tree roots, and small animals mix the soil and make it more permeable by channeling to great depths. Man also is altering the course of soil formation. He has changed the vegetation and drainage pattern and the chemical regime by liming and fertilizing.

Topography

Relief is a major influence on soil-forming processes. It affects the rate of surface drainage, the movement of water through the soil, and the local climate. Steep soils typically have greater runoff, less infiltration of water, and a higher rate of erosion than soils of lesser slope. Consequently, many of the steeper soils have thinner profiles and less distinct horizons than the less sloping soils. Such contrast is evident in the steeper Gilpin soils and the less sloping Wellston soils.

Topography directly affects the microclimate. Slopes that face south or southwest are drier and less productive than those that face north and northeast. The direction of slope affects the degree of exposure to the prevailing winds and the intensity of the sun rays. These forces, in turn, affect the evapotranspiration rate, the breakdown of organic matter, and the kind and rate of vegetative growth. For example, the Gilpin soils on the south aspects are less productive and have slightly less organic matter in the surface layer than the Gilpin soils on north aspects and generally support different kinds of vegetation.

Time

The length of time that parent material has been in place and exposed to the active forces of living organisms and climate is an important factor in soil formation. The soils in Washington County have been forming for varying lengths of time. Soils on the flood plains are among the youngest soils in Washington County. These soils are still affected by periodic flooding and alluvial deposition, both of which interrupt their formation. They have, however, formed a surface layer of organic-matter accumulation, and their subsoil shows evidence of alteration from the original material. Chagrin, Hartshorn, Huntington, Moshannon, and Newark soils are examples.

Others that have indistinct horizons are the steep to very steep soils. The soil material is removed by geologic erosion before it has time to form into a deep soil that has well-defined horizons. The Bt horizon in these soils is weakly expressed or not evident. Examples are the steep Dekalb and Gilpin soils.

Ashton, Conotton, Watertown, Sparta, Lakin, Hackers, Brookside, and Vandalia soils show a moderate degree of formation. They are on low level terraces, alluvial fans, or colluvial toe slopes that are above the flood level or are subject to infrequent flooding. Additional soil material is deposited by occasional high floodwater or by colluvial action.

In contrast, in the older soils on wide flat ridgetops and high level terraces distinct changes from the original parent material are evident. Soil formation has proceeded with few or no interruptions. Allegheny, Gallia, and Woodsfield soils have profile characteristics produced by long periods of essentially uninterrupted soil formation. Among these characteristics are the deep leaching of carbonates and the formation of a thick, well-defined Bt horizon.

Processes of Soil Formation

The factors of soil formation defined in the foregoing paragraphs largely control or influence four soil-forming processes (10), namely, additions, losses, transfers, and alterations. Change within a soil is promoted by some processes and retarded or precluded by others.

Additions to soils are chiefly the addition of organic matter to the surface layer, the addition of bases in the organic matter and in ground water, the deposition of silt by runoff water from sloping areas at higher elevations, and the addition of bases contained in lime and fertilizer. The dark-colored surface layer of Ashton, Belpre, and other soils is evidence of the addition of organic matter. All the soils

have had at least a thin layer of organic accumulation, but in some places cultivation has largely destroyed this identity. Also in all soils, to some extent, plant nutrients are recycled from soil to plants and back to soil in the form of litter or organic material. Chagrin, Hartshorn, Huntington, Moshannon, Newark, and other soils periodically receive additions of soil material from floodwater. Additions of lime and fertilizer in cultivated areas counteract, or exceed, losses of plant nutrients that ordinarily occur.

Losses in soils occur as removal of bases through leaching, removal of plant nutrients through cropping, and actual loss of soil through erosion. One of the most significant losses in Washington County soils involves the leaching of carbonates. In soils of the uplands, Lowell soils, for example, carbonates have been leached to a depth of 35 to 60 inches. Soil minerals break down and also are lost through leaching, but at a slower rate than the carbonates. The alteration of iron-enriched minerals produces free iron oxides, which appear as fairly bright reddish or brownish colors in such soils as Belpre and Upshur. The mottling in all but the well-drained soils is caused by reduction and resegregation of the iron oxides as a result of excess water or a slowly permeable soil horizon.

The most significant transfers in the soils of Washington County are the transfers of colloidal material from the surface layer to the lower horizons. The fine clays are suspended in water that percolates downward from the surface layer. During seasonal drying or precipitation the fine clays are deposited on the soil surface, in cracks or root channels. Clay films are evident in the lower horizons of Allegheny, Woodsfield, and Zanesville soils. Various sesquioxides are also transferred from the surface to lower horizons in most of the soils.

Alteration within the zone of weathering involves the transformation of primary minerals, such as feldspars and biotite, into silicate clay minerals. Illite and vermiculite are two of the most common clay minerals in the soils of Washington County. Kaolinite clay indicates fairly intense weathering and occurs in small amounts in most of the soils.

Classification of Soils

The purpose of soil classification is to help us remember the significant characteristics of soils, assemble our knowledge about the soils, see their relationships to one another and to the whole environment, and develop principles relating to their behavior and their response to manipulation. First through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The current system of soil classification (15) was adopted by the Cooperative Soil Survey in 1965. It is a comprehensive system, designed to accomodate all soils. It defines classes of soils in terms of observable or measurable properties. The properties chosen are primarily those that result in the grouping of soils of similar genesis, or mode of origin. Genesis does not, however, appear in the definitions of the classes.

The current system of classification has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. Table 10 shows the classification of the soils of Washington County according to this system. Brief descriptions of the six categories follow.

Order.--Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate orders are those that tend to give broad climatic groupings of soils. Two exceptions to this generalization are the Entisols and the Histosols, both of which occur in many different climates. Each order is identified by a name of three or four syllables ending in sol (Entisol).

Suborder.--Each order is divided into suborders, mainly on the basis of soil characteristics that result in grouping soils according to genetic similarity. The climatic range is narrower than that of the order. The properties used are mainly those that reflect either the presence or absence of waterlogging or differences in climate or vegetation. The names of suborders consist of two syllables, the last of which indicates the order. An example is Aquent (Aqu, meaning water or wet, and ent from Entisol).

Great group.--Each suborder is divided into great groups on the basis of similarity in the kind and sequence of the major horizons and in major soil properties. The horizons considered are those in which clay, iron, or humus have accumulated and those in which pans that interfere with the growth of roots and the movement of water have formed. The properties are soil temperature, chemical composition (mainly content of calcium, magnesium, sodium, and potassium), and the like. In the name of a great group, a prefix is added to the name of the suborder. An example is Haplaquents (Hapl, meaning simple horizons, aqu for wetness or water, and ent, from Entisol).

Subgroup.--Each great group is divided into subgroups, one that represents the central (typic) concept of the group. Typic Haplaquent, for example, means typical Haplaquent. Others, called intergrades, have one or more properties of another great group, suborder, or order.

Family.--Families are established within each subgroup, primarily on the basis of properties important to the growth of plants or properties significant in engineering. Texture,

kinds of clay minerals, reaction, soil temperature, permeability, thickness of horizons, and consistence are among the properties considered.

Series.--A series is a group of soils that have horizons similar in all important characteristics, except for texture of the surface layer, and similar in arrangement in the profile. (See the section "How This Survey Was Made.")

Laboratory Data

The results of laboratory analyses on soils representing 15 soil series in Washington County are shown in table 11. Profiles for these series are described in the section "Descriptions of the Soils," as well as in this section. The profiles described in this section represent part of the range of the series, but are not so typical as the representative profile in "Descriptions of the Soils."

Data in table 11 were determined at the Agronomy Department, Ohio Agricultural Research and Development Center (OARDC), Columbus, Ohio. The soils analyzed were selected to add to the knowledge about Ohio soils and to aid in their proper classification and interpretation. Of special concern in the classification of Washington County soils was the percent base saturation and texture family of many of the soils.

Published and unpublished laboratory data are available for nearly all Washington County soils. Published laboratory data are available in the soil surveys of nearby counties. Unpublished laboratory data are on file at the Agronomy Department OARDC, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio.

The following paragraphs outline some of the procedures used to obtain the data presented in table 11.

Particle-size distribution data were obtained by the pipette method outlined by Steele and Bradfield (11), but modified by using sodium hexametaphosphate as the dispersing agent and a 10-gram soil sample. The sand fractions were determined by sieving. The fine silt and coarse clay (20-0.2 micron) were determined by gravity sedimentation, and the fine clay (0.2 micron) was determined by sedimentation in a centrifuge. Coarse silt was obtained by substracting sand, fine silt, and clay from the total sample. The percentage of organic matter was determined by a dry combustion method. Extractable bases were extracted with a neutral solution of ammonium acetate. The extractable potassium in this solution was determined with a flame photometer (8). Extractable calcium and magnesium in this solution were determined by the EDTA method (3). Extractable hydrogen was determined by the triethanolamine method (8). All pH measurements were made using a 1:1 soil-water ratio.

The kinds of clay minerals are identified in the Gallia, Licking, Markland, and Otwell soils in table 12. Data in table 12 were determined by the Agronomy Department, OARDC, Columbus, Ohio under the direction of Dr. L. P. Wilding.

Procedures for X-ray analysis and for the interpretation of X-ray defractograms are essentially the same as reported previously (16, 18).

Licking (WS-2) and Markland (WS-3) soils formed in lacustrine sediments on terraces. According to the data in table 11 mineralogical placement of the Markland soil is illitic and that of the Licking soil is mixed, bordering on illitic. The Markland soil is classified as mixed; data are insufficient to warrant changing the mineralogical placement to illitic.

Markland and Licking soils have similar kinds of clay minerals. Neither contains appreciable amounts of expandable minerals, but each is about 10 to 20 percent interstratified components. In each profile the content of illite increases and that of vermiculite decreases with increasing depth, which reflects pedogenic weathering of illite to vermiculite in the upper part of the solum. On the basis of the percentage of clay and the kinds of clay minerals, both soils would be classified as having moderate to high shrink-swell potential in subsurface horizons.

Gallia (WS-1) and Otwell (WS-11) soils formed in water-deposited sandy and silty material. They are not fine textured; thus, the kind of clay mineral is not significant in the family classification. The clay mineral composition of the Gallia soil is mixed with about equal percentages of illite and kaolinite (20 to 30 percent of each) and somewhat lower quantities of vermiculite and expandable clays. The kaolinite in the Gallia soil seems to be inherited from the sandy parent material because the content increases with increasing depth and is highest in the lower part of the solum. No consistent trends were noted in other clay minerals of this profile.

The Otwell soil is characterized by a vermiculite-expandable clay mineral system. These high-activity clays result in an average cation-exchange capacity for the total clay fraction of about 10 milliequivalents for 100 grams of clay.

Gallia and Otwell soils have moderate shrink-swell potential.

From the standpoint of engineering interpretations, on a per unit clay basis, the hazard of instability would be more serious in a soil having more expandable clay mineral components (either montmorillonite or the montmorillonite-illite interstratified group) than in a soil having smaller quantities of these components.

TABLE 12.--CLAY MINERALS IN GALLIA, LICKING, MARKLAND, AND OTWELL SOILS

[Data determined by the Agronomy Department, Ohio Agricultural Research and Development Center, under the direction of Dr. L. P. Wilding. Percentages are rounded to nearest whole number, but are accurate to only about 5 percent. Dashes indicate specified minerals not detected]

Soil and sample number	Horizon	Depth	Illite	Expandables	Vermiculite	Chlorite	Kaolinite	Quartz	Interstratified
		Inches	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Gallia (WS-1).	Ap	0-8	23	4	22	4	11	20	17
	B21t	12-19	25	12	26	6	13	20	6
	B22t	23-30	23	19	19	--	25	14	T 1/
	B23t	30-41	19	18	25	--	22	16	T
	B24t	41-49	15	20	26	--	23	17	--
	B24t	62-67	31	12	52	--	29	12	--
	C	83-93	25	11	14	--	29	21	--
Licking (WS-2).	B&A	8-12	36	T	25	--	18	13	21
	B21t	16-22	41	T	23	--	14	10	15
	IIB22t	29-36	55	T	15	--	4	8	18
	IIB32	51-60	63	T	15	--	4	7	11
Markland (WS-3).	Ap	0-7	35	--	24	--	6	17	17
	B23t	17-23	56	--	23	--	7	5	8
	B3	33-49	65	--	12	T	4	7	10
	C	56-64	66	--	19	T	4	7	10
Otwell (WS-11).	A2	3-7	12	3	47	4	2	17	15
	B22t	16-22	19	17	33	8	6	17	--
	Bx1t	22-27	16	22	38	--	8	16	--
	Bx4t	42-49	12	48	24	--	8	9	--
	B3	70-75	12	41	20	--	6	21	--

1/ Trace, or less than 1 percent.

In evaluating the stability of soils for building purposes, however, it is necessary to consider both the total clay content and the type of clay mineral. The integrated effect of these two parameters is most influential in dictating the total magnitude of volume change in mineral soils.

The following soil profiles are not described in the section "Descriptions of the Soils."

Profile of Otwell silt loam in Waterford Township, 2 miles north of Beverly, 100 feet east of junction of State Highway 339 and Township Road 121.

O1--1¼ to ¼ inch, oak leaves and litter.
O2--¼ inch to 0, dark-brown mull.
A1--0 to 3 inches, very dark grayish-brown (10YR 3/2) silt loam; strong, fine, granular structure; friable; many roots; strongly acid; abrupt, wavy boundary.
A2--3 to 7 inches, brown (10YR 5/3) silt; massive in the upper part and moderate, medium, platy structure in lower part; friable; many roots; few fine pores; strongly acid; abrupt, wavy boundary.
B1--7 to 11 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, subangular blocky structure; friable; common roots; many fine pores; very strongly acid; clear, wavy boundary.
B21t--11 to 16 inches, yellowish-brown (10YR 5/6) silt loam; moderate, medium, subangular blocky structure; friable; 15 percent of ped faces have thin pale-brown (10YR 6/3) silty films, 5 percent of ped faces have thin yellowish-brown (10YR 5/4) clay films; common roots; many fine pores; very strongly acid; clear, smooth boundary.
B22t--16 to 22 inches, yellowish-brown (10YR 5/6) silt loam; moderate, medium, angular blocky structure; friable; common roots; many fine pores; 15 percent of ped faces have thin pale-brown (10YR 6/3) silty films, 15 percent of ped faces have thin yellowish-brown (10YR 5/4) clay films; very strongly acid; abrupt, wavy boundary.
Bx1--22 to 27 inches, yellowish-brown (10YR 5/6) silty clay loam; few, fine, light brownish-gray (10YR 6/2) mottles; weak, thick, platy structure parting to moderate, medium, angular blocky; firm, slightly brittle; few roots; common fine pores; 70 percent of ped faces have medium pale-brown (10YR 6/3) silty films, 20 percent of ped faces have medium-brown (7.5YR 4/4) clay films; very strongly acid; abrupt, wavy boundary.

Bx2--27 to 33 inches, yellowish-brown (10YR 5/6) silt loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, very coarse, prismatic structure parting to moderate, medium, angular blocky; very firm, brittle; few fine roots and pores; primary structure faces have 5 millimeters thick continuous brown (7.5YR 5/2) clay films; secondary structure faces have medium, patchy, brown (7.5YR 4/4) clay films; extremely acid; abrupt, smooth boundary.

Bx3--33 to 42 inches, yellowish-brown (10YR 5/6) silt loam; few, fine, distinct, grayish-brown (10YR 5/2) mottles; weak, very coarse, prismatic structure parting to weak, coarse, angular blocky; very firm, brittle; few roots; few fine pores; 50 percent of prism faces have mottled brown (7.5YR 5/2) and dark-brown (7.5YR 4/4) clay films 2 millimeters thick, 5 percent of ped faces have pale-brown (10YR 5/2) and dark-brown (7.5YR 4/4 clay films, 5 percent of ped faces have pale-brown (10YR 6/3) silty films; very strongly acid; gradual boundary.

Bx4--42 to 70 inches, yellowish-brown (10YR 5/6) silty clay loam; few, fine, distinct, grayish-brown (10YR 5/2) mottles; very weak, coarse, subangular blocky structure; very firm, brittle; few roots; few fine to medium pores; vertical structure faces have medium, continuous, light brownish-gray (10YR 6/2) clay films, horizontal structure faces and pores have thin, very patchy, brown (7.5YR 5/4) clay films; 5 percent small rotted pebbles; strongly acid; gradual boundary.

B3--70 to 75 inches, yellowish-brown (10YR 5/6) and light brownish-gray (10YR 6/2) silty clay loam; weak, coarse, subangular blocky structure; friable; many small seams of light brownish-gray (10YR 6/2) clay; slightly acid; abrupt, smooth boundary.

IIC--75 to 92 inches, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6) clay loam; very thick seams of light brownish-gray (10YR 6/2) clay; neutral. (Not sampled).

Profile of Vincent silt loam (WS-6) in Palmer Township, SE¼ sec. 25, ¼ mile north and 330 feet west of southeast corner.

A11--0 to 1 inch, very dark grayish-brown (10YR 3/2) silt loam; strong, medium, granular structure; friable; many fine and medium roots; slightly acid; abrupt, wavy boundary.

A12--1 to 5 inches, dark-brown (10YR 3/3) silt loam; weak, fine and medium, angular blocky structure; friable; many fine and medium roots; strongly acid; abrupt, wavy boundary.

A2--5 to 10 inches, dark-brown (7.5YR 4/4) silt loam; moderate, medium, subangular blocky structure; friable; many fine to coarse pores; strongly acid; abrupt, wavy boundary.

B1t--10 to 15 inches, brown (7.5YR 5/4) silt loam; moderate, medium, angular and subangular blocky structure; firm; common fine and medium roots; common fine to coarse pores; thin, patchy, reddish-brown (5YR 5/4) clay films on 25 percent of ped faces; very strongly acid; abrupt, smooth boundary.

IIB21t--15 to 21 inches, reddish-brown (5YR 5/4) silty clay loam; strong, fine and medium, angular blocky structure; firm; common fine and medium roots; common fine to coarse pores; thin, continuous, reddish-brown (5YR 5/4) clay films on 80 percent of ped faces; very strongly acid; clear, smooth boundary.

IIB22t--21 to 27 inches, reddish-brown (5YR 4/4) silty clay loam; weak, medium, prismatic structure parting to strong, medium, angular blocky; firm; common fine roots; few fine pores; thin, continuous, reddish-brown (2.5YR 4/4) clay films on 80 percent of ped faces; strongly acid; abrupt, irregular boundary.

IIB23t--27 to 34 inches, reddish-brown (5YR 4/4) silty clay; weak, coarse, prismatic structure parting to moderate, medium, angular blocky; firm; few fine roots; few fine pores; medium, continuous, reddish-brown (2.5YR 4/4) clay films; few small patches of thin reddish-brown (5YR 5/3) silt coatings; very strongly acid; gradual, smooth boundary.

IIB24t--34 to 46 inches, reddish-brown (5YR 4/4) silty clay loam; moderate, medium, angular blocky structure; firm; few roots; few black concretions; medium, continuous, reddish-brown (5YR 4/4) clay films; strongly acid; gradual, smooth boundary.

IIB3--46 to 52 inches, reddish-brown (5YR 4/4) silty clay; moderate, medium, angular blocky structure; firm; few roots; thin strong-brown (7.5YR 5/6) silt loam laminae; few coarse black concretions; thin, very patchy, reddish-brown (5YR 4/4) clay films; slightly acid; gradual, smooth boundary.

IIC--52 to 88 inches, dark reddish-brown (2.5YR 3/4) silty clay; massive; firm; thin strong-brown (7.5YR 5/6) silt loam laminae; neutral.

Profile of Wheeling silt loam (WS-10) in Waterford Township, 2 miles northwest of Beverly, ¼ mile northwest of junction of State Highways 83 and 60, 200 feet northeast of road.

A1--0 to 5 inches, dark-brown (10YR 3/3) silt loam; moderate, very fine, granular structure, friable; many fine roots; strongly acid; abrupt, smooth boundary.

A2--5 to 10 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, fine and medium, subangular blocky structure; friable; common fine roots; few fine pores; very strongly acid; clear, wavy boundary.

B1--10 to 16 inches, brown (7.5YR 4/4) silt loam; moderate, medium, subangular blocky structure; friable patchy brown (7.5YR 4/4) silty films; common fine roots; many fine and medium pores; very strongly acid; abrupt, wavy boundary.

B21t--16 to 25 inches, brown (7.5YR 4/4) silt loam; moderate, medium, angular blocky structure; friable; thin, patchy, brown (7.5YR 4/4) clay films on 25 percent of ped faces; common fine roots; many fine to coarse pores; very strongly acid; clear, smooth boundary.

B22t--25 to 29 inches, brown (7.5YR 4/4) silt loam; moderate, fine and medium, angular blocky structure; friable; thin, patchy, brown (7.5YR 4/4) clay films on 40 percent of ped faces; common fine roots; many fine to coarse pores; very strongly acid; abrupt, smooth boundary.

IIB23t--29 to 35 inches, brown (7.5YR 4/4) gravelly loam; weak, medium, subangular blocky structure; firm; clay bridging between sand grains; thin, patchy, brown (5YR 4/4) clay films on 70 percent of pebble surfaces; few fine concretions; common fine roots; many fine to coarse pores; 40 percent pebbles; very strongly acid; gradual, wavy boundary.

IIB24t--35 to 43 inches, brown (7.5YR 4/4 gravelly loam; weak, fine, subangular blocky structure, friable; clay bridging between sand grains; thin, patchy, brown (5YR 4/4) clay films on 40 percent of pebble surfaces; few fine concretions; few fine roots; common fine pores; 45 percent pebbles; very strongly acid; clear, wavy boundary.

IIB25t--43 to 60 inches, brown (7.5YR 4/4) very gravelly sandy clay loam; weak, fine, subangular blocky structure; friable; clay bridging between sand grains; thin, patchy brown (5YR 4/4) clay films on 30 percent of pebble surfaces; few fine roots; 55 percent pebbles; very strongly acid; clear, wavy boundary.

IIC--60 to 110 inches, dark yellowish-brown (10YR 3/4) stratified very gravelly sandy clay loam and coarse sandy loam; weak, fine, subangular blocky structure; friable; 55 percent pebbles; strongly acid; abrupt, smooth boundary.

IIIC2--110 to 158 inches, dark yellowish-brown (10YR 3/4) loamy sand; structureless; 5 percent pebbles; slightly acid.

Profile of Woodsfield silt loam in Watertown Township, SE¼SE¼SW¼ sec 8, 0.85 mile southeast of junction of County Road 2 and State Highway 676.

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

A2--2 to 6 inches, yellowish-brown (10YR 5/4) silt loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; many fine and medium roots; common fine and medium pores; medium acid; clear, wavy boundary.

B21t--6 to 14 inches, strong-brown (7.5YR 5/6) silt loam; moderate, medium, subangular blocky structure; friable; 70 percent of ped faces have thin, patchy, reddish-brown (5YR 5/4) clay films; common roots; common fine and medium pores; strongly acid; clear, smooth boundary.

B22t--14 to 22 inches, strong-brown (7.5YR 5/6) light silty clay loam; moderate, medium, angular blocky structure; friable; thin, patchy, reddish-brown (5YR 5/4) clay films on ped faces; common roots; common fine and medium pores; very strongly acid; clear, smooth boundary.

B23t--22 to 26 inches, reddish-brown (5YR 4/4) light silty clay loam; moderate, medium, angular blocky structure; firm; medium, continuous, reddish-brown (2.5YR 5/4) clay films; common roots; few fine and medium pores; very strongly acid; abrupt, smooth boundary.

IIB24t--26 to 30 inches, reddish-brown (2.5YR 4/4) silty clay; weak, medium, subangular blocky structure; firm; medium, continuous, reddish-brown (2.5YR 5/4) clay films on ped faces; few roots; few fine pores; very strongly acid; clear, smooth boundary.

IIB3t--30 to 48 inches, dark reddish-brown (2.5YR 3/4) clay; massive; very firm; medium, continuous, reddish-brown (2.5YR 4/4) clay films on vertical root channels; few roots; few coarse pores; very strongly acid; clear, wavy boundary.

IIIC--48 to 54 inches, yellowish-brown (10YR 5/4) rotted shale that crushes to silty clay loam; few, fine, distinct, grayish-brown (10YR 5/2) and common, medium, prominent, reddish-brown (5YR 4/4) mottles; massive; very firm; strongly acid.

General Nature of the County

Washington County, which originally included most of the eastern half of Ohio, was organized in 1788 as the first county in the State. In the same year, the first settlement in Ohio was established at the present site of Marietta. The pioneers were from the New England States. Subsequent settlers came from Virginia, Pennsylvania, and other States to the east.

The paragraphs that follow provide general information about Washington County. They describe the climate, bedrock geology, topography and drainage, farming, transportation, water supply, and minerals.

Climate[4]

From data collected at Marietta, table 13 shows, by months, the average daily maximum temperature, average daily minimum temperature, and average precipitation for Washington County. Table 14 shows probabilities of the last freezing temperatures in spring and the first in fall. Because the terrain is rugged, the dates of occurrence of selected spring and fall temperatures throughout the county are likely to differ from those shown in table 14.

Washington County has a continental climate marked by large annual, daily, and day to day ranges of temperature. Extremes usually occur soon after June 21 and December 22. Summers are moderately warm and humid. Temperatures exceeding 100° F. have been recorded occasionally. Winters are reasonably cold and cloudy. Subzero temperatures have been recorded on an average of 2 days each year. Usually the daily temperature range is greatest late in summer and is least in winter. Temperatures below freezing occur most frequently from mid-December to mid-February. Temperatures of 90° or higher have been recorded in April, but are more common during the period June through August.

Precipitation is typically abundant and well distributed throughout the year. Fall is the driest season. The average annual precipitation of 39.74 inches is nearly 1/2 inch above the average for south-central Ohio. Showers and thunderstorms account for most of the rainfall during the growing season. Thunderstorms occur on about 44 days each year, during the period May through August. Precipitation in winter is mostly rain. The average number of days each year having .01, .10, .50, and 1 inch or more of precipitation is 109, 80, 27, and 7 respectively. Heavy rains of 2.0, 2.8, 3.4, 4, 4.5, and 5 inches in 24 hours can be expected at least once every 2, 5, 10, 25, 50, and 100 years respectively.

Evaporation is greatest during the warm months when lack of moisture is most critical for crops. Potential evaporation exceeds the normal rainfall by about 10 inches during the period May through September. During the driest growing season of record, 1930, potential evaporation exceeded rainfall by more than 20 inches. Drought can occur when evaporation exceeds rainfall for prolonged periods; severe drought is rare in Washington County.

The seasonal cycle of soil moisture each year is almost independent of the amount of precipitation received. It reaches its lowest point in October. Moisture is replenished during winter and spring when precipitation exceeds water lost through evaporation. Rainfall is almost always insufficient to meet the needs of crops in July and August.

Records of humidity, cloudiness, sunshine, and wind are not available for Washington County, but from observations in Parkersburg, West Virginia, estimates of these variables can be made.

Humidity usually rises and falls inversely with the daily temperature and is lowest in summer and highest in winter. The average annual relative humidity is 79 percent at 1 a.m., 80 percent at 7 a.m., 56 percent at 1 p.m., and 68 percent at 7 p.m. Cloudiness is greatest in winter and least in summer. The percentage of possible sunshine received is 62 percent in July and 29 percent in December. The prevailing wind direction is from the west and southwest. Windspeed averages 5 miles per hour in summer and 7 miles per hour in winter. The occurrence of heavy fog varies with the terrain, but is most frequent in summer and fall. Many valleys have 50 days of heavy fog each year.

Bedrock Geology

The soils of Washington County are underlain by sedimentary rocks of the Greene and Washington Formations of the Permian System and the Monongahela Formation of the Pennsylvanian System. The rocks are shale, siltstone, sandstone, limestone, and coal. They strike northeast-southwest and dip an average of 25 feet per mile to the southeast.

Permian rocks underlie most of the county. Rocks of the Monongahela Formation crop out along valley sides, mainly along the larger streams and on the upper side slopes in the north-central parts of Aurelius, Salem, and Liberty townships. The layers of limestone and coal are mostly of the Monongahela Formation.

4/ By Jerry M. Davis, climatologist, National Oceanic and Atmospheric Administration.

Topography and Drainage

Washington County is on the unglaciated Allegheny Plateau. The landscape is one of hills, narrow ridgetops, and stream valleys. The eastern part of the county is rugged, and slopes are dominantly steep or very steep. Ridgetops are at elevations of 1,000 to 1,200 feet.

The central and western parts of the county have a more rolling topography, wider ridgetops, and fewer steep side slopes. Most ridgetops are at elevations of 800 to 1,000 feet. There are extensive areas of preglacial, high level terraces in the central and western parts. The terraces are remnants of the Teays-age drainage system (12). Former valleys of this system are now at elevations of 680 to 840 feet, and a few areas are as high as 940 feet. The valleys are 1/2 mile to 1 1/2 miles wide and have broad areas of undulating or rolling slopes.

The lowest elevation in the county, 580 feet above sea level, is in the southwestern corner on the Ohio River. River terraces range in elevation from 620 to 680 feet. The highest elevations are in the rough, hilly section in the northeastern part where many of the knobs are more than 1,200 feet above sea level.

All streams in the county drain directly or indirectly into the Ohio River. Most in the eastern part drain initially into the Little Muskingum River, but some drain directly into the Ohio River. Those in the central part drain into the Muskingum River and Duck Creek. Those in the western part drain into the Little Hocking River and Wolf Creek. Except for some small areas on stream bottoms, surface drainage is excellent.

Farming

According to the 1969 Census of Agriculture, about 43 percent of the land area in Washington County is in farms. Nearly all of the 1,196 farms are owner operated.

The leading source of farm income is livestock and livestock products, mainly dairy cows and beef cattle and to a lesser degree hogs and sheep. Vegetables and grain also are significant sources of income.

The principal grain crops are corn, wheat, and oats. Vegetable crops are chiefly tomatoes, sweet corn, snap beans, watermelons, and cucumbers.

According to the 1967 conservation needs inventory (7) 15 percent of Washington County is cropped, 18 percent pastured, and 64 percent forested.

Nearly all soils are well drained, but 62 percent are moderately steep to very steep. The hazard of erosion is a major concern in farming on the uplands.

The areas around Marietta, Belpre, Devloa, and Reno and between Lowell and Beverly have always been noted for vegetable production. The "Marietta tomato" is well known as a forerunner of the summer harvest. Labor costs and the high value of land for housing are causing a decline of vegetable production in these areas.

Transportation

The Ohio River provides the county with access to commercial barge traffic. The Muskingum River, which flows north to south through the county and has dams and locks, is used only by pleasure craft. Interstate Highway 77 crosses the county from north to south. Air service is provided by the Wood County Airport in nearby West Virginia.

Water Supply

Areas on flood plains along the Ohio and Muskingum Rivers have a good source of water supply from these rivers and from the underlying gravelly material. The cities and larger villages are located along streams. The rural areas on uplands depend on dug and drilled wells, farm ponds and cisterns. An aquiferous bedrock, such as the Upper Sewickley Sandstone, is used extensively. A short supply from wells, however, can be expected during prolonged dry spells.

Minerals

The countywide production of oil and gas, which are contained in several rock layers, is important to the local economy. High-value, Pennsylvania-grade crude oil predominates. Coal is surface mined in the northern part of the county, and good supplies of rock salt and brine are available. Some sandstone which was formerly quarried from the Marietta Sandstone Member and used for grindstones, is locally mined for aggregate. Sand and gravel are extensively mined for aggregate.

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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.

Acidity. See Reaction, soil.

Aeration, soil. The exchange of air in soil and air in the atmosphere. The air in a well-areated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

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. In this publication available water capacity is rated to a root-restricting zone or a 40-inch depth.

	Inches
Very low	Less than 2.4
Low	2.4 to 3.2
Medium	3.2 to 5.2
High	More than 5.2

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

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

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. See Texture, soil.

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

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

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.

Control section. That part of the soil upon which the classification of the soil is based.

Cove (not a shoreline cove). A protected hollow or recess on the hillside, typically at the heads of drainageways.

Creep, soil. The downward movement of masses of soil and soil material primarily through the action of gravity. The movement is generally slow and irregular. It occurs most commonly when the lower part of the soil is nearly saturated with water, and it may be facilitated by alternate freezing and thawing.

Crust, soil. A thin, massive platy layer that forms under the beating action of raindrops.

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 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.

Eluviation. The movement of material from one place to another within the soil, in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.--Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Illuviation. The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils has moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Landslide. The rapid downhill movement of a mass of soil and loose rock, usually when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

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

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

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.

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. In this publication permeability is rated as follows:

	Inches per hour
Very slow	Less than 0.06
Slow	0.06 to 0.2
Moderately slow	0.2 to 0.6
Moderate	0.6 to 2.0
Moderately rapid	2.0 to 6.0
Rapid	More than 6.0

pH. See Reaction, soil.

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

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

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

Root zone. The part of the soil that is penetrated, or can be penetrated by plant roots. In this survey the root zone is defined as follows:

	Inches
Shallow	Less than 20
Moderately deep	20 to 40
Deep	40 to 60

Sand. See Texture, soil.

Silt. See Texture, soil.

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 grained (each grain by itself, as in dune sand) or massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface, soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

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

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

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.