United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
United States Department
of Agriculture, Forest
Service; Ohio Department
of Natural Resources,
Division of Soil and Water
Conservation; Ohio
Agricultural Research and
Development Center; and
Ohio Cooperative
Extension Service

Soil Survey of Gallia County, Ohio

How To Use This Soil Survey

General Soil Map

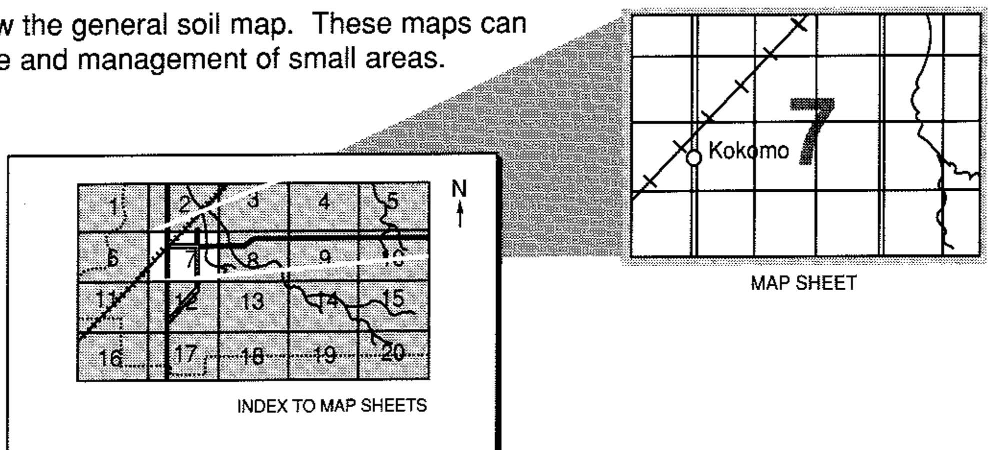
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

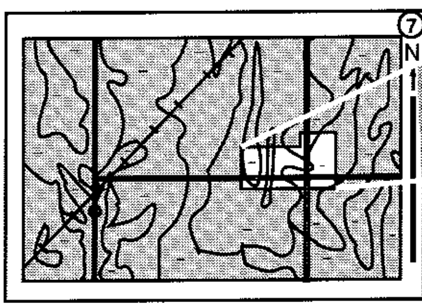
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



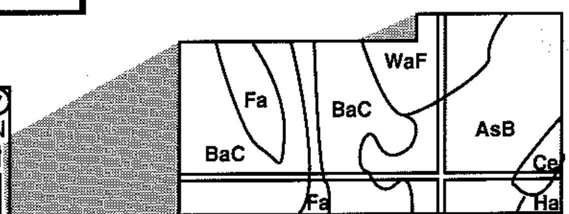
INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly 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 1987. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Natural Resources Conservation Service and Forest Service; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; the Ohio Agricultural Research and Development Center; and the Ohio Cooperative Extension Service. It is part of the technical assistance furnished to the Gallia Soil and Water Conservation District. Financial assistance was provided by the Gallia County Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: A pastured area of Lindside silt loam, occasionally flooded, in Gallia County.

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Issued September 1997

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Gallia County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Lawrence E. Clark
State Conservationist
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Soil Survey of Gallia County, Ohio

By M.M. Feusner, J.W. Kerr, and J.R. Svoboda, Ohio Department of Natural Resources, Division of Soil and Water Conservation

Fieldwork by M.M. Feusner, J.W. Kerr, J.R. Svoboda, and M.W. Johnson, Ohio Department of Natural Resources, Division of Soil and Water Conservation

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
United States Department of Agriculture, Forest Service; Ohio Department of Natural Resources, Division of Soil and Water Conservation; Ohio Agricultural Research and Development Center; and Ohio Cooperative Extension Service

General Nature of the County

Patty Dyer, district conservationist, Natural Resources Conservation Service, helped prepare this section.

Gallia County is in southern Ohio (fig. 1). It has a total area of 301,440 acres, or 471 square miles. It is bounded by Meigs and Vinton Counties on the north, Jackson County on the west, Lawrence County on the south, and the Ohio River on the east. In 1990, the population of the county was 30,954 and Gallipolis, the county seat and largest town, had a population of 4,831.

Woodland is the major land use in the county. Most of the woodland is in areas of steep or very steep soils. These soils are generally unsuited to cropland but are well suited or moderately well suited to woodland. Gallia County is in the central hardwood forest region. Pulp and lumber are important forest products.

Agriculture is an important land use. In some parts of the county, the cropland and pasture have been abandoned and are reverting to brush and trees. Dairying and the production of tobacco are the two leading sources of agricultural income in the county. Corn, soybeans, and small grain are the major crops on the river bottoms and in the larger valleys. Pasture and hay production and beef, sheep, and hog industries are the major agricultural enterprises in the uplands. Large areas of land in the northeastern and south-central portions of the county have been taken out of crop production and have been surface mined.

Figure 1.—Location of Gallia County in Ohio.

The slope and the hazard of erosion are the major management concerns. Wetness, droughtiness, flooding, moderately slow to very slow permeability, a high shrink-swell potential, and hillside slippage are additional limitations.

History

Gallia County was organized on April 30, 1803, from a tract of land known as Washington County, which then comprised a tract covering nearly half of the present area of the State of Ohio. It originally included the lands comprising the present counties of Gallia and Jackson, most of Lawrence and Meigs Counties, and part of Vinton County. The county was named "Gallia," which is an ancient name for France, in honor of the French emigrants who first settled within its borders in October 1790.

About 600 physicians, lawyers, and merchants brought their families to the New World to escape persecution during the French Revolution. Upon their arrival, they discovered that they had been deceived and defrauded. The lands described in the deeds they had purchased in France were actually owned by another company and were located far westward in an unbroken wilderness. After 10 weeks of conferences, an agreement was negotiated to settle the party on the western banks of the Ohio River, near the mouth of the Kanawha River *(4)*.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Gallipolis, Ohio, in the period 1952 to 1986. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 34 degrees F and the average daily minimum temperature is 24 degrees. The lowest temperature on record, which occurred at Gallipolis on January 21, 1984, is -20 degrees. In summer, the average temperature is 74 degrees and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred on July 26, 1952, is 108 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 41 inches. Of this, 22 inches, or 55 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.73 inches at Gallipolis on July 22, 1976. Thunderstorms occur on about 42 days each year.

The average seasonal snowfall is 20 inches. The greatest snow depth at any one time during the period of record was 21 inches. On the average, 9 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 60 percent of the time possible in summer and 35 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 11 miles per hour, in spring.

Periods of heavy rainfall can occur at any time of the year. Severe thunderstorms in summer sometimes cause flash flooding, particularly in narrow valleys.

Physiography, Relief, Geology, and Drainage

Gallia County is in the unglaciated Allegheny Plateau Region. It is extensively dissected by drainageways and has hilly and rough topography, except along the floors of preglacial stream valleys. The area bordering Jackson County in the northwestern and western parts of Gallia County has more gently sloping hills than areas farther east.

The topography of the eastern third of the county is dominated by much steeper and longer hills, which are steepest along the Ohio River. Areas in the central and north-central parts of the county are more gently sloping because of the influence of the preglacial Teays River system. The valleys were formed by the preglacial Marietta River, a tributary of the Teays River. Subsequently, glacial deposits blocked this early drainage system and the glacial meltwater and outwash produced the present-day stream pattern and terraces along the major streams *(13, 14, 16)*. Many of these more recent streams have cut gorgelike valleys throughout the county.

The maximum difference in elevation in the county is about 540 feet. The lowest point, about 515 feet above sea level, is along the Ohio River. The highest point, about 1,060 feet, is in section 25 of Harrison Township. The elevation of the major stream valleys is between 520 and 640 feet.

The soils of Gallia County are underlain by sedimentary rocks of the Allegheny, Conemaugh, and Monongahela Formations of the Pennsylvanian System. The rocks are siltstone, sandstone, clay shale, limestone, and coal. They have a northeast-southwest strike, with an average dip of 30 feet per mile toward the southeast. Rocks of the Allegheny Formation underlie the western part of the county, rocks of the Conemaugh Formation underlie the central part, and rocks of the Monongahela Formation underlie the upper part of hillsides in the eastern portion.

Seven major watersheds dissect the county. They all drain into the Ohio River.

Raccoon Creek has the largest watershed in the county. It drains most of the interior of the county, flowing southward across the central portion to the Ohio River. Its course across Gallia County is very crooked, and it has few tributaries of any size. The valley is more than a fourth of a mile wide in most areas and is characterized by prominent terraces, especially in its lower course *(8)*.

The central part of the county is drained by Chickamauga Creek, which drains into the Ohio River at Gallipolis. The Raccoon and Chickamauga Creek watersheds include most of the county's broad, gently sloping valley left by the preglacial Marietta and Albany Rivers.

The northeastern part of the county drains into Kyger and Campaign Creeks. Sediment from acid mine spoil has clogged many stream channels, causing increased flooding and ponding along these creeks and their tributaries. As the clogging of stream channels increased, additional and larger wetlands were produced.

Swan Creek drains the southeastern part of the county. It is a deeply entrenched drainageway with a relatively narrow valley and terraces. Its watershed is characterized by the steepest and longest hills in the county.

Symmes and Indian Guyan Creeks carry water from many areas in the western and southern parts of the county. They flow southward across Lawrence County and are very sluggish. Flooding and wetness are common problems along these creeks.

Farming

About 40 percent of the land in the county is used for farming *(7)*. About 860 farms are in the county.

In 1985, farmers in the county received more income from the sale of tobacco and other specialty crops than from any other source of farm income. Dairying was the leading income-producing livestock industry, followed by raising cattle. Other sources of agricultural income, in order, were corn, hogs, hay and oats, soybeans, and other livestock *(11)*.

Most of the cropland is in areas of nearly level to strongly sloping soils. Drainage is a problem on some of the nearly level soils. The remaining acreage of cropland has good surface drainage but is subject to a moderate or severe hazard of erosion.

Most of the pasture is in areas of moderately sloping or strongly sloping soils. These soils are subject to a moderate or severe hazard of erosion when they are overgrazed or improperly managed.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Survey Procedures

The general procedures followed in making this survey are described in the "National Soil Survey Handbook" of the Natural Resources Conservation Service. The soil maps made for conservation planning on individual farms prior to the start of the project soil survey, "Physiographic Features of Southeastern Ohio" *(14)*, and "Geology of Water in Ohio" *(15)* were among the references used.

Before the fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on aerial photographs made in 1974 at a scale of 1:38,000 and enlarged to a scale of 1:15,840. U.S. Geological

Survey topographic maps at a scale of 1:24,000 were studied to relate land and image features. The soil scientists then made a reconnaissance of the county in a vehicle.

The soil scientists traversed the landscape on foot, examining the soils. In areas where the soil pattern is very simple, such as the Gilpin-Upshur-Steinsburg general soil map unit, traverses were about 0.5 to 1.0 mile apart. In most of these areas, soil examinations along the transects were made 75 to 300 feet apart, depending on the landscape and soil pattern. As the transects were made, the soil scientists divided the landscape into segments in which use and management of the soils were different. A hillside, for example, would be separated from a ridgetop, a side slope from a foot slope, and a gently sloping ridgetop from a strongly sloping ridgetop.

In areas where the soil pattern is very complex, such as the Pope-Omulga-Stendal and Licking-Gallipolis-Nolin general soil map units, the traverses were as close as 100 yards. In most of these areas, soil examinations along the traverses were made 100 to 500 feet apart, depending on the landscape and soil pattern. As the traverses were made, the soil scientists separated flood plains from terraces and identified the different levels of terraces.

Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. Observations of such items as landforms, soil slips, vegetation, contour elevations, and roadcuts were made without regard to spacing. The soil material was examined with the aid of a bucket auger or soil tube to a depth of about 4 feet or to bedrock if the bedrock was at a depth of less than 4 feet. The pedons described as typical were observed and studied in pits that were dug with shovels, mattocks, and digging bars.

After completion of the soil mapping on aerial photographs, map unit delineations were transferred by hand to another set of aerial photographs taken in 1983. Surface drainage was mapped in the field and plotted stereoscopically. Cultural features were recorded from observations of the maps and the landscape.

At the beginning of the survey, sample areas were selected to represent the major landscapes in the county. These areas were mapped at a rate roughly half of that used in the rest of the county. Extensive notes were taken on the composition of map units in these preliminary study areas. As mapping progressed, these preliminary notes were modified and the final assessment of the composition of the individual map units was made.

Samples for chemical and physical analyses and for analysis of engineering properties were taken from representative sites of several of the soils in the county. The chemical and physical analyses were made by the Soil Characterization Laboratory, Department of Agronomy, the Ohio State University, Columbus, Ohio. The results of the analyses are stored in a computerized data file at the laboratory. The analysis for engineering properties were made by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section, Columbus, Ohio. A description of the laboratory procedures can be obtained by request from the two laboratories. The results of laboratory analyses can be obtained from the School of Natural Resources, the Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Soil and Water Conservation, Columbus, Ohio; and the Natural Resources Conservation Service, State Office, Columbus, Ohio.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

Soils on Uplands

These soils make up about 89 percent of the county. They are excessively drained to moderately well drained and are nearly level to very steep. They are on ridgetops and hillsides in the uplands. The maximum difference in local relief is about 540 feet. The soils formed in residuum or local colluvium derived from sandstone, siltstone, limestone, or shale or in regolith from surface mining. Woodland is the dominant land use. Management concerns are the slope, a severe or very severe erosion hazard, bedrock at a depth of 20 to 40 inches, droughtiness, hillside slippage, a high shrink-swell potential, and slow permeability.

1. Gilpin-Upshur-Steinsburg

Moderately deep and deep, strongly sloping to very steep, well drained soils formed in residuum and colluvium derived from sandstone, siltstone, and shale

This map unit consists of soils on hillsides that have narrow to broad ridgetops and narrow valleys. The hillsides commonly have narrow benches and moderately steep colluvial foot slopes. They are dissected by drainageways. The narrower ridgetops are typically moderately steep, and the wider ones are strongly sloping. Slopes range from 8 to 70 percent.

This map unit makes up about 58 percent of the county. It is about 35 percent Gilpin soils, 25 percent Upshur soils, 10 percent Steinsburg soils, and 30 percent soils of minor extent (fig. 2).

Gilpin soils are on ridgetops and hillsides. These moderately deep soils are strongly sloping to steep. Permeability is moderate, and available water capacity is low or moderate.

Upshur soils are on ridgetops and hillsides. These deep soils are strongly sloping to very steep. Permeability is slow, and available water capacity is low or moderate. These soils have a high shrink-swell potential and are subject to hillside slippage.

Steinsburg soils are on hillsides. These moderately deep, well drained soils are steep or very steep. Permeability is moderately rapid, and available water capacity is low or very low.

The minor soils in this map unit include the Berks, Chagrin, Guernsey, Kanawha, Rarden, and Vandalia soils. Berks soils are on very steep slopes. They have a higher content of coarse fragments in the subsoil than the major soils. Chagrin soils formed in alluvium on flood plains. Guernsey soils are on strongly sloping shoulder slopes or steep side slopes. They are not so red in the subsoil as the Upshur soils, and they have more clay in the subsoil than the Gilpin and Steinsburg soils. Kanawha soils formed in loamy deposits on low terraces. Rarden soils are on strongly sloping ridgetops and steep hillsides. They are moderately well drained and moderately deep. They have more clay in the subsoil than the Gilpin and Steinsburg soils. Vandalia soils are on strongly sloping or moderately steep foot slopes. They have more sandstone fragments throughout than the Upshur soils, and they have more clay in the subsoil than the Gilpin and Steinsburg soils.

Most of the acreage in this map unit is used as woodland. The wider ridgetops and narrow valleys are commonly used for cultivated crops or pasture. The steeper soils are generally unsuited to cropland and urban development; however, they are well suited or moderately well suited to woodland. The soils on the wider, nearly level ridgetops and in the narrow valleys are well suited to farming. The soils on the strongly sloping and moderately steep ridgetops are eroded and are poorly suited to farming.

The major limitations affecting most land uses are the slope and a severe or very severe erosion hazard. The slow permeability, hillside slippage, and the high shrink-swell potential of the Upshur soils and the moderate depth to bedrock in areas of the Gilpin and Steinsburg soils are additional concerns. The north- and east-facing slopes are better woodland sites than the south- and west-facing slopes because they are characterized by less evapotranspiration and cooler temperatures.

2. Steinsburg-Rarden-Lily

Moderately deep, strongly sloping to steep, well drained and moderately well drained soils formed in material weathered from sandstone, siltstone, and shale

This map unit consists of soils on hillsides and narrow ridgetops. The hillsides are highly dissected by numerous drainageways. Most of the stream valleys are narrow. Slopes range from 8 to 50 percent.

This map unit makes up about 23 percent of the county. It is about 25 percent Steinsburg soils, 20 percent Rarden soils, 15 percent Lily soils, and 40 percent soils of minor extent (fig. 3).

Steinsburg soils are on hillsides. These well drained soils are steep. Permeability is moderately rapid, and available water capacity is very low.

Rarden soils are on ridgetops and hillsides. These

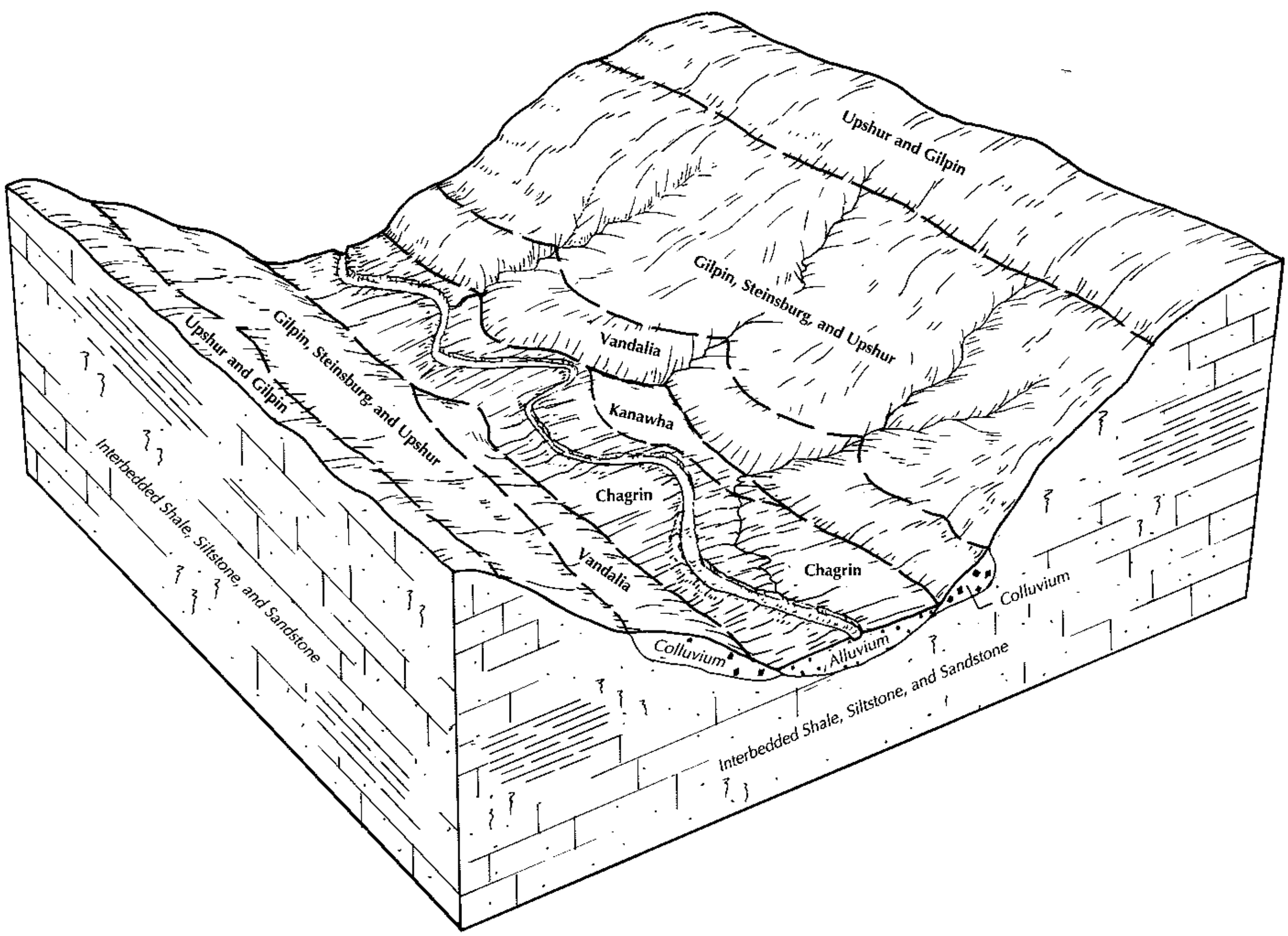

Figure 2.—Typical pattern of soils and parent material in the Gilpin-Upshur-Steinsburg map unit.

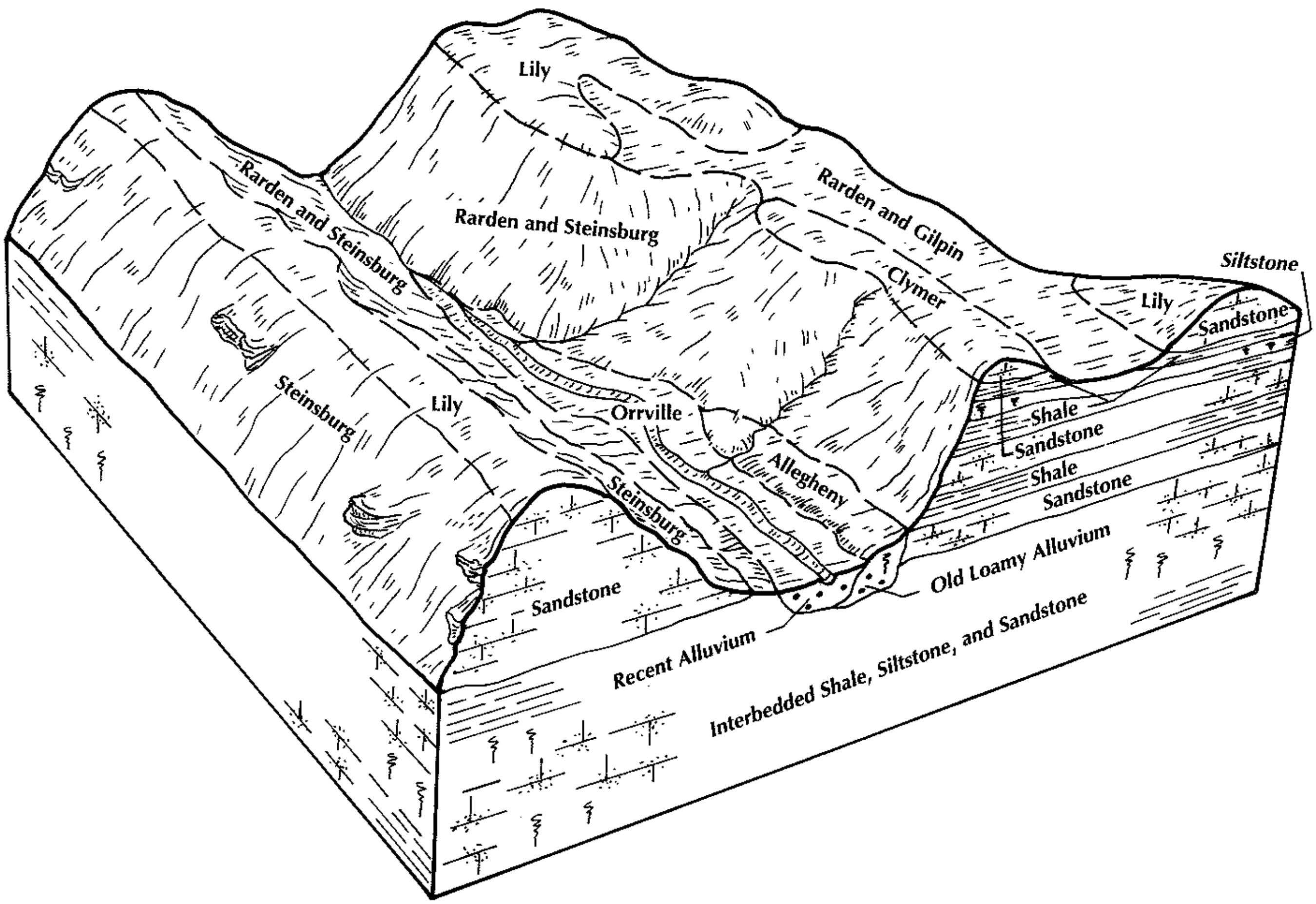

Figure 3.—Typical pattern of soils and parent material in the Steinsburg-Rarden-Lily map unit.

moderately well drained soils are strongly sloping to steep. Permeability is slow, and available water capacity is low. The seasonal high water table is at a depth of 1.5 to 3.0 feet during extended wet periods. The shrink-swell potential is high.

Lily soils are on ridgetops and hillsides. These well drained soils are strongly sloping and moderately steep. Permeability is moderately rapid, and available water capacity is low or moderate.

The minor soils in this map unit include the Allegheny, Clymer, Gilpin, and Orrville soils. Allegheny soils are deep and are on the side slopes of terraces or terrace remnants. Clymer soils are deep and are on hillsides and ridgetops of sandstone uplands. Gilpin soils are moderately deep and are on hillsides and ridgetops of interbedded shale, siltstone, and sandstone uplands. The topography of the upland soils is influenced and controlled by the underlying bedrock. Orrville soils are deep and somewhat poorly drained. They are on narrow flood plains.

Most of the acreage in this map unit is used as woodland. Buildings and local roads generally are built only on the narrow ridgetops and in the stream valleys. The steep soils are generally unsuited to cropland, pasture, and urban development. They are moderately well suited to woodland. The strongly sloping soils on ridgetops are moderately well suited to cropland.

The major limitations affecting most land uses are the slope, a very severe erosion hazard, the moderate depth to bedrock, and the limited size of areas on narrow ridgetops and in valleys. Seasonal wetness, the slow permeability, and the high shrink-swell potential of the Rarden soils are additional concerns. The north- and east-facing slopes are better woodland sites than the south- and west-facing slopes because they are characterized by less evapotranspiration and cooler temperatures.

3. Fairpoint-Bethesda

Deep, nearly level to very steep, well drained soils formed in regolith from surface mining

This map unit consists of soils in areas that have been surface mined for coal and of soils on the adjoining undisturbed hillsides and ridgetops. The mined areas are graded or rounded ridgetops and side slopes. The ridgetops are generally narrow, and the hillsides are dissected by drainageways. Slopes range from 1 to 70 percent.

This map unit makes up about 1 percent of the county. It is about 55 percent Fairpoint soils, 35 percent Bethesda soils, and 10 percent soils of minor extent.

Fairpoint soils are on ridgetops and hillsides in areas surface mined for coal. They are nearly level to steep. Permeability is moderately slow, and available water capacity is low.

Bethesda soils are on ridgetops and hillsides in areas surface mined for coal. They are strongly sloping to very steep. Permeability is moderately slow, and available water capacity is low.

The minor soils in this map unit include the Steinsburg and Upshur soils. Steinsburg soils are moderately deep. Upshur soils have more clay in the subsoil than the major soils. Steinsburg and Upshur soils are on hillsides in areas that have not been mined.

Most of the acreage in this map unit is used as grassland or is sparsely vegetated. The steep soils in unmined areas are wooded. Most of the steep soils in both mined and unmined areas are generally unsuited to cultivated crops, pasture, and urban development. They are moderately well suited or poorly suited to woodland.

The major limitations affecting most land uses are the slope and a severe or very severe erosion hazard. The moderately slow permeability and the low available water capacity of the major soils are additional concerns.

4. Gilpin-Pinegrove-Guernsey

Moderately deep and deep, nearly level to very steep, excessively drained to moderately well drained soils formed in residuum and colluvium derived from sandstone, siltstone, limestone, and shale and in regolith from surface mining

This map unit consists of soils in areas that have been surface mined for coal and of the soils on the surrounding undisturbed hillsides and ridgetops. The mined areas are graded or rounded ridgetops and dissected side slopes. The ridgetops are narrow to broad. The hillsides are broken by narrow benches and dissected by drainageways. They commonly have moderately steep colluvial foot slopes. Slopes range from 1 to 70 percent.

This map unit makes up about 7 percent of the county. It is about 25 percent Gilpin soils, 20 percent Pinegrove soils, 15 percent Guernsey soils, and 40 percent soils of minor extent.

Gilpin soils are on ridgetops and hillsides. These moderately deep, well drained soils are strongly sloping to steep. Permeability is moderate, and available water capacity is low or moderate.

Pinegrove soils are on the ridgetops, benches, and hillsides of areas surface mined for coal. These deep, excessively drained soils are nearly level to very steep. Permeability is rapid, and available water capacity is low.

Guernsey soils are on shoulder slopes and hillsides. These deep, moderately well drained soils are strongly sloping to steep. Permeability is moderate or slow, and available water capacity is moderate. These soils have a high shrink-swell potential and are subject to hillside slippage.

The minor soils in this map unit include the Bethesda, Steinsburg, and Upshur soils. Bethesda soils have a higher content of coarse fragments in the substratum than the major soils. They are in strongly sloping to very steep areas that have been surface mined. Steinsburg soils have less clay than the major soils. They are moderately deep and are on very steep side slopes. Upshur soils have more clay in the subsoil than the Gilpin and Pinegrove soils. They are deep and well drained. They are on broad ridgetops and steep hillsides. Also of minor extent are areas of rock outcrop on the upper part of very steep hillsides.

Most of the acreage in this map unit is used as woodland. The wider ridgetops and the narrow valleys commonly are used for cultivated crops or pasture. The steeper soils are generally unsuited to cultivated crops and urban development; however, they are moderately well suited or poorly suited to woodland. Most of the mined areas are generally unsuited to cropland, pasture, and urban development. The soils on the wider, strongly sloping ridgetops are moderately well suited to farming. The soils on the moderately steep ridgetops are eroded and generally are unsuited to farming.

The major limitations affecting most land uses are the slope and a severe or very severe erosion hazard. Additional concerns are the rapid permeability, acidity, and the low available water capacity of the Pinegrove soils; the slow permeability, hillside slippage, and the high shrink-swell potential of the Guernsey soils; and the moderate depth to bedrock in areas of the Gilpin soils. The north- and east-facing slopes are better woodland sites than the south- and west-facing slopes because they are characterized by less evapotranspiration and cooler temperatures.

Soils on Terraces and Flood Plains and in Preglacial Valleys

These soils make up about 11 percent of the county. They are nearly level to moderately steep and are well drained to very poorly drained. They are in preglacial valleys and on terraces and flood plains. The soils formed in alluvium, colluvium, loess, or lacustrine sediments. They are used as woodland, cropland, or pasture or for urban development. Management concerns are flooding, the erosion hazard, the slope, slow or moderately slow permeability, a high shrink-swell potential, and seasonal wetness.

5. Gallipolis-Elkinsville-Nolin

Deep, nearly level to strongly sloping, moderately well drained and well drained soils formed in alluvium and lacustrine sediments on terraces and flood plains

This map unit consists of soils on flat and undulating terraces and on slope breaks between terraces in broad areas of major stream valleys. The soils are subject to rare flooding in some areas. Slopes range from 0 to 15 percent.

This map unit makes up about 3 percent of the county. It is about 25 percent Gallipolis soils, 20 percent Elkinsville soils, 20 percent Nolin soils, and 35 percent soils of minor extent.

Gallipolis soils are on terraces. These moderately well drained soils are nearly level to strongly sloping. Permeability is moderately slow, and available water capacity is high. The seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

Elkinsville soils are on slight rises on terraces. These well drained soils are nearly level and gently sloping. Permeability is moderate, and available water capacity is high or very high.

Nolin soils are on flood plains. These well drained soils are nearly level. Permeability is moderate, and available water capacity is high.

The minor soils in this map unit include the Newark, Taggart, and Wheeling soils. Newark soils are on the lower part of flood plains. Taggart soils are in nearly level areas or depressions along drainageways on terraces. Newark and Taggart soils are somewhat poorly drained. Wheeling soils have more sand in the subsoil than the major soils. They are on the highest level of terraces and on slope breaks.

Most of the acreage in this map unit is used as cropland or pasture. Some areas are used for urban or industrial development. The nearly level and gently sloping soils are well suited to cropland and pasture. The major soils are well suited, moderately well suited, or poorly suited to urban development. The areas that are subject to flooding are generally unsuited to urban development.

The major limitations affecting most land uses are flooding on the Nolin soils, the slope and an erosion hazard in areas of the Elkinsville and Gallipolis soils, and seasonal wetness in the Gallipolis soils. Crusting of the surface layer also is a concern when the major soils are used for row crops.

6. Omulga-Monongahela

Deep, nearly level to strongly sloping, moderately well drained soils formed in loess, colluvium, and old alluvium in preglacial valleys

This map unit consists of soils in preglacial valleys. The valleys generally are broad and are as much as a mile wide. Slopes range from 1 to 15 percent.

This map unit makes up about 2 percent of the county. It is about 60 percent Omulga soils, 15 percent Monongahela soils, and 25 percent soils of minor extent.

Omulga soils are in broad areas and on terrace remnants in preglacial valleys. They are nearly level to strongly sloping. Permeability is moderate or slow, and available water capacity is low. The seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

Monongahela soils formed in loamy material in dissected areas of preglacial valleys. They are strongly sloping. Permeability is moderate or slow, and available water capacity is low. The seasonal high water table is at a depth of 1.5 to 3.0 feet during extended wet periods.

The minor soils in this map unit include the Doles, Chagrin, and Gallia soils. Doles soils are somewhat poorly drained. They are on flats of terrace remnants in preglacial valleys. Chagrin and Gallia soils are well drained. Chagrin soils have more sand in the subsoil than the major soils. They are on flood plains. Gallia soils are on dissected terrace remnants. They formed in old alluvium in preglacial valleys.

Most of the acreage in this map unit is used as cropland or pasture. Omulga soils are well suited or moderately well suited to row crops, hay, and pasture. Monongahela soils are moderately well suited to cropland, hay, and pasture. Omulga and Monongahela soils are moderately well suited to buildings and poorly suited to septic tank absorption fields.

The major limitations affecting most land uses are the erosion hazard in strongly sloping areas and the seasonal wetness. Crusting of the surface layer is a concern after periods of heavy rainfall. The wetness is a limitation affecting building site development, and the slow permeability and the wetness are limitations affecting septic tank absorption fields.

7. Pope-Omulga-Stendal

Deep, nearly level to strongly sloping, well drained to somewhat poorly drained soils formed in alluvium, loess, colluvium, and old alluvium in preglacial valleys

This map unit consists of soils on flood plains and on dissected remnants of preglacial drainage systems. The landscape is characterized by narrow to relatively broad flood plains along the floor of the valley and by slightly higher terraces and knolls above the valley floor. Slopes range from 0 to 15 percent.

This map unit makes up about 3 percent of the county. It is about 30 percent Pope soils, 25 percent Omulga soils, 15 percent Stendal soils, and 30 percent soils of minor extent.

Pope soils formed in alluvium on flood plains. These well drained soils are nearly level. Permeability is moderate or moderately rapid, and available water capacity is moderate. These soils are frequently or occasionally flooded.

Omulga soils are in broad areas and on terrace remnants in preglacial valleys. These moderately well drained soils are nearly level to strongly sloping. Permeability is moderate or slow, and available water capacity is low. The seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

Stendal soils formed in alluvium on flood plains. These deep, somewhat poorly drained soils are nearly level. Permeability is moderate, and available water capacity is very high. The seasonal high water table is at a depth of 1 to 3 feet during extended wet periods. These soils are occasionally flooded.

The minor soils in this map unit include the Cuba, Allegheny, and Piopolis soils. Cuba and Allegheny soils are well drained. Cuba soils are on flood plains. Allegheny soils are on stream terraces and on dissected terrace remnants. Piopolis soils are poorly drained and very poorly drained. They are on flood plains.

Most of the acreage in this map unit is used as pasture or cropland. The cropland is mainly in areas of the Omulga soils and the Pope soils that are only occasionally flooded. The major soils are well suited or moderately well suited to corn, soybeans, hay, and pasture. The flooding, an erosion hazard, and the seasonal wetness are the major limitations. Winter wheat and other crops planted on the flood plains may be severely damaged by flooding in winter and early spring. A drainage system is needed in areas of the Stendal soils for optimum crop production. Suitable outlets for subsurface drains are difficult to establish in some areas. Streambank erosion is a major source of the sediments that pollute water.

Pope and Stendal soils are generally unsuited to building site development and septic tank absorption fields, whereas Omulga soils are moderately well suited or poorly suited to these uses. The flooding on the Pope and Stendal soils, the seasonal wetness of the Omulga and Stendal soils, and the slow permeability and slope of the Omulga soils are limitations affecting urban development.

8. Licking-Gallipolis-Nolin

Deep, nearly level to moderately steep, moderately well drained and well drained soils formed in loess, lacustrine sediments, and alluvium on flood plains and terraces along streams

This map unit consists of soils on relatively broad, flat flood plains and low terraces in valleys that have meandering streams. Slopes range from 0 to 25 percent.

This map unit makes up about 2 percent of the county. It is about 30 percent Licking soils, 25 percent Gallipolis soils, 20 percent Nolin soils, and 25 percent soils of minor extent.

Licking soils are on slight rises or slope breaks of terraces. These moderately well drained soils are nearly level to moderately steep. Permeability is slow, and available water capacity is moderate. The seasonal high water table is at a depth of 1.5 to 3.0 feet during extended wet periods. The shrink-swell potential is high.

Gallipolis soils are on slight rises and slope breaks of broad terraces. These moderately well drained soils are nearly level to strongly sloping. Permeability is moderately slow, and available water capacity is high. The seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

Nolin soils are on flood plains adjacent to major streams. These well drained soils are nearly level. Permeability is moderate, and available water capacity is high. The seasonal high water table is at a depth of 3 to 6 feet during extended wet periods. These soils are occasionally flooded.

The minor soils in this map unit include the Chagrin and Pope soils. Chagrin and Pope soils are on flood plains. Chagrin soils have more sand than the Nolin soils. Pope soils have less clay than the Nolin soils.

Most of the acreage in this map unit is used as cropland or pasture. The less sloping areas of these soils are well suited to cropland, pasture, and woodland. The major soils generally are unsuited, poorly suited, or moderately well suited to most urban uses. Gallipolis soils are better suited to urban development than Nolin or Licking soils.

The major limitations affecting most land uses are the flooding of the Nolin soils; the seasonal wetness and the moderately slow permeability of the Gallipolis soils; and the seasonal wetness, the slow permeability, and the high shrink-swell potential of the Licking soils. Crusting of the surface layer is a management concern when the major soils are used for row crops. The slope and an erosion hazard are additional concerns on slope breaks in areas of the Gallipolis and Licking soils.

9. Stendal-Cuba-Piopolis

Deep, nearly level, very poorly drained, poorly drained, somewhat poorly drained, and well drained soils formed in alluvium on flood plains

This map unit is in relatively wide, flat valleys of meandering streams and in steep areas on the adjacent uplands. The soils are occasionally or frequently flooded. Slopes range from 0 to 3 percent.

This map unit makes up about 1 percent of the county. It is about 30 percent Stendal soils, 25 percent Cuba soils, 15 percent Piopolis soils, and 30 percent soils of minor extent.

Stendal soils are in the middle of flood plains and in low areas adjacent to uplands. These somewhat poorly drained soils are occasionally flooded. Permeability is moderate, and available water capacity is very high. The seasonal high water table is at a depth of 1 to 3 feet during extended wet periods.

Cuba soils are on the highest part of flood plains. These well drained soils are occasionally flooded. Permeability is moderate, and available water capacity is high.

Piopolis soils are on the lowest part of flood plains. These poorly drained and very poorly drained soils are frequently flooded. Permeability is slow, and available water capacity is high. The seasonal high water table is near or above the surface during extended wet periods.

The minor soils in this map unit include the Allegheny, Chagrin, and Pope soils. Allegheny and Chagrin soils have more sand and gravel than the major soils. The subsoil of the Allegheny soils is more developed than that of the major soils. Allegheny soils are on fans and terraces along valley walls. Chagrin soils are in narrow valleys. Pope soils have less clay in the subsoil than the major soils. They are well drained and are on flood plains.

Most of the acreage in this map unit is used as cropland, pasture, or woodland. The Cuba soils and drained areas of the Stendal and Piopolis soils are used as cropland. The major soils are moderately well suited or well suited to cropland, pasture, and woodland. Although the choice of crops is limited, these soils are used for corn and soybeans, which can be planted after the normal period of spring flooding has ended. Winter wheat can be severely damaged by the flooding and the seasonal wetness in winter and spring. The soils are generally unsuited to urban development.

The major limitations affecting most land uses are the hazard of flooding on all three soils and the seasonal wetness of the Stendal and Piopolis soils. Crusting of the surface layer also is a concern when the major soils are used for row crops.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Omulga silt loam, 1 to 6 percent slopes, is a phase of the Omulga series.

Some map units are made up of two or more major soils. These map units are called soil complexes or soil associations.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Upshur-Gilpin complex, 8 to 15 percent slopes, eroded, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Gilpin-Steinsburg-Upshur association, steep, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The map unit Dumps, mine, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

AaC—Aaron silt loam, 8 to 15 percent slopes. This deep, moderately well drained, strongly sloping soil is on ridgetops in the uplands. Most areas are long and narrow or irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 48 inches thick. The upper part is yellowish brown, firm silt loam and silty clay loam. The next part is yellowish brown, mottled, very firm silty clay. The lower part is yellowish brown, mottled, very firm clay and channery clay. The substratum is gray, firm channery silty clay. Calcareous, light olive brown clay shale is at a depth of about 53 inches. In some areas bedrock is at a depth of 30 to 50 inches. In other areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Upshur soils in saddles. These soils are deep and well drained. They make up about 15 percent of most areas.

Permeability is slow in the Aaron soil. The root zone is deep. The available water capacity is moderate. Runoff is rapid. The shrink-swell potential and the potential for frost action are high. A perched seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as pasture. Some are used as cropland or woodland.

This soil is moderately well suited to cultivated crops and small grain and to grasses and legumes for hay. Controlling erosion is the major management concern. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, incorporation of crop residue into the plow layer, contour tillage, stripcropping, and grassed waterways help to maintain tilth and the organic matter content, control runoff, and prevent excessive soil loss. A subsurface drainage system may be needed in scattered seepy areas.

This soil is well suited to pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species. Applying trash mulch or other no-till seeding methods or growing cover crops or companion crops when pastures are reseeded helps to control erosion.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields. The wetness and the slow permeability are limitations on sites for absorption fields. An aeration disposal system is used in some areas. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. Installing perimeter drains around septic tank systems lowers the seasonal high water table.

This soil is poorly suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness and the high shrink-swell potential. Installing drains at the base of footings, backfilling with suitable material, and coating the exterior basement walls minimize the damage caused by wetness and by shrinking and swelling. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4C. The pasture and hayland suitability group is A-6.

AkB—Allegheny loam, 3 to 8 percent slopes. This deep, well drained, gently sloping soil is on terraces. Most areas are dissected by one or more small drainageways. They are long and narrow or irregularly shaped and range from 2 to 15 acres in size.

Typically, the surface layer is brown, friable loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is strong brown and yellowish brown, friable and firm loam. The lower part is dark yellowish brown, friable sandy loam. In some places the surface layer is silt loam. In other places the subsoil has gray mottles.

Included with this soil in mapping are small areas of the moderately well drained Licking, Monongahela, and Omulga soils on terrace remnants of preglacial valleys. Also included are small areas of droughty soils along Raccoon Creek. These droughty soils have a surface layer of loamy fine sand or sand. Included soils make up about 20 percent of most areas.

Permeability is moderate in the Allegheny soil. The root zone is deep. The available water capacity is moderate or high. Runoff is medium.

Most areas are used as cropland or pasture. A few are wooded.

This soil is moderately well suited to corn, tobacco, soybeans, and small grain. Controlling erosion and maintaining tilth and the organic matter content are management concerns. Cultivated crops and small grain can be grown year after year if conservation practices are applied. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, contour tillage, cover crops, grassed waterways, and incorporation of crop residue into the plow layer are good management practices. The soil is well suited to no-till farming.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees; however, only a small acreage supports native hardwoods. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is well suited to septic tank absorption fields, buildings, and roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

AkC—Allegheny loam, 8 to 15 percent slopes. This deep, well drained, strongly sloping soil is on side slopes and in saddles near the head of drainageways on terraces. Most areas are dissected by one or more small drainageways. They are long and narrow or irregularly shaped and range from 3 to 25 acres in size.

Typically, the surface layer is brown, friable loam about 8 inches thick. The subsoil is about 39 inches thick. The upper part is yellowish brown and strong brown, firm loam. The lower part is strong brown, firm sandy loam. The substratum to a depth of about 82 inches is yellowish brown, friable to loose sandy loam and loamy sand. In places the surface layer is silt loam. In a few areas along drainageways, the slope is steeper.

Included with this soil in mapping are small areas of the moderately well drained Licking, Monongahela, and Omulga soils on terrace remnants of preglacial valleys. Also included are small areas of droughty soils along Raccoon Creek. These droughty soils have a surface layer of loamy fine sand or sand. Included soils make up about 20 percent of most areas.

Permeability and the available water capacity are moderate in the Allegheny soil. The root zone is deep. Runoff is medium.

Most areas are used for hay and pasture. A few small areas are used as cropland or woodland.

This soil is moderately well suited to corn, soybeans, and small grain. If the soil is cultivated or the vegetative cover is removed, the hazard of erosion is severe. Controlling erosion and maintaining tilth and the organic matter content are management concerns. Cultivated crops and small grain can be grown every other year if conservation practices are applied. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, contour stripcropping, cover crops, grassed waterways, and incorporation of crop residue into the plow layer are good management practices. The soil is well suited to no-till farming.

This soil is well suited to hay and pasture. If the soil is overgrazed or if it is plowed during seedbed preparation, the hazard of erosion is severe. Applying trash mulch or other no-till seeding methods or growing companion crops or cover crops when pastures are reseeded helps to control erosion. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees; however, only a small acreage supports trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Cutting and filling to a more desirable slope can improve sites for log landings.

This soil is well suited to septic tank absorption fields and to buildings. The slope is the main limitation. Installing distribution lines for septic tank absorption fields across the slope helps to prevent seepage of effluent to the surface. Buildings should be designed so that they conform to the natural slope of the land. Constructing local roads on the contour minimizes the extent of cut and fill areas. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

AkD—Allegheny loam, 15 to 25 percent slopes. This deep, well drained, moderately steep soil is on side slopes and in saddles near the head of drainageways on terraces. Most areas are dissected by one or more small drainageways. They are long and narrow or irregular in shape and range from 3 to 25 acres in size.

Typically, the surface layer is dark yellowish brown, friable loam about 8 inches thick. The subsoil is about 42 inches thick. The upper part is yellowish brown, firm loam. The lower part is strong brown, firm loam and sandy clay loam. The substratum to a depth of about 64 inches is yellowish brown, friable sandy loam that has lenses of loamy sand. In places the surface layer is silt loam.

Included with this soil in mapping are small areas of the moderately well drained Monongahela, Omulga, and Licking soils on terrace remnants of preglacial valleys. Also included are small areas of droughty soils along Raccoon Creek. These droughty soils have a surface layer of loamy fine sand or sand. Included soils make up about 20 percent of most areas.

Permeability and the available water capacity are moderate in the Allegheny soil. The root zone is deep. Runoff is rapid.

Most areas are used as pasture or woodland. This soil is poorly suited to corn, soybeans, and small grain.

Controlling erosion and maintaining tilth and the organic matter content are management concerns. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, contour stripcropping, cover crops, grassed waterways, and incorporation of crop residue into the plow layer are good management practices. The soil is moderately well suited to no-till farming.

This soil is moderately well suited to hay and pasture. If the soil is overgrazed or if it is plowed during seedbed preparation, the hazard of erosion is severe. Applying trash mulch or other no-till seeding methods or growing companion crops or cover crops when pastures are reseeded helps to control erosion. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Building haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

This soil is moderately well suited to septic tank absorption fields. The slope is the main limitation. Installing distribution lines for septic tank absorption fields across the slope helps to prevent seepage of effluent to the surface.

This soil is moderately well suited to buildings. Land shaping is needed in most areas to help overcome the slope. Establishing driveways across the slope helps to control erosion and reduce the angle of incline. Providing suitable base material helps to prevent the road damage caused by frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

BcF—Berks-Upshur association, very steep. These well drained soils are on side slopes in the uplands. The Berks soil is moderately deep, and the Upshur soil is deep. The steepest, very sharp breaks are sandstone escarpments or deeply entrenched drainageways. Most of the slopes are uneven, but some are smooth and even. Some areas are characterized by a series of sharp breaks and narrow benches in a stair-stepped pattern. Slopes dominantly range from 50 to 70 percent. Areas are irregular in shape and range from 20 to several hundred acres in size. Most are about 45 percent Berks soil and 30 percent Upshur soil. The Berks soil is commonly on very steep slopes on the upper and middle parts of back slopes. The Upshur soil is commonly on the middle and lower parts of back slopes and on benches. Because of present and anticipated soil uses, it is not considered practical or necessary to map the soils separately.

Typically, the Berks soil has a surface layer of brown, friable channery silt loam about 4 inches thick. The subsoil is about 29 inches thick. The upper part is brown, friable channery and very channery silt loam. The lower part is brown, friable very flaggy and extremely flaggy silt loam. Brown and light olive brown, fine grained sandstone and shale bedrock is at a depth of about 33 inches. In places the soil is shallower or deeper over bedrock.

Typically, the Upshur soil has a surface layer of brown, friable silty clay loam about 2 inches thick. The subsoil is about 37 inches thick. The upper part is reddish brown, very firm silty clay and clay. The next part is dark red, very firm silty clay and clay. The lower part is dark reddish brown, firm silty clay. The substratum is dark reddish brown, firm silty clay. Dark reddish brown shale and siltstone bedrock is at a depth of about 53 inches. In places the subsoil has some brown colors and is mottled.

Included with these soils in mapping are small areas of Gilpin and Steinsburg soils and rock outcrop. Gilpin soils have a lower content of rock fragments than the Berks soil. They are on middle slopes or the lower back slopes. Steinsburg soils have more sand and a lower content of rock fragments than the Berks soil. They are on shoulder slopes and the upper back slopes. The rock outcrop is on shoulder slopes and escarpments near drainageways, primarily along the Ohio River. Inclusions make up about 25 percent of most areas.

Permeability is moderate or moderately rapid in the Berks soil and slow in the Upshur soil. The root zone is moderately deep in the Berks soil and deep in the Upshur soil. It is restricted, however, by the high content of clay in the Upshur soil. The available water capacity is very low in the Berks soil and moderate in the Upshur soil. Surface runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Berks soil.

Most areas support native hardwoods. These soils are generally unsuited to cultivated crops, hay, and pasture because of the slope, a very severe hazard of erosion, the limited depth to bedrock in the Berks soil, and the high content of clay in the subsoil of the Upshur soil.

These soils are poorly suited to trees and habitat for woodland wildlife. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Applying mulch around seedlings reduces the seedling mortality rate. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to septic tank absorption fields and to buildings. The hazard of erosion is very severe if the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects. The pasture and hayland suitability group is H-1.

BhD—Bethesda channery clay loam, 8 to 25 percent slopes. This deep, well drained, strongly sloping and moderately steep soil is on the side slopes of mine spoil and on benches of mine spoil in areas surface mined for coal. Areas commonly have uneven slopes and shallow gullies. Most are long and narrow or irregular in shape. They range from 3 to 35 acres in size.

Typically, the surface layer is brown, firm channery clay loam about 3 inches thick. The substratum to a depth of about 70 inches is multicolored, firm channery, very channery, and extremely channery silty clay loam and clay loam. In places the surface layer is channery silty clay loam or channery loam. In a few areas the soil has layers that are less acid.

Included with this soil in mapping are small areas of the Pinegrove soils. These soils are more droughty than the Bethesda soil. They make up about 10 percent of most areas.

Permeability is moderately slow in the Bethesda soil. The root zone is deep. The available water capacity is low. Runoff is rapid.

Most of the acreage of this soil is idle land. It supports only a sparse stand of grasses and trees. The soil is generally unsuited to hay and the commonly grown field crops and is poorly suited to pasture. It is a poor medium for root development and is droughty, low in fertility, and very low in organic matter content. The surface layer is channery. It puddles and crusts easily. Ground cover and surface mulch help to control runoff and erosion and increase the rate of water infiltration. Orchardgrass, tall fescue, and Korean lespedeza are some of the forage plants that grow best. Overgrazing reduces the extent of the stand and increases the runoff rate and the amount of soil lost through erosion. A source of water for livestock often is not available.

This soil is best suited to the trees that can grow under acid, droughty conditions. Grasses and legumes commonly are planted to help control erosion during the establishment of trees. Applying mulch around seedlings reduces the seedling mortality rate. Establishing haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

In areas where the soil has had sufficient time to settle and the slope is 8 to 15 percent, the soil is poorly suited to septic tank absorption fields. Onsite investigation is needed to determine the limitations affecting absorption fields. In areas where the soil has not had sufficient time to settle or the slope is 15 to 25 percent, the soil is generally unsuited to absorption fields. The depth to bedrock, the hazard of hillside slippage, the rapid runoff, and the moderately slow permeability are additional limitations affecting absorption fields. Installing the distribution lines in suitable fill material helps to overcome the restricted permeability.

In areas where the soil has had sufficient time to settle and the slope is 8 to 15 percent, the soil is moderately well suited to buildings and roads. It is better suited to houses without basements than to houses with basements because of the slope and the large stones. In areas where the soil has not had sufficient time to settle or the slope is 15 to 25 percent, the soil is generally unsuited to buildings. Installing a drainage system and providing suitable base material help to prevent damage to roads. The droughtiness and the rock fragments, which hinder mowing, are limitations affecting lawns. Blanketing the lawns with suitable fill material helps to overcome these limitations.

The land capability classification is VIs. The woodland ordination symbol is 4R. The pasture and hayland suitability group is E-3.

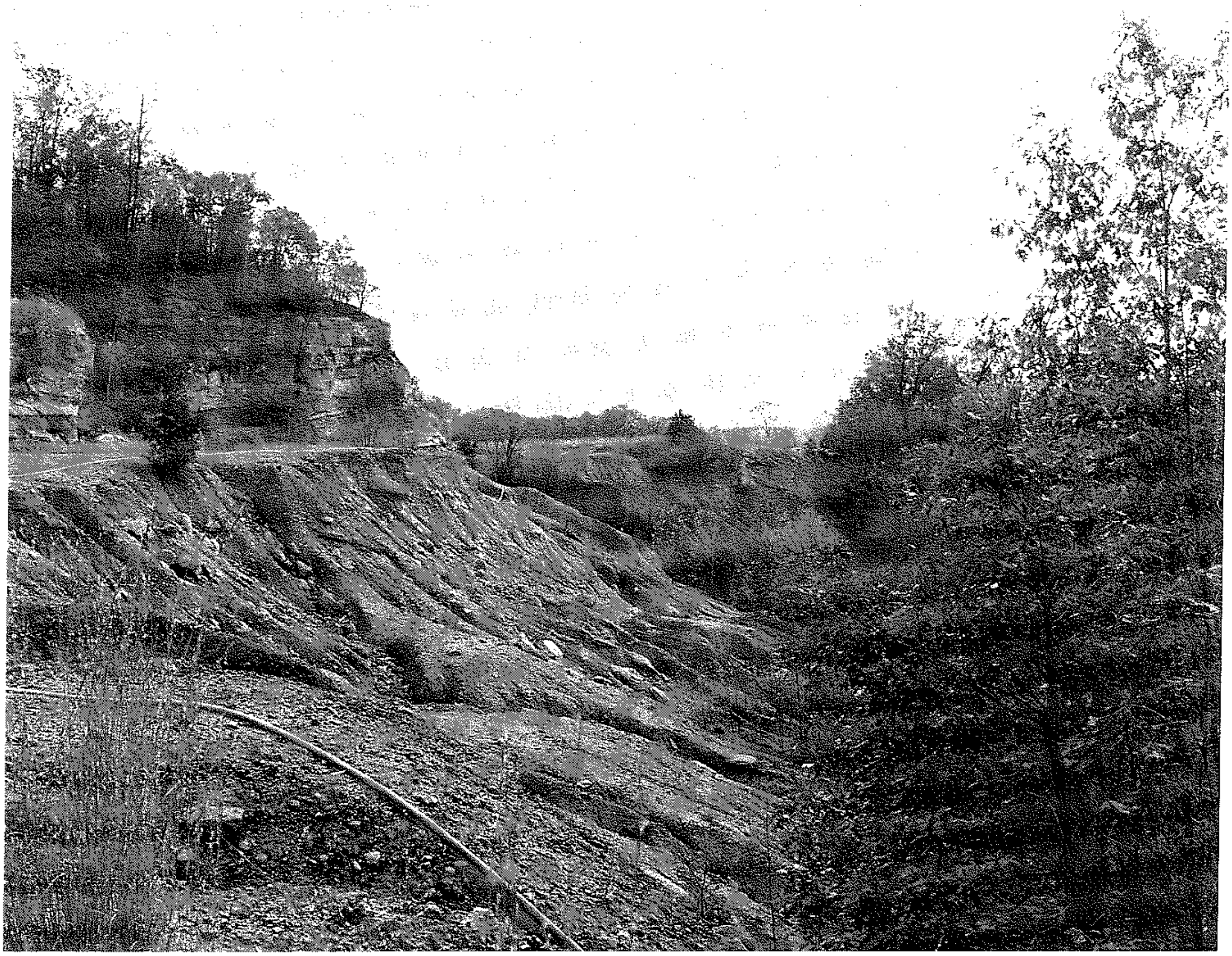

Figure 4.—An area of Bethesda channery clay loam, 40 to 70 percent slopes.

BhF—Bethesda channery clay loam, 40 to 70 percent slopes. This deep, well drained, very steep soil is on side slopes in areas surface mined for coal (fig. 4). It is a mixture of rock fragments and partially weathered fine-earth material that was in or below the original soil. The rock fragments are mainly shale, siltstone, or sandstone. Most areas are long and narrow or irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is brown, firm channery clay loam about 6 inches thick. The substratum to a depth of about 63 inches is multicolored, firm very channery clay loam and very channery and extremely channery silty clay loam. In places the soil has some layers that are less acid.

Included with this soil in mapping are areas of soils on benches. The benches are about 50 to 100 feet wide and have slopes of 5 to 15 percent. They are adjacent to exposed highwalls. Included soils make up about 20 percent of most areas.

Permeability is moderately slow in the Bethesda soil. The root zone is deep. The available water capacity is low. Runoff is very rapid.

Most areas have a sparse cover of grasses and trees. This soil is generally unsuited to cropland and pasture because of the slope, droughtiness, low fertility, and a very low content of organic matter. The rock fragments in the surface layer limit the use of conventional tillage equipment. Erosion is a very severe hazard. Areas that have been limed and fertilized generally support thin stands of grasses interspersed with barren spots. Ground cover and surface mulch help to control runoff and erosion and increase the rate of water infiltration.

This soil is best suited to the trees that can grow under acid, droughty conditions. Grasses and legumes help to control erosion during the establishment of trees. Applying mulch around seedlings reduces the seedling mortality rate. Establishing haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Haul roads and log landings should not be located on active slips. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting. The soil is generally unsuited to sanitary facilities and buildings.

The land capability classification is VIIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is H-1.

Cg—Chagrin silt loam, frequently flooded. This deep, nearly level, well drained soil is on flood plains. Most areas are long and narrow and range from 9 to 160 acres in size. Slopes range from 0 to 3 percent.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is dark yellowish brown and brown, friable and firm loam about 38 inches thick. The substratum to a depth of about 77 inches is dark yellowish brown and brown, firm and friable silt loam. In a few areas the surface layer is loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Orrville and Newark soils. These soils are in slight depressions, abandoned stream channels, and narrow bands adjacent to slope breaks to terraces and uplands. They make up about 15 percent of most areas.

Permeability is moderate in the Chagrin soil. The root zone is deep. The available water capacity is high. Runoff is slow. A perched seasonal high water table is at a depth of 4 to 6 feet during extended wet periods.

Most areas are used as pasture or woodland. Some are used as cropland.

Although the choice of crops is limited because of the flooding, this soil is well suited to corn and soybeans. Small grain, such as winter wheat, may be severely damaged by flooding in winter and early spring. Streambank erosion is the main cause of water pollution in the unit. Stabilizing the eroded streambanks is difficult in most places. Weed control is a problem because seeds from weeds are carried in and deposited on the soil by floodwater. Winter cover crops help to protect the soil from scouring. Returning crop residue to the soil and regularly adding other organic material help to improve fertility, minimize crusting, and increase the rate of water infiltration. Applying no-till or minimum tillage practices reduces the amount of time needed to prepare the field, improves soil structure and tilth, and minimizes compaction and crusting.

This soil is well suited to hay and pasture. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of fertilizer and lime help to maintain the maximum stand of key forage species. Limited grazing during winter months and other wet periods minimizes compaction.

This soil is well suited to woodland. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-5.

ChD—Clymer loam, 15 to 25 percent slopes. This deep, well drained, moderately steep soil is on hillsides and ridgetops of sandstone uplands. The topography of the soil is influenced and controlled by the underlying bedrock. Individual areas on ridgetops are irregular in shape. Those on hillsides are long and narrow. Areas range from 4 to 50 acres in size.

Typically, the surface layer is brown, friable loam about 5 inches thick. The subsoil is about 33 inches thick. The upper part is brownish yellow and yellowish brown, friable loam. The lower part is strong brown, friable sandy loam. The substratum is yellowish brown and strong brown, friable loam and very friable sandy loam. Yellowish brown, weathered sandstone bedrock is at a depth of about 60 inches. In places the subsoil contains less sand or less clay.

Included with this soil in mapping are small areas of the moderately well drained Rarden soils. These soils are in landscape positions similar to those of the Clymer soil. They make up about 15 percent of most areas.

Permeability is moderate in the Clymer soil. The root zone is deep. The available water capacity is low or moderate. Runoff is rapid.

Most areas are used as woodland or pasture. A few are used as hayland. Many areas of this soil that were pastured are reverting to brush and woodland.

This soil is moderately well suited to small grain and to grasses and legumes for hay. It is poorly suited to cultivated row crops, which can be grown only occasionally. Highly dissected areas of the soil are better suited to pasture and woodland because of the difficulty in cultivating the soil. A commonly used crop rotation includes a cultivated crop once every 4 years. In cultivated areas controlling erosion and maintaining the organic matter content are management concerns. No-till farming or another system of conservation tillage that leaves crop residue on the surface, incorporation of crop residue into the plow layer, a cropping system that includes grasses and legumes, contour stripcropping, cover crops, diversions, and grassed waterways help to control erosion and maintain tilth and the organic matter content.

This soil is moderately well suited to pasture. If the soil is overgrazed or if it is plowed during seedbed preparation, the hazard of erosion is very severe. The seed should be planted early in the spring because of droughtiness in summer. Proper stocking rates, pasture rotation, mowing to control weeds, and timely applications of lime and fertilizer help to keep the pasture in good condition. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation. Limited grazing in winter and other wet periods helps to prevent compaction. Deep-rooted legumes are difficult to maintain in some areas. The slope hinders the operation of some farm machinery.

This soil is well suited to trees. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

This soil is poorly suited to septic tank absorption fields because of the slope. Installing leach lines on the contour helps to prevent seepage of effluent to the surface.

This soil is poorly suited to buildings because of the slope. It is better suited to dwellings without basements than to dwellings with basements. Excavating the soil is difficult because bedrock is at a depth of 40 to 84 inches. Grading sites for dwellings helps to overcome the slope. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system helps to prevent damage to roads. Building the roads on the contour, where possible, minimizes the extent of cut and fill areas. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

CkB—Clymer silt loam, 3 to 8 percent slopes. This deep, well drained, gently sloping soil is on ridgetops of sandstone uplands. The topography of the soil is influenced and controlled by the underlying bedrock. Individual areas, which are irregular in shape, follow the contour of the ridgetops. They range from 1 to 5 acres in size.

Typically, the surface layer is brown, friable silt loam about 11 inches thick. The subsoil is about 21 inches thick. The upper part is yellowish brown, firm silt loam and loam. The lower part is strong brown, firm loam. The substratum is strong brown, friable sandy loam. Soft sandstone bedrock is at a depth of about 46 inches. In places the soil is moderately deep over bedrock.

Included with this soil in mapping are small areas of the deep Wellston and Zanesville soils on gently sloping, broad ridgetops. Wellston soils have a lower content of sand and coarse fragments in the subsoil than the Clymer soil. Zanesville soils are moderately well drained. Included soils make up about 15 percent of most areas.

Permeability is moderate in the Clymer soil. The root zone is deep. The available water capacity is low or moderate. Runoff is medium.

This soil is used mostly as cropland, pasture, or woodland. It is well suited to corn and small grain. Erosion is a moderate hazard, but cultivated crops can be grown year after year if erosion is controlled. The surface layer crusts after hard rains. Controlling erosion and maintaining tilth and the organic matter content are management concerns. No-till farming or another system of conservation tillage that leaves crop residue on the surface, grassed waterways, incorporation of crop residue into the plow layer, a cropping system that includes grasses and legumes, contour stripcropping, and cover crops help to prevent excessive soil loss, control runoff, minimize crusting, maintain tilth and the organic matter content, and increase the rate of water infiltration.

This soil is well suited to woodland. It also is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to septic tank absorption fields. The limited depth to bedrock and the moderate permeability are the main limitations.

Enlarging the absorption field and backfilling trenches with suitable material improve the capacity of the field to absorb effluent. Installing septic tank absorption fields in suitable fill material helps to overcome the limited depth to bedrock and the poor filtering capacity of the soil.

This soil is moderately well suited to buildings. It is better suited to houses without basements than to houses with basements because of the depth to bedrock. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

CkC—Clymer silt loam, 8 to 15 percent slopes. This deep, well drained, strongly sloping soil is on the upper side slopes and ridgetops of sandstone uplands. The topography of the soil is influenced and controlled by the underlying bedrock. Individual areas on ridgetops are irregular in shape. Those on the upper side slopes are long and narrow. Areas range from 1 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is strong brown, friable silt loam and channery loam. The lower part is strong brown, friable sandy loam. The substratum is strong brown, very friable sandy loam. Strong brown, soft sandstone bedrock is at a depth of about 53 inches. In some areas the subsoil has less sand or less clay. In other areas the soil is moderately deep over bedrock.

Included with this soil in mapping are small areas of Wellston and Zanesville soils on gently sloping ridgetops. Zanesville soils are moderately well drained. Wellston soils have a lower content of sand and coarse fragments in the subsoil than the Clymer soil. Included soils make up about 15 percent of most areas.

Permeability is moderate in the Clymer soil. The root zone is deep. The available water capacity is low or moderate. Runoff is medium.

This soil is used mostly as hayland, pasture, or woodland. It is moderately well suited to cultivated crops and small grain. Controlling erosion is the major management concern. No-till farming or another system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, a cropping system that includes grasses and legumes, cover crops, and incorporation of crop residue into the surface layer help to prevent excessive soil loss, control runoff, minimize crusting, maintain tilth and the organic matter content, and increase the rate of water infiltration.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. The seed should be planted early in the spring because of droughtiness in summer. Proper stocking rates, pasture rotation, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation.

This soil is well suited to woodland. Cutting and filling to a more desirable slope can improve sites for log landings.

This soil is only moderately well suited to septic tank absorption fields because of the depth to bedrock, the moderate permeability, and the slope. Installing leach lines on the contour helps to prevent seepage of effluent to the surface. Enlarging the absorption field and backfilling trenches with suitable material improve the capacity of the field to absorb effluent. Installing septic tank absorption fields in suitable fill material helps to overcome the limited depth to bedrock and the poor filtering capacity of the soil.

This soil is only moderately well suited to buildings because of the depth to bedrock and the slope. It is better suited to dwellings without basements than to dwellings with basements because bedrock is at a depth of 40 to 84 inches. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. Constructing local roads on the contour minimizes the extent of cut and fill areas. Providing suitable base material and installing a tile drainage system help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

CoB—Coolville silt loam, 1 to 6 percent slopes. This deep, moderately well drained, nearly level and gently sloping soil is on ridgetops in the uplands. Most areas are rounded or long and narrow and range from 2 to 20 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part is yellowish brown and strong brown, friable silt loam and firm silty clay loam. The lower part is yellowish red, reddish brown, and red, mottled, firm and very firm silty clay. Yellowish brown, soft shale bedrock is at a depth of about 42 inches. In some areas the subsoil has less clay. In a few areas the clayey textures are closer to the surface.

Included with this soil in mapping are small areas of the moderately deep Gilpin and Rarden soils. Gilpin soils are on the highest part of the landscape. Rarden soils are in dissected areas. Included soils make up about 10 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Coolville soil and slow or very slow in the lower part of the subsoil. The root zone is deep. The available water capacity is moderate. Runoff is medium. The potential for frost action is high. A perched seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

Most of the acreage is pastured or wooded. This soil is well suited to corn, soybeans, tobacco, and small grain. If the soil is cultivated, erosion is a hazard. Cultivated crops can be grown year after year if erosion is controlled and improved management practices are applied. Maintaining tilth and the organic matter content is an additional management concern. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, incorporation of crop residue into the plow layer, contour tillage, stripcropping, and grassed waterways help to maintain tilth and control runoff and erosion. Tilling within the optimum moisture range minimizes compaction.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields. The wetness and the slow or very slow permeability are severe limitations. Increasing the size of the absorption area or installing an aeration disposal system helps to overcome these limitations. Installing perimeter drains around the absorption field lowers the seasonal high water table.

This soil is moderately well suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Building sites should be graded to help keep surface water away from foundations. Excavations around walls and foundations should be backfilled with material that has a lower shrink-swell potential. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4C. The pasture and hayland suitability group is A-6.

Cu—Cuba silt loam, occasionally flooded. This deep, well drained, nearly level soil is in the highest areas on the flood plains along the major streams. It is occasionally flooded. Individual areas are broad and irregular in shape or are long and winding. They range from 2 to 40 acres in size. Slopes range from 0 to 3 percent.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown and dark yellowish brown, friable silt loam about 32 inches thick. The substratum to a depth of about 83 inches is yellowish brown and dark yellowish brown, mottled, friable silt loam. In some areas the subsoil has more sand and less silt. In other areas the soil is moderately well drained.

Included with this soil in mapping are small areas of Stendal and Piopolis soils. These soils are in slight depressions, abandoned stream channels, and narrow bands adjacent to slope breaks to terraces and uplands. They are ponded for a short time following periods of flooding or heavy rainfall. Stendal soils are somewhat poorly drained. Piopolis soils are poorly drained and very poorly drained. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Cuba soil. The root zone is deep. The available water capacity is very high. Runoff is slow. The potential for frost action is high.

Most areas are used for cultivated crops or forage crops. Some are used as pasture or woodland.

If good management practices are applied, this soil is well suited to continuous cropping of corn and soybeans. The flooding is the major management concern. Siltation and the flooding in winter and early spring are detrimental to small grain. Planting is delayed in some years because of the flooding in spring. Streambank erosion is severe in many areas. Stabilizing eroded streambanks is difficult in most places; however, maintaining a vegetative cover can help to control erosion. Returning crop residue to the soil and regularly adding other organic material help to improve fertility, minimize crusting, increase the rate of water infiltration, and minimize the damage caused by flooding. Applying no-till or minimum tillage practices reduces the amount of time needed to prepare the field, improves soil structure and tilth, and minimizes compaction and crusting. Random subsurface drains are needed in the included areas of wetter soils.

This soil is well suited to grasses and legumes for pasture and hay. Overgrazing or grazing when the soil is wet causes compaction. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. A few areas support native hardwoods. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding. Building dikes to control flooding is difficult. Local roads and streets can be constructed on fill material, above the normal level of flooding. Providing suitable base material minimizes the damage caused by frost action in roadfill and by piping in dikes.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-5.

DbA—Doles silt loam, 0 to 3 percent slopes. This deep, somewhat poorly drained, nearly level soil is on flats in preglacial valleys. Most areas are irregularly shaped and range from 3 to 40 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The upper part of the subsoil is yellowish brown, mottled, friable and firm silt loam. The next part is a fragipan of light brownish gray and yellowish brown, mottled, very firm and brittle silt loam. The lower part to a depth of about 70 inches is yellowish brown, very firm clay loam.

Included with this soil in mapping are small areas of the moderately well drained Omulga soils on slight rises. Also included are areas of soils that do not have a fragipan. Included soils make up about 10 percent of most areas.

Permeability is slow in the Doles soil. The root zone is mainly restricted to the 20- to 30-inch zone above the fragipan. The available water capacity in this zone is low. Runoff is slow on the soil. The potential for frost action is high. A perched seasonal high water table is at a depth of 12 to 24 inches during extended wet periods.

Most areas are used as cropland or pasture. A few are wooded.

If drained, this soil can be intensively cropped and is well suited to corn, soybeans, small grain, and hay. A drainage system is needed for optimum crop production. Subsurface drains are effective if they are installed on or above the slowly permeable fragipan and if the trenches are backfilled with more permeable material. Maintaining tilth and the organic matter content is a management concern. The surface layer crusts after hard rains. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain tilth and the organic matter content and minimize crusting. Tilling within the optimum range in moisture content minimizes compaction.

If drained, this soil is well suited to pasture. Undrained areas are poorly suited to grazing early in spring. Most of the pastured areas are undrained. Overgrazing or grazing when the soil is wet causes compaction and reduced yields. The soil is suited to bluegrass, tall fescue, ladino clover, alsike clover, birdsfoot trefoil, and reed canarygrass. Stands of deep-rooted legumes are difficult to maintain. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Logging can be done when the soil is frozen or during the drier parts of the year. Site preparation and planting can be done during dry periods.

This soil is poorly suited to septic tank absorption fields. The wetness and the slow permeability are severe limitations. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. An aeration disposal system is used in some areas. Installing perimeter drains around the absorption field and backfilling with suitable material lower the seasonal high water table. Outlets for perimeter drains are not available in some areas.

This soil is poorly suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system and providing suitable base material help to prevent the damage caused by frost action and low strength.

The land capability classification is IIw. The woodland ordination symbol is 4D. The pasture and hayland suitability group is C-2.

Dm—Dumps, mine. This map unit consists of nearly level to steep areas of waste from underground coal mining and from the processing and loading operations involved in coal mining. Most areas consist of piles of coal fragments and refuse, shale, clay, or sandstone rock fragments. They are irregular in shape and range from 3 to 10 acres in size.

The material in this map unit is strongly acid to ultra acid and has poor physical properties for plant growth. Most areas are barren. The material is difficult to reclaim and can be hazardous because it is a source of sediments and acid drainage to local streams in abandoned areas. Coal-loading facilities currently in operation are surrounded by embankments to direct runoff into holding basins rather than into local streams. Soil material used to reclaim abandoned areas should be seeded with grasses or planted with trees that can tolerate the acid conditions and low available water capacity.

No land capability classification, woodland ordination symbol, or pasture and hayland suitability group is assigned.

EkB—Elkinsville silt loam, 1 to 6 percent slopes. This deep, well drained, nearly level and gently sloping soil is on terraces along the major streams. Individual areas are broad and irregular in shape and range from 2 to 400 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 44 inches thick. The upper part is dark yellowish brown and yellowish brown, friable and firm silt loam. The lower part is yellowish brown, friable loam. The substratum to a depth of about 74 inches is strong brown, very friable sandy loam. In some areas the subsoil has more sand and less silt. In other areas the soil is moderately well drained.

Included with this soil in mapping are small areas of Peoga and Taggart soils in depressions along drainageways. The lower areas of these soils are subject to rare flooding. Peoga soils are poorly drained. Taggart soils are somewhat poorly drained. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Elkinsville soil. The root zone is deep. The available water capacity is high or very high. Runoff is slow or medium. The potential for frost action is high.

Most areas are used for cultivated crops or forage crops. A few small areas are used as pasture or woodland.

This soil is well suited to continuous cropping of corn, soybeans, tobacco, and small grain if erosion is controlled and improved management practices are applied. Returning crop residue to the soil and regularly adding other organic material help to improve fertility, minimize crusting, and increase the rate of water infiltration. Applying no-till or minimum tillage practices reduces the amount of time needed to prepare the field, improves soil structure and tilth, minimizes compaction, and helps to prevent excessive soil loss.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is well suited to septic tank absorption fields. The moderate permeability is a limitation. Enlarging the absorption field improves the capacity of the field to absorb effluent.

This soil is well suited to buildings. Properly designing foundations and footings and backfilling along the foundations with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Installing a drainage system and providing suitable base material help to prevent damage to roads and streets. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. The included areas of soils that are subject to rare flooding are generally unsuited to buildings.

The land capability classification is IIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-6.

FaB—Fairpoint channery silty clay loam, 1 to 8 percent slopes. This deep, well drained, nearly level and gently sloping soil is on narrow and broad ridgetops and wide benches in areas surface mined for coal. It has been graded following mining. The substratum is a mixture of rock fragments and partially weathered fine-earth material that was in or below the original soil. The rock fragments are mostly shale, siltstone, or sandstone. Individual areas are long and narrow or irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark grayish brown, firm channery silty clay loam about 3 inches thick. The substratum to a depth of about 64 inches is brown, yellowish brown, and dark grayish brown, firm channery and very channery clay loam and very channery and extremely channery silty clay loam. In some areas the soil is more acid throughout. In other areas the surface layer is thicker and redder.

Included with this soil in mapping are small areas of Pinegrove soils. These soils are more sandy than the Fairpoint soil. They formed in material derived from coarse, weakly cemented, acid sandstone. Also included are some areas of soils that have been blanketed with natural soil material. Included soils make up about 10 percent of most areas.

Permeability is moderately slow in the Fairpoint soil. The depth of the root zone varies because of differences in compactness of the soil. The available water capacity is low. Runoff is medium.

Most areas are used as idle grassland. A few areas are used as hayland and pasture.

This soil is generally unsuited to cultivated crops and small grain because of the low available water capacity and numerous rock fragments throughout the soil. Rock fragments on the surface may limit the use of tillage equipment. Maintaining a vegetative cover and applying mulch help to control runoff and erosion, increase the rate of water infiltration, and improve the retention of water.

This soil is poorly suited to hay and pasture. In areas where the soil has not been limed and fertilized, the stand of grass is thin. No-till seeding of grass and legume mixtures works well in areas where the rock fragments on the surface are not too large or numerous. Orchardgrass, tall fescue, and Korean lespedeza are some of the forage plants that grow best. Maintaining a vegetative cover helps to control runoff and erosion, increase the rate of water infiltration, and improve the retention of water. Overgrazing causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to trees. The species that can withstand droughtiness should be selected for planting. Mechanical planting is not practical in many areas because of the rock fragments in the surface layer.

This soil is poorly suited to septic tank absorption fields. The moderately slow permeability and instability of fill material are limitations on sites for septic tank absorption fields. An aeration disposal system is used in some areas. Enlarging the size of the leach field and backfilling trenches with suitable material improve the capacity of the field to absorb effluent. Sanitary systems should be installed only in areas that have had sufficient time to settle after regrading.

This soil is only moderately well suited to buildings because of the instability of fill material. Buildings should be constructed only in areas that have had sufficient time to settle after grading. The soil is better suited to houses without basements than to houses with basements in areas where the soil contains many large stones. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIs. No woodland ordination symbol is assigned. The pasture and hayland suitability group is B-1.

FaD—Fairpoint channery silty clay loam, 8 to 25 percent slopes. This deep, well drained, strongly sloping and moderately steep soil is on side slopes and benches in areas surface mined for coal. It has been graded following mining. The substratum is a mixture of rock fragments and partially weathered fine-earth material that was in or below the original soil. The rock fragments are mostly shale, siltstone, or sandstone. Individual areas are long and narrow or irregular in shape and range from 5 to 35 acres in size.

Typically, the surface layer is dark grayish brown and yellowish brown, firm channery silty clay loam about 3 inches thick. The substratum to a depth of about 80 inches is multicolored, firm very channery silty clay loam. In some areas the substratum is more acid. In other areas the surface layer is thicker and redder.

Included with this soil in mapping are small areas of Pinegrove soils and areas of spoil that have not been regraded. Pinegrove soils are more sandy than the Fairpoint soil. They formed in material derived from coarse, weakly cemented, acid sandstone. Also included are some areas of soils that have been blanketed with natural soil material. Inclusions make up about 10 percent of most areas.

Permeability is moderately slow in the Fairpoint soil. The depth of the root zone varies because of differences in compactness of the soil. The available water capacity is low. Runoff is medium or rapid.

Most areas are used as idle grassland. A few are used as woodland.

This soil is generally unsuited to row crops and hay because of the droughtiness, numerous rock fragments throughout the soil, the low organic matter content, and low fertility. The hazard of erosion is severe if the soil is plowed during seedbed preparation. Rock fragments on or near the surface limit the use of tillage equipment. Maintaining a vegetative cover and applying mulch help to control runoff and erosion, increase the rate of water infiltration, and improve the retention of water.

This soil is poorly suited to pasture. In areas where the soil has not been limed and fertilized, the stand of grass is thin. No-till seeding of grass and legume mixtures works well in areas where the rock fragments on the surface are not too large or numerous. Orchardgrass, tall fescue, and Korean lespedeza are some of the forage plants that grow best. Maintaining a vegetative cover helps to control runoff and erosion, increase the rate of water infiltration, and improve the retention of water. Overgrazing causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to trees. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

This soil is poorly suited to septic tank absorption fields. The moderately slow permeability, instability of fill material, and the slope are limitations on sites for absorption fields. An aeration disposal system is used in some areas. Enlarging the size of the absorption field, backfilling trenches with suitable material, and installing the distribution lines on the contour improve the capacity of the field to absorb effluent and help to prevent seepage of effluent to the surface. Sanitary systems should be installed only where spoil has had sufficient time to settle after regrading.

This soil is moderately well suited to buildings. The strongly sloping areas of this soil are better sites for buildings than the moderately steep areas. Instability of fill material and the slope are limitations on sites for buildings. Buildings should be constructed only in areas that have had sufficient time to settle after regrading. The soil is better suited to houses without basements than to houses with basements if the soil contains many large stones. Properly landscaping and grading around the building site help to keep surface water away from the foundation. Installing a drainage system and providing suitable base material help to prevent damage to roads. Building roads on the contour minimizes the extent of cut and fill areas.

The land capability classification is VIs. No woodland ordination symbol is assigned. The pasture and hayland suitability group is B-1.

FaE—Fairpoint channery silty clay loam, 25 to 40 percent slopes. This deep, well drained, steep soil is on side slopes in areas surface mined for coal. Most areas have been graded following mining. The substratum is a mixture of rock fragments and partially weathered fine-earth material that was in or below the original soil. The rock fragments are mostly sandstone, shale, or siltstone. Some are limestone or coal. Individual areas are long and narrow or irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is mixed dark yellowish brown and yellowish brown, firm channery silty clay loam about 6 inches thick. The substratum to a depth of about 60 inches is mixed yellowish brown and dark yellowish brown, firm channery clay loam and very channery silty clay loam. In some areas the soil has fewer rock fragments. In other areas the substratum is more acid. In places the surface layer is thicker and redder.

Included with this soil in mapping are small areas of Pinegrove soils and areas of spoil that have not been regraded. Pinegrove soils are more acid than the Fairpoint soil. They formed in material derived from sandstone. Inclusions make up about 10 percent of most areas.

Permeability is moderately slow in the Fairpoint soil. The depth of the root zone varies because of differences in compactness of the soil. The available water capacity is low. Runoff is very rapid.

Most areas are seeded to grass or a mixture of grasses and legumes. These areas, however, are not being used as pasture or hayland. The soil generally is unsuited to row crops and hay because of the slope, droughtiness, and low natural fertility.

This soil is poorly suited to pasture. Areas that have been covered with soil material and have been fertilized support good stands of grasses if enough moisture is available. Areas that have not been covered with soil material support thin stands of vegetation. Orchardgrass, tall fescue, and Korean lespedeza are some of the species that grow best.

This soil is poorly suited to trees. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

This soil is generally unsuited to septic tank absorption fields and to buildings.

The land capability classification is VIIe. No woodland ordination symbol is assigned. The pasture and hayland suitability group is B-2.

GaC2—Gallia loam, 8 to 15 percent slopes, eroded. This deep, well drained, strongly sloping soil is on loamy, dissected terrace remnants of abandoned preglacial drainage systems. Erosion has removed part of the original surface layer of the soil. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are long and narrow or irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is brown, friable loam about 7 inches thick. It is mixed with reddish brown material from the subsoil. The subsoil is about 61 inches thick. The upper part is reddish brown and dark reddish brown, firm clay loam. The next part is reddish brown, red, and dark reddish brown, firm and friable loam. The lower part is reddish brown, friable sandy loam. The substratum to a depth of about 80 inches is strong brown, loose stratified gravelly loamy sand and sandy loam. In some areas, the subsoil has more clay and the soil is moderately well drained. In other areas the subsoil has more sand and is not so red.

Included with this soil in mapping are small areas of Omulga and Monongahela soils and a red silty soil. All three of these soils are in landscape positions similar to those of the Gallia soil. Omulga and Monongahela soils have a fragipan. The red silty soil has less sand than the Gallia soil. Also included are small sand pits where molding sand has been removed. Inclusions make up about 10 percent of most areas.

Permeability is moderate in the Gallia soil. The root zone is deep. The available water capacity is moderate or high. Runoff is medium.

Most areas are used as pasture or woodland. Some are used for row crops.

This soil is moderately well suited to corn, soybeans, tobacco, and small grain. Controlling erosion is the major management concern. No-till farming or another system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, a cropping system that includes grasses and legumes, cover crops, and incorporation of crop residue into the plow layer help to prevent excessive soil loss, minimize crusting, control runoff, maintain tilth and the organic matter content, and increase the rate of water infiltration.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to woodland. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Cutting and filling to a more desirable slope can improve sites for log landings.

This soil is well suited to septic tank absorption fields and to buildings. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Backfilling along foundations with material that has a low shrink-swell potential helps to prevent the structural damage caused by shrinking and swelling of the soil. Installing leach lines in septic tank absorption fields along the contour helps to prevent seepage of effluent to the surface. Constructing local roads on the contour minimizes the extent of cut and fill areas. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-1.

GbB—Gallipolis silt loam, 1 to 6 percent slopes. This deep, moderately well drained, nearly level and gently sloping soil is on terraces along the major streams. Individual areas are broad and irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is yellowish brown, firm silty clay loam. The next part is brown, mottled, firm silty clay loam. The lower part is brown, mottled, firm silt loam. The substratum to a depth of about 74 inches is brown, mottled, firm silty clay loam. In some areas the subsoil has more sand.

Included with this soil in mapping are small areas of Taggart and Peoga soils in depressions and along minor natural drainageways. The lower areas of these soils are subject to rare flooding. Taggart soils are somewhat poorly drained. Peoga soils are poorly drained. Included soils make up about 10 percent of most areas.

Permeability is moderately slow in the Gallipolis soil. The root zone is deep. The available water capacity is high. Runoff is slow or medium. The potential for frost action is high. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Most areas are used as cropland or pasture. A few small areas are used as woodland.

This soil is well suited to cultivated crops and small grain. It dries out slowly in the spring because of the wetness. Tillage is often delayed in the spring by the wetness in the included areas of the Taggart soils. A subsurface drainage system is needed in areas of the Taggart soils. Crop yields are reduced somewhat in wet years; however, unless high-value crops are grown, installing a complete tiling system is generally not justified. If cultivated crops are grown, erosion is the main problem. Cultivated crops can be grown year after year if erosion is controlled and improved management practices are applied. The surface layer crusts after hard rains. Minimum tillage and other conservation practices that leave crop residue on the surface, winter cover crops, grassed waterways, and a cropping system that includes grasses and legumes are good management practices.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction. Proper stocking rates, pasture rotation, timely deferment of grazing, timely applications of lime and fertilizer, and mowing to control weeds help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields because of the wetness and the moderately slow permeability. An aeration disposal system is used in some areas. Installing perimeter drains around the absorption field lowers the seasonal high water table. Enlarging the size of the absorption field improves the capacity of the field to absorb effluent.

Because of the wetness, this soil is only moderately well suited to buildings. It is better suited to buildings without basements than to buildings with basements. Installing drains at the base of footings and coating exterior basement walls help to keep basements dry. Properly landscaping building sites helps to keep surface water away from foundations. Backfilling along foundations with material that has a low shrink-swell potential helps to prevent the structural damage caused by shrinking and swelling of the soil. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. The included areas of soils that are subject to rare flooding are generally unsuited to buildings.

The land capability classification is IIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-6.

GbC—Gallipolis silt loam, 6 to 15 percent slopes. This deep, moderately well drained, strongly sloping soil is on terraces along the major streams. Individual areas are long and narrow and range from 5 to 15 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 45 inches thick. The upper part is yellowish brown, friable silt loam. The lower part is yellowish brown, mottled, friable and firm silt loam and silty clay loam. The substratum to a depth of about 70 inches is yellowish brown, mottled, firm and very firm silty clay loam. In some areas the subsoil has a higher content of sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Taggart soils. These soils are in depressions and along minor natural drainageways. They are subject to rare flooding in the lower areas. They make up about 10 percent of most areas.

Permeability is moderately slow in the Gallipolis soil. The root zone is deep. The available water capacity is high. Runoff is medium. The potential for frost action is high. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Most areas are used as cropland or pasture. A few small areas are wooded.

This soil is moderately well suited to cultivated crops and small grain. It dries out slowly in the spring because of the wetness. Tillage is often delayed in the spring by the wetness in the included areas of the Taggart soils. A subsurface drainage system is needed in areas of the Taggart soils. Crop yields are reduced somewhat in wet years; however, unless high-value crops are grown, installing a complete tiling system is generally not justified. If cultivated crops are grown, erosion is a hazard. The soil can be cropped successfully, but the cropping system should include hay or pasture for long periods of time. The surface layer crusts after hard rains. Applying a system of conservation tillage that leaves crop residue on the surface, growing cover crops, tilling at the proper moisture content, and establishing grassed waterways help to control erosion, improve tilth, and maintain the organic matter content.

This soil is moderately well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields because of the wetness and the moderately slow permeability. An aeration disposal system is used in some areas. Installing an absorption field that is larger than normal improves the capacity of the field to absorb effluent. Installing perimeter drains around the absorption field lowers the seasonal high water table.

This soil is moderately well suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Buildings should be designed so that they conform to the natural shape of the land. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. The included areas of soils that are subject to rare flooding are generally unsuited to buildings.

The land capability classification is IIIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-6.

GdE—Gilpin-Rarden association, steep. These moderately deep soils are on side slopes in the uplands. The Gilpin soil is well drained, and the Rarden soil is moderately well drained. Slopes dominantly range from 25 to 40 percent. Areas are irregularly shaped and range from 20 to several hundred acres in size. Most are about 40 percent Gilpin soil and 35 percent Rarden soil. The Gilpin soil is on the steeper part of hillsides, and the Rarden soil is on the gentler slopes of hillsides and on benches. Because of present and anticipated soil uses, it is not considered practical or necessary to map the soils separately.

Typically, the Gilpin soil has a surface layer of brown, friable silt loam about 4 inches thick. The subsoil is about 31 inches thick. The upper part is yellowish brown, firm silt loam. The lower part is yellowish brown and strong brown, firm channery and very channery silty clay loam. Light olive brown siltstone bedrock is at a depth of about 35 inches. In some places, the subsoil is thicker and the bedrock is at a depth or more than 40 inches. In other places the subsoil has more sand. In some areas on the steeper slopes and shoulder slopes, the soil is less than 20 inches deep.

Typically, the Rarden soil has a surface layer of brown, friable silt loam about 5 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, firm silt loam. The next part is yellowish red, mottled, very firm silty clay and red, very firm clay. The lower part is yellowish red, firm channery silty clay. Reddish brown clay shale is at a depth of about 40 inches. In some places, the subsoil is thicker and the soil is deep over bedrock. In other places the subsoil is not so red.

Included with these soils in mapping are small areas of Steinsburg and Wellston soils. Steinsburg soils have more sand in the subsoil than the Gilpin and Rarden soils. They are on shoulder slopes. Wellston soils are well drained. They are on narrow ridgetops. Individual areas of included soils are less than 20 acres in size. Inclusions make up about 25 percent of most areas.

Permeability is moderate in the Gilpin soil and slow in the Rarden soil. The available water capacity is low or moderate in the Gilpin soil and low in the Rarden soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Rarden soil and low in the Gilpin soil. The potential for frost action is high in the Rarden soil. The Rarden soil has a perched seasonal high water table at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as woodland. A few are pastured. These soils are generally unsuited to cultivated crops, hay, and pasture because of the slope, a very severe hazard of erosion, and the high content of clay in the subsoil of the Rarden soil.

These soils are moderately well suited to trees. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Rarden soil. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to buildings and sanitary facilities (fig. 5).

The land capability classification is VIIe. The woodland ordination symbol is 4R in areas of the Gilpin soil and 3R in areas of the Rarden soil. The pasture

Figure 5.—A high shrink-swell potential and slippage are severe limitations affecting building site development in areas of Gilpin-Rarden association, steep.

and hayland suitability group is F-2 in areas of both soils.

GeE—Gilpin-Steinsburg-Upshur association, steep. These well drained soils are on hillsides in the uplands. The Gilpin and Steinsburg soils are moderately deep, and the Upshur soil is deep. Most of the slopes are smooth and even; however, some are benched with sharp breaks at sandstone escarpments. Slopes dominantly range from 25 to 50 percent. Areas are irregularly shaped and range from 10 to several hundred acres in size. Most are about 35 percent Gilpin soil, 25 percent Steinsburg soil, and 25 percent Upshur soil. The Gilpin soil is commonly on the middle and lower parts of back slopes. The Steinsburg soil is commonly on shoulder slopes and the upper part of back slopes. The Upshur soil is commonly on benches on the middle of slopes and on the lower part of back slopes. Because of present and anticipated soil uses, it is not considered practical or necessary to map the soils separately.

Typically, the Gilpin soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is about 26 inches thick. The upper part is brown, firm loam. The lower part is strong brown and brown, firm channery loam. The substratum is dark yellowish brown, firm very channery loam. Yellowish brown sandstone bedrock is at a depth of about 36 inches. In some areas the soil is deeper over bedrock. In other areas the soil has a higher base saturation in the lower part of the profile.

Typically, the Steinsburg soil has a surface layer of brown, very friable sandy loam about 4 inches thick. The subsoil is yellowish brown and brownish yellow, friable sandy loam and channery sandy loam about 16 inches thick. The substratum is yellowish brown, loose channery sandy loam. Strong brown, weakly cemented sandstone bedrock is at a depth of about 24 inches. In some areas the soil is deeper over bedrock. In a few areas the subsoil has more sand.

Typically, the Upshur soil has a surface layer of brown, friable silty clay loam about 4 inches thick. The subsoil is about 46 inches thick. The upper part is brown and yellowish red, firm and very firm silty clay loam and silty clay. The lower part is red and yellowish red, very firm clay. The substratum is reddish brown, firm channery silty clay loam. Light olive gray, calcareous siltstone bedrock is at a depth of about 67 inches. In places, the substratum has gray mottles or the subsoil has a higher content of sandstone fragments.

Included with these soils in mapping are small areas of Berks and Guernsey soils and areas of rock outcrop. Berks soils have a high content of coarse fragments in the subsoil. They are on shoulder slopes and in dissected areas. Guernsey soils are moderately well drained. They are on benches and the lower part of side slopes. The rock outcrop is on shoulder slopes. Individual areas of the included soils are less than 20 acres in size. Inclusions make up about 15 percent of most areas.

Permeability is moderate in the Gilpin soil, moderately rapid in the Steinsburg soil, and slow in the Upshur soil. The root zone is moderately deep in the Gilpin and Steinsburg soils and deep in the Upshur soil. The available water capacity is low in the Gilpin soil, very low in the Steinsburg soil, and moderate in the Upshur soil. Runoff is very rapid. The shrink-swell potential is low in the Gilpin and Steinsburg soils and high in the subsoil of the Upshur soil.

Most areas are used as woodland. A few are used as permanent pasture. These soils are generally unsuited to cultivated crops, hay, and pasture because of the slope, a very severe hazard of erosion, the limited depth to bedrock in the Steinsburg and Gilpin soils, and the high content of clay in the subsoil of the Upshur soil.

These soils are moderately well suited to woodland. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate on all three soils. In addition, applying mulch around seedlings reduces the seedling mortality rate on the Steinsburg soil and planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Upshur soil. The windthrow hazard on the Upshur soil can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength in the Upshur soil. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

This association is generally unsuited to septic tank absorption fields and to buildings. The hazard of erosion is severe when the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible.

The land capability classification is VIIe. The woodland ordination symbol is 4R in areas of the Gilpin soil and 4R on north aspects and 3R on south aspects in areas of the Steinsburg and Upshur soils. The pasture and hayland suitability group is F-2 in areas of the Gilpin soil, H-1 in areas of the Steinsburg soil, and F-6 in areas of the Upshur soil.

GsC—Guernsey-Gilpin silt loams, 8 to 15 percent slopes. These strongly sloping soils are on ridgetops and shoulder slopes in the uplands. The Guernsey soil is deep and moderately well drained, and the Gilpin soil is moderately deep and well drained. Some areas are on the lower part of side slopes. Most areas are about 45 percent Guernsey soil and 40 percent Gilpin soil. The Guernsey soil is in saddles and concave areas, and the Gilpin soil is on ridge crests. These soils occur as areas so intricately mixed or so small that separating them in mapping is not practical. Areas generally follow the contour of the ridgetop and are commonly long and narrow. They range from 5 to 50 acres in size.

Typically, the Guernsey soil has a surface layer of brown, friable silt loam about 5 inches thick. The subsoil is about 37 inches thick. The upper part is yellowish brown, firm silt loam. The next part is yellowish brown, mottled, firm silty clay loam. The lower part is yellowish brown, mottled, very firm silty clay and channery silty clay. The substratum is light olive brown, very firm channery silty clay. Weathered shale bedrock is at a depth of about 51 inches. In places bedrock is at a depth of 30 to 50 inches.

Typically, the Gilpin soil has a surface layer of mixed brown and yellowish brown, friable silt loam about 8 inches thick. The subsoil is about 26 inches thick. The upper part is strong brown, firm and very firm silt loam and silty clay loam. The lower part is yellowish brown, firm channery silt loam. Weathered siltstone bedrock is at a depth of about 34 inches. In places the subsoil has gray mottles.

Included with these soils in mapping are small areas of Upshur soils in saddles or on benches. Upshur soils are deep and well drained. They make up about 15 percent of most areas.

Permeability is moderately slow in the Guernsey soil and moderate in the Gilpin soil. The root zone is deep in the Guernsey soil and moderately deep in the Gilpin soil. The available water capacity is moderate in the Guernsey soil and low in the Gilpin soil. Runoff is rapid on both soils. The shrink-swell potential is high in the subsoil of the Guernsey soil and low in the Gilpin soil. The potential for frost action is high in the Guernsey soil. The Guernsey soil has a perched seasonal high water table at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as pasture. Some are used as cropland or woodland.

These soils are moderately well suited to cultivated crops and small grain and to grasses and legumes for hay. Controlling erosion is the major management concern. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, incorporation of crop residue into the plow layer, contour tillage, stripcropping, and grassed waterways help to maintain tilth and the content of organic matter, control runoff, and prevent excessive soil loss. A subsurface drainage system may be needed in scattered seepy areas.

These soils are well suited to pasture. Overgrazing or grazing when the soils are wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species. Applying trash mulch or other no-till seeding methods or growing cover crops or companion crops when pastures are reseeded helps to control erosion.

These soils are well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. The bedrock can be ripped with construction equipment. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Cutting and filling to a more desirable slope can improve sites for log landings.

These soils are poorly suited to septic tank absorption fields. The depth to bedrock in the Gilpin soil and the wetness and the restricted permeability in the Guernsey soil are limitations on sites for absorption fields. The bedrock generally can be ripped with heavy construction equipment. An aeration disposal system is used in some areas. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. Installing perimeter drains around the absorption field lowers the seasonal high water table in the Guernsey soil. Installing septic tank absorption fields in suitable fill material helps to overcome the limited depth to bedrock and the poor filtering capacity.

These soils are poorly suited to buildings. They are better suited to houses without basements than to houses with basements because of the limited depth to bedrock in the Gilpin soil and the wetness and the high shrink-swell potential in the Guernsey soil. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. Installing drains at the base of footings, backfilling with suitable fill material, and coating the exterior basement walls minimize the damage caused by wetness and by shrinking and swelling of the Guernsey soil. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6 in areas of the Guernsey soil and F-1 in areas of the Gilpin soil.

GwE—Guernsey-Gilpin association, steep. These soils are on hillsides and along deeply entrenched drainageways. The Guernsey soil is deep and moderately well drained, and the Gilpin soil is moderately deep and well drained. Slopes are generally smooth. In some areas, however, the slopes have benches and sharp breaks at sandstone bedrock escarpments and irregularities at hillside slips. Slopes dominantly range from 25 to 50 percent. Areas are irregularly shaped and range from 10 to several hundred acres in size. Most are about 50 percent

Guernsey soil and 35 percent Gilpin soil. The Guernsey soil is on side slopes, and the Gilpin soil is on shoulder slopes and side slopes. Because of present and anticipated soil uses, it is not considered practical or necessary to map the soils separately.

Typically, the Guernsey soil has a surface layer of dark grayish brown, firm silty clay loam about 3 inches thick. The surface layer is mixed with light olive brown material from the subsoil. The subsoil is about 48 inches thick. The upper part is yellowish brown, firm silty clay loam. The next part is yellowish brown and light olive brown, mottled, very firm silty clay. The lower part is dark yellowish brown and olive yellow, mottled, very firm and firm silty clay and channery silty clay loam. The substratum to a depth of about 72 inches is yellowish brown and light olive brown, mottled, firm and friable channery silty clay loam. In some areas carbonates are not so deep. In other areas the soil is well drained.

Typically, the Gilpin soil has a surface layer of mixed dark grayish brown and yellowish brown, friable loam about 5 inches thick. The subsoil is about 24 inches thick. The upper part is yellowish brown, friable channery loam. The lower part is brown and strong brown, firm silt loam. The substratum is strong brown, firm channery silt loam. Siltstone bedrock is at a depth of about 35 inches. In places the lower part of the subsoil has a higher degree of reaction.

Included with these soils in mapping are small areas of the well drained Vandalia soils on benches and colluvial toe slopes. Also included are areas that have very steep shale and siltstone escarpments. Inclusions make up about 15 percent of most areas.

Permeability is moderately slow or slow in the Guernsey soil and moderate in the Gilpin soil. The root zone is deep in the Guernsey soil and moderately deep in the Gilpin soil. The available water capacity is moderate in the Guernsey soil and low in the Gilpin soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Guernsey soil and low in the Gilpin soil. The potential for frost action is high in the Guernsey soil. The Guernsey soil has a perched seasonal high water table at a depth of 18 to 36 inches during extended wet periods. Slippage is a hazard in areas of the Guernsey soil.

Most areas are used as woodland. A few small areas are pastured. Some of the pastured areas are reverting to brush because they cannot be easily managed. These soils are generally unsuited to cropland, hay, and pasture because of the slope and a very severe hazard of erosion.

These soils are moderately well suited to trees. Most areas support native hardwoods. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Guernsey soil. Plant competition can be controlled by removing vines and the less desirable trees and shrubs on the Guernsey soil. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope and the hazard of hillside slippage in areas of the Guernsey soil, these soils are generally unsuited to sanitary facilities and buildings. Construction is very difficult in areas used for recreation and in urban areas. The hazard of erosion is severe when the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible. Constructing roads on the contour helps to minimize the extent of cut and fill areas and prevent excessive soil loss. Seeding and applying mulch in roadside ditches help to prevent the formation of gullies.

The land capability classification is VIIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-3 in areas of the Guernsey soil and F-2 in areas of the Gilpin soil.

KaB—Kanawha silt loam, 1 to 8 percent slopes. This deep, well drained, nearly level and gently sloping soil is on low terraces. Individual areas are irregularly shaped and range from 4 to 30 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 32 inches thick. The upper part is brown and strong brown, firm silt loam and clay loam. The next part is yellowish red, firm gravelly clay loam and gravelly loam. The lower part is yellowish red, firm very gravelly loam. The substratum to a depth of about 60 inches is reddish brown and strong brown, friable very gravelly and extremely gravelly sandy loam. In places, the surface layer is gravelly loam and the subsoil contains more gravel.

Included with this soil in mapping are small areas of a soil that has a dark surface layer and a soil that has a lower content of coarse fragments than the Kanawha soil. These soils are in landscape positions similar to those of the Kanawha soil. In some areas in narrow valleys, they are subject to very brief periods of rare flooding or flash flooding. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Kanawha soil. The root zone is deep. The available water capacity is moderate. Runoff is medium.

Most areas are used as cropland or pasture. A few small areas are used as woodland.

This soil is well suited to corn, tobacco, soybeans, and small grain. If the soil is cultivated, erosion is a management concern. Cultivated crops can be grown year after year if erosion is controlled and improved management practices are applied. Maintaining tilth and the organic matter content is a management concern. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, incorporation of crop residue into the plow layer, contour tillage, and grassed waterways help to maintain tilth, control runoff, and prevent excessive soil loss. Tilling within the optimum moisture range minimizes compaction.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to septic tank absorption fields. Increasing the size of the absorption field improves the capacity of the field to absorb effluent.

This soil is well suited to buildings. The included areas of soils that are subject to flooding are generally unsuited to buildings. Providing suitable base material helps to prevent damage to roads.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

Kg—Kyger loamy sand, frequently flooded. This deep, very poorly drained, nearly level soil is along streams on flood plains. It is covered by a layer of acid, sandy and loamy sediments from strip mines. It is flooded several times a year. Because of a buildup of mine sediments at the edge of the streams, most areas remain ponded for several months after floodwaters recede. Most areas are long and narrow and range from 10 to 65 acres in size. Slopes are 0 to 2 percent.

Typically, this soil has 44 inches of overwash sediments underlain by a buried soil. The upper 9 inches of sediments is brownish yellow, loose loamy sand. The next part is yellowish brown and strong brown, very friable and loose loam and stratified loamy sand, sandy loam, and silt loam. The lower part is dark gray and dark grayish brown, mottled, friable silt loam. The upper part of the buried soil is dark grayish brown, friable loam. The lower part to a depth of about 80 inches is dark yellowish brown and strong brown, friable and very friable loam and sandy loam. In some areas the overwash has more gravel. In other areas it is silty, acid material. In places the soil is ponded and somewhat poorly drained.

Included with this soil in mapping are small areas of soils along streams. These soils have 2 to 4 feet of acid, sandy overwash. They make up about 10 percent of most areas.

Permeability is moderate or moderately rapid in the Kyger soil. The root zone is deep; however, it is restricted by the wetness. The available water capacity is high. Runoff is very slow or ponded. The potential for frost action is high. The seasonal high water table is near or above the surface during extended wet periods.

Most areas are used as wetland wildlife habitat because of the ponding, the flooding, and the high acidity of the surface layer. This soil is generally unsuited to cropland, pasture, woodland, septic tank absorption fields, and buildings. Draining the soil is not practical because sediments in stream channels block drainage outlets. Many drainageways and stream channels are completely filled with sediments. A fluctuating water level limits the survival of many trees. Most areas provide good habitat for ducks, muskrats, beavers, and other wetland wildlife.

The land capability classification is VIw. No woodland ordination symbol or pasture and hayland suitability group is assigned.

LcB—Licking silt loam, 1 to 6 percent slopes. This deep, moderately well drained, nearly level and gently sloping soil is on lacustrine terraces along the major streams. Most areas are round or irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 48 inches thick. The upper part is yellowish brown, friable silt loam. The lower part is yellowish brown, mottled, firm silty clay loam and very firm silty clay. The substratum to a depth of about 71 inches is yellowish brown, mottled, firm silty clay. In some places the silty mantle has been removed by erosion. In other areas the subsoil is redder.

Included with this soil in mapping are small areas of Gallipolis and Omulga soils. These soils have more silt in the subsoil than the Licking soil. They are in landscape positions similar to those of the Licking soil. Omulga soils have a fragipan. Included soils make up about 10 percent of most areas.

Permeability is slow in the Licking soil. The root zone is deep. The available water capacity is moderate. Runoff is medium. The shrink-swell potential is high in the subsoil. The potential for frost action is high. A perched seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

This soil is used mostly for row crops, hay, or pasture. It is moderately well suited to corn, soybeans, small grain, and tobacco. Erosion is a severe hazard, especially if the slopes are long. Applying no-till farming or another system of conservation tillage that leaves crop residue on the surface, growing cover crops, tilling at the proper moisture content, and establishing grassed waterways help to control erosion, improve tilth, and maintain the organic matter content.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to woodland. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields because of the slow permeability and the wetness. Installing distribution lines for septic tank absorption fields on the contour helps to prevent seepage of effluent to the surface. Installing perimeter drains around the absorption field lowers the seasonal high water table. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. An aeration disposal system is used in some areas.

This soil is poorly suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness and the high shrink-swell potential. Properly designing foundations and footings helps to prevent the structural damage caused by shrinking and swelling of the soil. Excavations around walls and foundations should be backfilled with material that has a low shrink-swell potential. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. Installing a drainage system and providing suitable base material help to prevent damage to roads.

The land capability classification is IIe. The woodland ordination symbol is 4C. The pasture and hayland suitability group is A-6.

LcC2—Licking silt loam, 6 to 15 percent slopes, eroded. This deep, moderately well drained, strongly sloping soil is on terraces along the major streams and on slope breaks on terraces. Erosion has removed part of the original surface layer of the soil. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are long and narrow and range from 2 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper part is yellowish brown, friable and firm silty clay loam. The lower part is yellowish brown, mottled, firm and very firm silty clay. The substratum to a depth of about 72 inches is yellowish brown, mottled, firm silty clay. In places the surface layer is silty clay loam. In a few areas the subsoil is redder. In other areas the soil is well drained.

Included with this soil in mapping are small areas of Gallipolis and Omulga soils. These soils have more silt in the subsoil than the Licking soil. They are in landscape positions similar to those of the Licking soil. Omulga soils have a fragipan. Included soils make up about 10 percent of most areas.

Permeability is slow in the Licking soil. The root zone is deep. The available water capacity is moderate. Runoff is rapid. The shrink-swell potential is high in the subsoil. The potential for frost action is high. A perched seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

Most areas are used for row crops or as pasture (fig. 6). A few areas along streams are used as woodland.

This soil is poorly suited to corn, soybeans, and small grain. It can be cropped, but the cropping system should include hay or pasture for long periods of time. Erosion is a severe hazard, especially if the slopes are long. Applying no-till farming or another system of conservation tillage that leaves crop residue on the surface, growing cover crops, tilling at the proper moisture content, and establishing grassed waterways help to control erosion, improve tilth, and maintain the organic matter content.

This soil is moderately well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced

Figure 6.—A pastured area of Licking silt loam, 6 to 15 percent slopes, eroded.

yields. Cover crops, companion crops, and no-till seeding help to control erosion when pastures are reseeded. Proper stocking rates, pasture rotation, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to woodland. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields because of the slow permeability and the wetness. Installing distribution lines for septic tank absorption fields on the contour helps to prevent seepage of effluent to the surface. Installing perimeter drains around the absorption field lowers the seasonal high water table. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. An aeration disposal system is used in some areas.

This soil is poorly suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness and the high shrink-swell potential. Properly designing foundations and footings helps to prevent the structural damage caused by shrinking and swelling of the soil. Excavations around walls and foundations should be backfilled with material that has a low shrink-swell potential. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Buildings should be designed so that they conform to the natural shape of the land. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. Installing a drainage system and providing suitable base material help to prevent damage to roads.

The land capability classification is IVe. The woodland ordination symbol is 4C. The pasture and hayland suitability group is A-6.

LcD2—Licking silt loam, 15 to 25 percent slopes, eroded. This deep, moderately well drained, moderately steep soil is on terraces along the major streams and on slope breaks on terraces. Erosion has removed part of the original surface layer of the soil. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are long and narrow or irregularly shaped and range from 2 to 20 acres in size.

Typically, the surface layer is dark yellowish brown and yellowish brown, friable silt loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown, friable silt loam. The lower part is yellowish brown, mottled, firm and very firm silty clay. The substratum to a depth of about 60 inches is yellowish brown, very firm stratified silt loam and silty clay loam. In some places the soil is well drained. In other places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Elkinsville and Gallipolis soils. These soils have more silt in the subsoil than the Licking soil. They are in landscape positions similar to those of the Licking soil. They make up about 10 percent of most areas.

Permeability is slow in the Licking soil. The root zone is deep. The available water capacity is moderate. Runoff is rapid. The shrink-swell potential is high in the subsoil. The potential for frost action is high. A perched seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as pasture or woodland. This soil is generally unsuited to corn and small grain.

This soil is poorly suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Cover crops, companion crops, and no-till seeding help to control erosion when pastures are seeded. Proper stocking rates, pasture rotation, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to woodland. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope, the wetness, the slow permeability, and the high shrink-swell potential, this soil is generally unsuited to septic tank absorption fields and to buildings. Construction is very difficult in areas used for recreation and in urban areas. Limiting the extent of cut and fill areas on slopes minimizes hillside slippage. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

LgD—Lily loam, 15 to 25 percent slopes. This moderately deep, well drained, moderately steep soil is on side slopes and ridgetops of sandstone uplands. The topography of the soil is influenced and controlled by the underlying bedrock. Most areas on ridgetops are irregular in shape. Those on the upper side slopes are long and narrow. Areas range from 4 to 50 acres in size.

Typically, the surface layer is brown, friable loam about 7 inches thick. The subsoil is about 28 inches thick. The upper part is yellowish brown and strong brown, firm loam. The next part is yellowish brown, firm sandy clay loam. The lower part is strong brown, firm channery sandy loam. Yellowish brown, soft sandstone bedrock is at a depth of about 35 inches. Hard sandstone bedrock is at a depth of about 50 inches. In some areas the bedrock is deep. In other areas the subsoil has less clay. In a few small areas, the lower part of the subsoil is gray.

Included with this soil in mapping are small areas of Steinsburg soils close to slope breaks or on knobs. These soils have less clay than the Lily soil. Also included are some areas that have very steep bedrock escarpments. Inclusions make up about 10 percent of most areas.

Permeability is moderately rapid in the Lily soil. The root zone is moderately deep. The available water capacity is low. Runoff is rapid.

Most areas are used as pasture or woodland. Some are used as hayland. Many areas of this soil that were pastured are reverting to brush and woodland.

This soil is generally unsuited to cultivated crops and small grain. Erosion is a severe hazard if the soil is plowed during seedbed preparation or if it is cultivated.

This soil is poorly suited to pasture. The hazard of erosion is severe if the soil is overgrazed or if it is plowed during seedbed preparation. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain a good stand of key forage species. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation. Limited grazing in winter and other wet periods helps to prevent compaction. Deep-rooted legumes are difficult to maintain in some areas. The highly dissected, moderately steep slopes hinder the operation of farm machinery.

This soil is moderately well suited to trees. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Applying mulch around seedlings reduces the seedling mortality rate. The bedrock can be ripped with construction equipment. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

This soil is generally unsuited to septic tank absorption fields and is poorly suited to buildings because of the slope and the limited depth to bedrock. It is better suited to dwellings without basements than to dwellings with basements. Excavating the soil is difficult because of the depth to bedrock. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. Properly landscaping building sites helps to keep surface water away from the foundations. Installing a drainage system helps to prevent damage to roads. Building roads on the contour, where possible, minimizes the extent of cut and fill areas. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects. The pasture and hayland suitability group is F-1.

LhC—Lily silt loam, 8 to 15 percent slopes. This moderately deep, well drained, strongly sloping soil is on the upper side slopes and ridgetops of sandstone uplands. The topography of the soil is influenced and controlled by the underlying bedrock. Most areas on ridgetops are irregular in shape or long and narrow. Areas range from 3 to 60 acres in size but dominantly are 5 to 25 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 26 inches thick. The upper part is brown and strong brown, firm loam. The lower part is strong brown, firm fine sandy loam and channery fine sandy loam. Yellowish brown, soft sandstone bedrock is at a depth of about 32 inches. Hard sandstone bedrock is at a depth of about 50 inches. In some places the depth to bedrock is more than 40 inches. In other places the subsoil has less clay.

Included with this soil in mapping are small areas of Rarden, Wellston, and Zanesville soils. Rarden soils are on knolls or slope breaks. They are underlain by shale bedrock. Rarden and Zanesville soils are moderately well drained. Wellston and Zanesville soils are deep. They are on gently sloping ridgetops. Included soils make up about 15 percent of most areas.

Permeability is moderately rapid in the Lily soil. The root zone is moderately deep. The available water capacity is low. Runoff is medium.

Most areas are used as pasture or woodland. Some are used as cropland.

This soil is moderately well suited to cultivated crops and small grain. Controlling erosion is the major management concern. No-till farming or another system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, a cropping system that includes grasses and legumes, cover crops, and incorporation of crop residue into the plow layer help to prevent excessive soil loss, control runoff, minimize crusting, maintain tilth and the organic matter content, and increase the rate of water infiltration.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, and timely applications of lime and fertilizer are good management practices. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation.

This soil is well suited to woodland. The bedrock can be ripped with construction equipment. Cutting and filling to a more desirable slope can improve sites for log landings.

This soil is moderately well suited to septic tank absorption fields. The limited depth to bedrock is the main management concern. Heavy equipment may be needed to rip the bedrock. Installing septic tank absorption fields in suitable fill material helps to overcome the limited depth to bedrock and the poor filtering capacity of the soil.

This soil is only moderately well suited to buildings because of the limited depth to bedrock and the slope. It is better suited to houses without basements than to houses with basements because of the depth to bedrock. Properly landscaping the building site helps to overcome the slope. Constructing local roads on the contour minimizes the extent of cut and fill areas. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4D. The pasture and hayland suitability group is F-1.

LmD—Lily-Rarden complex, 15 to 25 percent slopes. These moderately deep, well drained and moderately well drained, moderately steep soils are on ridgetops and side slopes in the uplands. The Lily soil generally is on summits and on shoulder slopes, the middle of slopes, and the upper back slopes on hillsides. The Rarden soil generally is in saddles on ridgetops and the middle of slopes and the lower back slopes on hillsides. Some areas are broad and irregular in shape, while others are long and winding and follow the contour of the landscape. Most areas range from 8 to 45 acres in size. They are about 45 percent Lily soil and 40 percent Rarden soil. In some places these soils occur as areas so intricately mixed or so small that separating them in mapping is not practical. In other places they do not occur together but occur as relatively pure areas of either the Lily soil or the Rarden soil.

Typically, the Lily soil has a surface layer of brown, friable sandy loam about 5 inches thick. The subsoil is friable sandy loam about 29 inches thick. The upper part is yellowish brown, and the lower part is strong brown. Brownish yellow sandstone bedrock is at a depth of about 34 inches. Hard sandstone bedrock is at a depth of about 48 inches. In places the depth to bedrock is more than 40 inches.

Typically, the Rarden soil has a surface layer of brown, friable silt loam about 5 inches thick. The subsoil is about 29 inches thick. The upper part is yellowish brown, friable silty clay loam. The next part is yellowish red, mottled, firm silty clay loam. The lower part is red, mottled, very firm silty clay. The substratum is strong brown, mottled, very firm silty clay. Reddish brown clay shale bedrock is at a depth of about 38 inches. In some areas the depth to bedrock is more than 40 inches. In other areas the subsoil does not have yellowish red colors.

Included with these soils in mapping are small areas of deep, moderately well drained soils that have bedrock at a greater depth than the Lily and Rarden soils. These deep soils are on foot slopes. Also included are small areas of shallow soils that have bedrock at a depth of 10 to 20 inches. These shallow soils are in steep, convex areas or in highly dissected areas. Included soils make up about 15 percent of most areas.

Permeability is moderately rapid in the Lily soil and slow in the Rarden soil. The root zone is moderately deep in both soils. The available water capacity is low. Runoff is very rapid. The shrink-swell potential is high in the subsoil of the Rarden soil and low in the Lily soil. The potential for frost action is high in the Rarden soil. The Rarden soil has a perched seasonal high water table at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as pasture or woodland. A few are used as hayland. Many areas of these soils that were pastured are reverting to brush and woodland.

These soils are generally unsuited to cultivated crops and small grain because of the slope and a very severe hazard of erosion. The hazard of erosion is greater on the Rarden soil than on the Lily soil.

These soils are poorly suited to pasture. If the soils are overgrazed or if they are plowed during seedbed preparation, erosion is a very severe hazard. Applying trash mulch or other no-till seeding methods or growing cover crops or companion crops when pastures are reseeded helps to control erosion and reduce the rate of runoff. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain a good stand of key forage species. Limited grazing in winter and other wet periods helps to prevent compaction. Deep-rooted legumes are difficult to maintain in some areas. Maintaining pasture and harvesting hay are somewhat difficult because the slope hinders the operation of farm machinery.

These soils are moderately well suited to trees. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Applying mulch around seedlings reduces the seedling mortality rate. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Rarden soil. The windthrow hazard on the Rarden soil can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The bedrock can be ripped with construction equipment. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to septic tank absorption fields and are poorly suited to buildings. They are better suited to houses without basements than to houses with basements because of the limited depth to bedrock. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. Installing drains at the base of footings, backfilling with suitable material, and coating exterior walls minimize the damage caused by wetness and by shrinking and swelling of the Rarden soil. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R in areas of the Lily soil and 3R in areas of the Rarden soil. The pasture and hayland suitability group is F-1 in areas of both soils.

LpD—Lily-Upshur complex, 15 to 25 percent slopes. These well drained, moderately steep soils are on side slopes and ridgetops in the uplands. The Lily soil is moderately deep, and the Upshur soil is deep. Most areas are about 50 percent Lily soil and 35 percent Upshur soil. The two soils are in relatively narrow, alternating bands on hillsides. In areas on ridgetops, the Lily soil is on knolls and convex slopes and the Upshur soil is on benches, in saddles, and in concave areas. The areas on side slopes are commonly long and winding and are dissected by small drainageways. The areas on ridgetops follow the contour of the ridgetop and are commonly long and narrow. Most areas are 6 to 60 acres in size. These soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically the Lily soil has a surface layer of brown, very friable loam about 4 inches thick. The subsoil is about 28 inches thick. The upper part is yellowish brown, friable and firm sandy loam and loam. The next part is strong brown, firm sandy clay loam. The lower part is strong brown, firm channery sandy loam. Weathered, strong brown sandstone bedrock is at a depth of about 32 inches. Hard sandstone bedrock is at a depth of about 40 inches. In places the surface layer is silt loam or sandy loam.

Typically, the Upshur soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is about 34 inches thick. The upper part is brown, firm silty clay loam. The next part is reddish brown and dark red, very firm clay. The lower part is dark red, very firm silty clay. The substratum is dark reddish brown, firm channery silty clay. Weathered, reddish brown, calcareous clay shale bedrock is at a depth of about 48 inches. In some areas the soil is moderately deep over bedrock. In other areas the surface layer is silty clay loam. In places the subsoil is not so red.

Included with these soils in mapping are small areas of Steinsburg soils on the upper part of hillsides. Steinsburg soils have less clay in the substratum than the Lily and Upshur soils. Also included are small areas of the moderately well drained Guernsey soils on benches and areas of rock outcrop near slope breaks. Inclusions make up about 15 percent of most areas.

Permeability is moderately rapid in the Lily soil and slow in the subsoil of the Upshur soil. The root zone is moderately deep in the Lily soil and deep in the Upshur soil. The available water capacity is low in the Lily soil and low or moderate in the Upshur soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Lily soil.

Most areas are used as woodland. Some are pastured.

These soils are generally unsuited to cultivated crops and small grain and poorly suited to hay and pasture. The hazard of erosion is very severe when these soils are cultivated, plowed during seedbed preparation, or overgrazed. Cover crops, companion crops, and no-till seeding help to control erosion when pastures are seeded. Proper stocking rates and pasture rotation help to prevent overgrazing and control erosion.

These soils are moderately well suited to woodland. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Upshur soil. The windthrow hazard on the Upshur soil can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The bedrock can be ripped with construction equipment. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

These soils are poorly suited to buildings and generally unsuited to septic tank absorption fields. Because it has a lower content of clay in the subsoil, the Lily soil is better suited to buildings than the Upshur soil. Because slippage is a hazard in areas of the Upshur soil, foundations for all buildings should extend to the bedrock. Land shaping is needed in most areas. Installing drains at the base of footings helps to intercept water moving laterally in the Upshur soil. Excavations around foundations should be backfilled with material that has a low shrink-swell potential. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. Extensive excavation generally is needed when local roads are built. Building roads may increase the hazard of slippage if the roads are in areas of the Upshur soil.

The land capability classification is VIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects. The pasture and hayland suitability group is F-1 in areas of the Lily soil and F-5 in areas of the Upshur soil.

Ls—Lindside silt loam, occasionally flooded. This deep, moderately well drained, nearly level soil is on flood plains. Slopes range from 0 to 3 percent. Most areas are long and narrow and range from 9 to 90 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, firm silt loam. The lower part is yellowish brown and brown, mottled, firm silt loam and silty clay loam. The substratum to a depth of about 80 inches is brown, dark yellowish brown, and yellowish brown, mottled, firm silt loam, loam, and silty clay loam. In some areas the soil is well drained.

Included with this soil in mapping are small areas of the somewhat poorly drained Orrville soils. These soils are in depressions on flood plains, in abandoned stream channels, and in narrow bands adjacent to terraces and uplands. They make up about 5 percent of most areas.

Permeability is moderate or moderately slow in the Lindside soil. The root zone is deep. The available water capacity is high or very high. Runoff is slow. The potential for frost action is high. The seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

Most areas are used for row crops, forage crops, or pasture. A few areas are wooded.

This soil is well suited to cultivated crops. Corn and soybeans are seldom damaged by the flooding, but small grain may be severely damaged by the flooding in winter and early spring. Controlling the flooding and the wetness, maintaining tilth and the organic matter content, and draining wet depressions are management concerns. Diversions and subsurface drains are needed to intercept water from adjacent hillside slopes in many places. Random subsurface drains can drain wet areas if adequate outlets are available. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain tilth and the organic matter content. Controlling weeds is a problem in many areas.

This soil is well suited to permanent pasture and forage crops. Overgrazing or grazing when the soil is wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, mowing for weed control, and restricted grazing during wet periods help to keep the pasture in good condition. Timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-5.

McB—McGary silt loam, 1 to 6 percent slopes. This deep, somewhat poorly drained, nearly level and gently sloping soil is on terraces along the major streams. Most areas range from 25 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 34 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam and silty clay. The next part is gray, mottled, very firm silty clay. The lower part is brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam. In places the substratum has a lower content of lime.

Included with this soil in mapping are small areas of Taggart and Licking soils. Taggart soils are somewhat poorly drained. They are in landscape positions similar to those of the McGary soil. They have a thicker silty mantle than the McGary soil. Licking soils are moderately well drained. They are on small rises or near slope breaks. Included soils make up about 10 percent of most areas.

Permeability is slow or very slow in the McGary soil. The root zone is deep. The available water capacity is moderate. Runoff is medium. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 12 to 36 inches during extended wet periods.

Most areas are used as pasture or cropland. This soil is moderately well suited to row crops and small grain. The wetness, the slow or very slow permeability, and the hazard of erosion are management concerns. Surface and subsurface drains help to overcome the wetness. Applying no-till farming or another system of conservation tillage that leaves crop residue on the surface, growing cover crops, tilling at the proper moisture content, and establishing grassed waterways help to control erosion, improve tilth, and maintain the organic matter content.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Stands of deep-rooted legumes are difficult to maintain. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to woodland. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Logging can be done when the soil is frozen or during the drier parts of the year.

This soil is poorly suited to septic tank absorption fields because of the slow or very slow permeability and the wetness. Installing distribution lines for septic tank absorption fields on the contour helps to prevent seepage of effluent to the surface. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. An aeration disposal system is used in some areas. Installing perimeter drains around the absorption field and backfilling with more permeable material lower the seasonal high water table.

This soil is poorly suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness and the high shrink-swell potential. Properly designing foundations and footings helps to prevent the structural damage caused by shrinking and swelling of the soil. Excavations around walls and foundations should be backfilled with material that has a low shrink-swell potential. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. Installing a drainage system and providing suitable base material help to prevent damage to roads.

The land capability classification is IIIe. The woodland ordination symbol is 4W. The pasture and hayland suitability group is C-2.

MoC—Monongahela loam, 8 to 15 percent slopes. This deep, moderately well drained, strongly sloping soil is on terrace remnants in dissected parts of preglacial valleys. Most areas are broad or irregularly shaped. Areas along small drainageways are long and narrow. Most areas range from 5 to 40 acres in size.

Typically, the surface layer is brown, friable loam about 8 inches thick. The subsoil is about 47 inches thick. The upper part is yellowish brown, firm loam. The lower part is a fragipan of yellowish brown, mottled, very firm and brittle loam. The substratum to a depth of about 72 inches is light gray and strong brown, mottled, firm sandy clay loam and clay loam. In places the subsoil contains more silt and less sand.

Included with this soil in mapping are small areas of the well drained Allegheny and Gallia soils. These soils are in dissected areas and on knolls of terrace remnants. They make up about 15 percent of most areas.

Permeability is moderate above the fragipan in the Monongahela soil and moderately slow or slow in the fragipan. The root zone is mainly restricted to the 18- to 30-inch zone above the fragipan. The available water capacity in this zone is low. Runoff is medium on the soil. A perched seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

Most areas are used for hay and pasture. Some are used for cultivated crops.

This soil is moderately well suited to row crops and small grain. It dries out slowly in the spring, and planting is delayed in most years. The surface layer crusts after hard rains. Diversions or subsurface drains at the base of slope breaks to the uplands help to overcome the wetness in some areas. A complete subsurface drainage system is needed only in areas used for high-value crops. The hazard of erosion is severe in cultivated areas. Applying no-till farming or another system of conservation tillage that leaves crop residue on the surface, establishing grassed waterways, contour stripcropping, including grasses and legumes in the cropping system, growing cover crops, tilling within the optimum range in moisture content, and incorporating crop residue into the plow layer help to prevent excessive soil loss, minimize crusting, control runoff, maintain tilth and the organic matter content, and increase the rate of water infiltration.

This soil is moderately well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. The hazard of erosion can be reduced by laying out logging roads and skid trails on the contour or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting increase the vigor of the stand and reduce the windthrow hazard. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields. The restricted permeability is a severe limitation. An aeration disposal system is used in some areas. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. Perimeter drains lower the seasonal high water table.

This soil is moderately well suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings, backfilling with suitable material, and coating exterior walls minimize the damage caused by wetness. Properly landscaping building sites helps to keep surface water away from foundations. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. Installing a drainage system and providing suitable base material help to prevent damage to roads. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is F-3.

Ne—Newark silt loam, frequently flooded. This deep, somewhat poorly drained, nearly level soil is on flood plains. It is frequently flooded. It generally is in narrow to wide bands adjacent to the uplands or stream terraces. It also is in abandoned stream channels and small drainage ditches and in slight depressions or concave areas that receive seepage or runoff from the adjacent slopes. Most areas range from 3 to 80 acres in size. Slopes are 0 to 2 percent.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is mottled, firm silt loam about 14 inches thick. The upper part is grayish brown, and the lower part is dark yellowish brown. The substratum to a depth of about 62 inches is dark grayish brown, mottled, firm silty clay loam and loam. In places the subsoil has less silt and more sand.

Included with this soil in mapping are small areas of the moderately well drained Lindside soils and poorly drained soils. Lindside soils are on slight rises. The poorly drained soils are in depressions and old stream meanders. Also included are areas of soils near strip mines. Some of these soils have a surface layer of sandy loam or loamy sand. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Newark soil. The root zone is deep; however, it is restricted by the wetness. The available water capacity is high. Runoff is very slow. The potential for frost action is high. The seasonal high water table is at a depth of 6 to 18 inches during extended wet periods.

Most areas are used for cultivated crops, hay, or pasture. A few small areas are wooded.

If drained, this soil is well suited to row crops. It can be intensively cropped. The flooding and the wetness delay planting and limit the choice of crops. The flooding in winter and early spring and siltation are detrimental to small grain; however, other crops, such as corn, are seldom damaged by the flooding. A surface drainage system helps to remove excess surface water. A subsurface drainage system and diversions at the base of the slopes below uplands and terraces help to overcome the wetness in areas where outlets are available. The surface layer crusts after hard rains. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain tilth and the organic matter content and minimize crusting. Tilling within the optimum range in moisture content minimizes compaction. Planting cover crops helps to maintain the content of organic matter and protect the surface during flooding.

This soil is moderately well suited to pasture and forage crops. It is better suited to pasture than to hay in undrained areas. Forage yields can be increased by installing surface and subsurface drainage systems. The soil is better suited to grasses and shallow-rooted legumes than to deep-rooted legumes. Overgrazing or grazing when the soil is wet causes compaction. Proper stocking rates, pasture rotation, timely deferment of grazing, and timely applications of lime and fertilizer help to maintain key forage species.

This soil is well suited to trees. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur. Logging can be done when the soil is frozen or during the drier parts of the year. Site preparation and planting can be done during dry periods.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding and the wetness. Roads can be constructed on fill material, above the normal level of flooding. Providing suitable base material minimizes the damage to roads caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 5W. The pasture and hayland suitability group is C-3.

No—Nolin silt loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains. It is occasionally flooded. Most areas are broad and irregularly shaped or long and winding. They range from 3 to 365 acres in size. Slopes range from 0 to 3 percent.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsurface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 33 inches thick. The upper part is dark yellowish brown, friable silt loam. The lower part is brown, firm silty clay loam. The substratum to a depth of about 82 inches is brown, firm silty clay loam and silt loam. In some areas the subsoil and substratum have more sand and less silt. In other areas the soil is moderately well drained.

Included with this soil in mapping are small areas of Newark and Pope soils. Newark soils are somewhat poorly drained. They are in slight depressions or in narrow bands adjacent to hillsides. Pope soils have more sand in the subsoil than the Nolin soil. They are in thin bands adjacent to stream channels. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Nolin soil. The root zone is deep. The available water capacity is high. Runoff is slow. The seasonal high water table is at a depth of 36 to 72 inches during extended wet periods.

Most areas are used for cultivated crops or forage crops. Some are pastured. A few small areas support native hardwoods.

This soil is well suited to corn and soybeans. The flooding is the major management concern. Siltation and the flooding in winter and early spring are detrimental to small grain; however, other crops, such as corn and soybeans, are seldom damaged by the flooding. Streambank erosion is severe in many areas. Stabilizing eroded streambanks is difficult in most places; however, maintaining a vegetative cover helps to control erosion. Weed control is a problem because seeds from weeds are carried in and deposited on the soil by floodwater. Returning crop residue to the soil and regularly adding other organic material help to improve fertility, minimize crusting, increase the rate of water infiltration, and minimize the damage caused by flooding. Tilling within the optimum range in moisture content minimizes compaction and crusting and helps to maintain soil structure and tilth.

This soil is well suited to grasses and legumes for pasture and hay. Overgrazing or grazing when the soil is wet causes compaction. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding. Local roads can be constructed on fill material, above the normal level of flooding. Providing suitable base material minimizes the damage caused by low strength in roadfill and by piping in dikes.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-5.

OmB—Omulga silt loam, 1 to 6 percent slopes. This deep, moderately well drained, nearly level and gently sloping soil is in broad areas in preglacial valleys. Most areas are long and narrow or irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 62 inches thick. The upper part is yellowish brown, firm silt loam. The next part is a fragipan of yellowish brown, mottled, very firm and brittle silt loam. The lower part is yellowish brown and strong brown, mottled, firm clay loam and silty clay loam. The substratum to a depth of about 82 inches is strong brown, very firm silty clay.

Included with this soil in mapping are small areas of

Figure 7.—An area of Omulga silt loam, 1 to 6 percent slopes, used for hay.

Allegheny, Doles, and Licking soils. Allegheny soils are well drained. They are in dissected areas. Doles soils are somewhat poorly drained. They are along drainageways and in small depressions. Licking soils have more clay in the subsoil than the Omulga soil. They are in convex areas. Included soils make up about 15 percent of most areas.

Permeability is moderate above the fragipan in the Omulga soil and slow in the fragipan. The root zone is mainly restricted to the 18- to 36-inch zone above the fragipan. The available water capacity in this zone is low. Runoff is slow or medium on the soil. The potential for frost action is high. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Most areas are used as cropland. A few areas are used as hayland, pasture, or woodland (fig. 7).

This soil is well suited to corn, soybeans, tobacco, and small grain. If cultivated crops are grown, erosion is the main hazard. Cultivated crops can be grown year after year if erosion is controlled and improved management practices are applied. Maintaining tilth and the organic matter content is a management concern. The surface layer crusts after hard rains. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, incorporation of crop residue into the plow layer, contour tillage, stripcropping, and grassed waterways help to maintain tilth, minimize crusting, control runoff, and prevent excessive soil loss. Tilling within the optimum moisture range minimizes compaction.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields. The wetness and the slow permeability are severe limitations. An aeration disposal system is used in some areas. Installing an absorption field that is larger than normal improves the capacity of the field to absorb effluent. Installing perimeter drains around the absorption fields lowers the seasonal high water table.

This soil is moderately well suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Landscaping building sites helps to keep surface water away from foundations. Excavations around walls and foundations should be backfilled with material that has a low shrink-swell potential. Installing a drainage system and providing suitable base material help to prevent the road damage caused by frost action and low strength. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4D. The pasture and hayland suitability group is F-3.

OmC—Omulga silt loam, 6 to 15 percent slopes. This deep, moderately well drained, strongly sloping soil is on valley fill remnants in dissected parts of preglacial valleys. Most areas are long and narrow and range from 3 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 59 inches thick. The upper part is yellowish brown, firm silt loam. The next part is a fragipan of strong brown and yellowish brown, mottled, very firm and brittle silt loam and clay loam. The lower part is yellowish brown and light brownish gray, firm clay loam and silt loam. The substratum to a depth of about 78 inches is strong brown and yellowish brown, mottled, very friable sandy loam and firm silty clay loam. In a few areas the soil has more sand throughout.

Included with this soil in mapping are small areas of Allegheny, Gallia, and Licking soils. Allegheny and Gallia soils are well drained. They are on slope breaks. Licking soils have more clay in the subsoil than the Omulga soil. They are on knolls and along drainageways. Included soils make up about 15 percent of most areas.

Permeability is moderate above the fragipan in the Omulga soil and slow in the fragipan. The root zone is mainly restricted to the 18- to 36-inch zone above the fragipan. The available water capacity in this zone is low or moderate. Runoff is medium on the soil. The potential for frost action is high. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Most areas are used for hay and pasture. Some are wooded.

This soil is moderately well suited to corn, soybeans, and small grain. It can be cropped successfully, but the cropping system should include hay or pasture for long periods of time. Erosion is a severe hazard, especially if the slopes are long. The surface layer crusts after hard rains. Applying a system of conservation tillage that leaves crop residue on the surface, growing cover crops, tilling at the proper moisture content, and establishing grassed waterways help to control erosion, improve tilth, and maintain the organic matter content.

This soil is moderately well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Applying mulch to the surface during reseeding or no-till seeding helps to conserve moisture and control erosion during pasture renovation. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields. The wetness and the slow permeability are severe limitations. An aeration disposal system is used in some areas. Installing an absorption field that is larger than normal improves the capacity of the field to absorb effluent. Installing perimeter drains around the absorption fields lowers the seasonal high water table.

This soil is moderately well suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Buildings should be designed so that they conform to the natural shape of the land. Excavations around walls and foundations should be backfilled with material that has a low shrink-swell potential. Installing a drainage system and providing suitable base material help to prevent the road damage caused by frost action and low strength. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4D. The pasture and hayland suitability group is F-3.

Or—Orrville silt loam, frequently flooded. This deep, somewhat poorly drained, nearly level soil is on flood plains. It is frequently flooded. Most areas are long and narrow and range from 3 to 75 acres in size. Slopes are 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is about 39 inches thick. The upper part is grayish brown and brown, mottled, friable and firm silt loam. The lower part is light brownish gray, mottled, firm loam and friable sandy loam. The upper part of the substratum is light brownish gray, mottled, friable sandy loam and gray, firm silt loam. The lower part to a depth about 80 inches is light brownish gray, mottled, loose loamy sand. In some areas the subsoil is more acid. In other areas it has less clay or less sand. In places the surface layer is lighter in color.

Included with this soil in mapping are small areas of Chagrin, Pope, Lindside, and Piopolis soils. Chagrin and Pope soils are well drained. Lindside soils are moderately well drained. Chagrin, Pope, and Lindside soils are on slight rises. Piopolis soils are poorly drained and very poorly drained. They are in depressions on flood plains and in abandoned stream channels. Included soils make up about 15 percent of most areas.

Permeability is moderate in the Orrville soil. The root zone is deep; however, it is restricted by the wetness. The available water capacity is high. Runoff is slow. The potential for frost action is high. The seasonal high water table is at a depth of 1.0 to 2.5 feet during extended wet periods.

Most areas are used as cropland or pasture. Some are used as woodland.

If drained, this soil is well suited to corn and soybeans. It can be intensively cropped. The flooding and the wetness delay planting and limit the choice of crops. A surface drainage system helps to remove excess surface water. Subsurface drains also are needed to remove excess water from the subsoil, but suitable outlets are difficult to establish in some areas. The surface layer crusts after hard rains. Maintaining tilth and the organic matter content is a management concern. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain tilth and the organic matter content and minimize crusting. Planting cover crops helps to maintain the content of organic matter and protect the surface during flooding. In undrained areas, the soil is commonly used as pasture; however, it is poorly suited to grazing early in spring.

This soil is better suited to grasses and shallow-rooted legumes than to deep-rooted legumes. Overgrazing or grazing when the soil is wet causes compaction and reduced yields. Drained areas are moderately well suited to forage crops and pasture. Proper stocking rates, pasture rotation, mowing for weed control, and restricted grazing during wet periods help to keep the pasture in good condition. Timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding and the wetness. Building dikes to control flooding is difficult. Local roads can be constructed on fill material, above the normal level of flooding. Providing suitable base material helps to prevent the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is C-3.

Pe—Peoga silt loam. This deep, poorly drained, nearly level soil is in the lowest areas on terraces along the major streams. Most areas are long and narrow or rounded and range from 3 to 25 acres in size. Slopes are 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is mottled, firm silty clay loam about 61 inches thick. The upper part is gray and light brownish gray, and the lower part is yellowish brown. The substratum to a depth of about 84 inches is yellowish brown, mottled, firm silty clay loam. In some areas the surface layer is silty clay loam. In other areas the subsoil has more clay.

Included with this soil in mapping are small areas of Gallipolis, Newark, and Taggart soils. Newark soils are somewhat poorly drained, Gallipolis soils are moderately well drained, and Taggart soils are somewhat poorly drained. Taggart soils are on small rises. Newark soils are along drainageways. Included soils make up about 10 percent of most areas.

Permeability is slow in the Peoga soil. The root zone is deep; however, it is restricted by the wetness. The available water capacity is high. Runoff is slow or very slow. The potential for frost action is high. The seasonal high water table is near the surface during extended wet periods.

Most areas are used as cropland or pasture. A few are wooded. Some of the acreage is idle land.

This soil is moderately well suited to corn, soybeans, and small grain. It can be intensively cropped. Planting is delayed in undrained areas. Because of the slow internal water movement, a combination of surface drains and subsurface drains is needed in most areas. The soil dries out slowly in spring even if it is drained. It crusts after hard rains and puddles and clods if worked when wet. Maintaining tilth and the organic matter content is a management concern. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain tilth and the organic matter content and minimize crusting.

This soil generally is moderately well suited to pasture and hay. It is poorly suited to grazing early in spring. It is better suited to grasses and shallow-rooted legumes than to deep-rooted legumes. Overgrazing or grazing when the soil is wet causes compaction and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to trees. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Logging can be done when the soil is frozen or during the drier parts of the year. Site preparation and planting can be done during dry periods.

This soil is poorly suited to septic tank absorption fields. The wetness and the slow permeability are severe limitations. An aeration disposal system is used in some areas. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. Installing perimeter drains around the absorption field and backfilling with more permeable material lower the seasonal high water table.

This soil is poorly suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Constructing ditches and installing a subsurface drainage system help to overcome the wetness. Properly landscaping building sites helps to keep surface water away from foundations. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Installing a drainage system and providing suitable base material help to prevent the damage caused by frost action and low strength.

The land capability classification is IIIw. The woodland ordination symbol is 5W. The pasture and hayland suitability group is C-2.

PgB—Pinegrove sandy loam, 1 to 8 percent slopes. This deep, excessively drained, nearly level and gently sloping soil is on narrow and broad ridgetops and wide benches in areas surface mined for coal. It has been graded and blanketed with a thin layer of soil material. The substratum is a mixture of rock fragments and sandy or loamy fine-earth material that was in or below the original soil. The rock fragments are mostly sandstone. Individual areas are long and narrow or irregular in shape and range from 5 to 15 acres in size.

Typically, the surface layer is yellowish brown, friable sandy loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown and brown, loose channery loamy coarse sand and loamy coarse sand. In some areas the subsoil has a higher content of coarse fragments. In other areas the surface layer is thicker.

Included with this soil in mapping are small areas of Bethesda soils. These soils have a higher content of coarse fragments and less sand in the substratum than the Pinegrove soil. They are in landscape positions similar to those of the Pinegrove soil. They make up about 10 percent of most areas.

Permeability is rapid in the Pinegrove soil. The root zone is deep. The available water capacity is low. Runoff is medium.

In most areas, vegetation is sparse and the acreage is idle land. This soil is generally unsuited to cultivated crops and small grain. A vegetative cover and heavy applications of mulch help to control runoff and erosion, increase the rate of water infiltration, and improve the retention of water.

This soil is poorly suited to hay and pasture. No-till seeding of a mixture of grasses and legumes works well. Orchardgrass, tall fescue, and Korean lespedeza are some of the forage plants that grow best. Overgrazing causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to trees. Tree species that can grow under acid, droughty conditions should be selected for planting.

This soil is poorly suited to septic tank absorption fields. The unstable fill and the rapid permeability are limitations. Sanitary systems should be installed only in areas that have had sufficient time to settle after regrading. The soil easily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity of the soil may result in the pollution of ground-water supplies. Constructing the absorption field in suitable fill material or installing an aeration disposal system minimizes this hazard.

This soil is only moderately well suited to buildings because of the large stones in the substratum and the unstable fill. It is better suited to houses without basements than to houses with basements if many large stones are in the soil. Buildings should be constructed only in areas that have had sufficient time to settle after grading. Installing a drainage system and providing suitable base material help to prevent the damage caused by frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIIs. No woodland ordination symbol is assigned. The pasture and hayland suitability group is H-1.

PnD—Pinegrove sand, 8 to 25 percent slopes. This deep, excessively drained, strongly sloping and moderately steep soil is on rounded ridges of mine spoil and on side slopes in areas surface mined for coal. It is a mixture of rock fragments and partially weathered fine-earth material that was in or below the profile of the original soil. Most areas are irregularly shaped and range from 3 to 70 acres in size.

Typically, the surface layer is brown, very friable sand about 2 inches thick. The upper 24 inches of the substratum is strong brown and yellowish brown, very friable channery loamy sand. The lower part to a depth of about 72 inches is yellowish brown, loose channery and very channery loamy sand. In a few areas the surface layer is sandy loam or channery sand. In places the soil has a higher content of coarse fragments throughout.

Included with this soil in mapping are small unmined areas of the moderately deep Lily and Steinsburg soils. These soils make up about 10 percent of most areas.

Permeability is rapid in the Pinegrove soil. The root zone is deep. The available water capacity is low. Runoff is rapid.

In most areas, vegetation is sparse and the acreage is idle land. This soil is too toxic to support most vegetation. Some areas have been regraded. Extensive modifications are needed to create a zone favorable for root development. Examples of these modifications include neutralizing the acid reaction, adding plant nutrients, and blanketing the soil with suitable soil material. Acid-tolerant plants can grow if large amounts of sewage sludge, manure, fly ash, and the natural soil material that was present before mining are incorporated into the soil. The hazard of erosion is severe. Regraded areas can be planted to trees and used as habitat for openland wildlife. The soil is generally unsuitable as a site for reservoirs because of the hazard of seepage.

This soil is best suited to the trees that can grow under acid, droughty conditions. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

In areas where the slope is 8 to 15 percent and the soil has had sufficient time to settle, the soil is poorly suited to buildings and moderately well suited to septic tank absorption fields. In areas where the slope is 15 to 25 percent or the soil has not had sufficient time to settle, the soil is generally unsuited to absorption fields and buildings. Onsite investigation is needed to determine the limitations affecting absorption fields and buildings. The depth of the soil over bedrock and control of runoff should be considered during the site investigation. Concrete and uncoated steel in foundations and floors and buried utility lines are subject to severe corrosion. The soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity of the soil may result in the pollution of ground-water supplies. Droughtiness is a severe limitation affecting lawns. Blanketing lawns with suitable soil material helps to provide a more favorable root zone and increase the available water capacity.

The land capability classification is VIIs. No woodland ordination symbol is assigned. The pasture and hayland suitability group is H-1.

PnF—Pinegrove sand, 25 to 70 percent slopes. This deep, steep and very steep, excessively drained soil dominantly is on side slopes in areas surface mined for coal. In some areas it is on spoil ridges that are adjacent and parallel to the highwall. It is a mixture of rock fragments and partially weathered fine-earth material that was in or below the profile of the original soil. Most areas are long and winding and range from 8 to 280 acres in size.

Typically, the surface layer is yellowish brown, very friable sand about 8 inches thick. The upper part of the substratum is variegated yellowish brown and very dark grayish brown, loose loamy coarse sand. The lower part to a depth of about 60 inches is variegated yellowish brown and brown, loose channery loamy coarse sand. In places, the surface layer is channery loamy sand and the substratum has a higher content of coarse fragments.

Included with this soil in mapping are small areas of Bethesda soils. These soils have a higher content of coarse fragments and less sand in the substratum than the Pinegrove soil. They are in landscape positions similar to those of the Pinegrove soil. They make up about 15 percent of most areas.

Permeability is rapid in the Pinegrove soil. The root zone is deep. The available water capacity is low. Runoff is very rapid.

In most areas, vegetation is sparse and the acreage is idle land. This soil is too toxic to support most vegetation. Extensive modifications are needed to create a zone favorable for root development. Examples of these modifications include neutralizing the acid reaction, adding plant nutrients, and blanketing the soil with suitable soil material. Plants that can tolerate the acid conditions and withstand the droughtiness can grow if large amounts of sewage sludge, manure, fly ash, and the natural soil material that was present before mining are incorporated into the soil. The hazard of erosion is very severe. Sedimentation, in addition to the erosion, is a severe problem along drainageways. A plant cover reduces the hazard of erosion and minimizes the contamination of water. Regraded areas can be planted to grasses and trees and used as habitat for openland wildlife. The soil is generally unsuitable as a site for reservoirs because of the hazard of seepage.

This soil is generally unsuited to trees. It also is generally unsuited to sanitary facilities and buildings because of the slope and the hazard of hillside slippage. Sloughing is a hazard in excavated areas.

The land capability classification is VIIe. No woodland ordination symbol is assigned. The pasture and hayland suitability group is H-1.

Pp—Piopolis silt loam, frequently flooded. This deep, nearly level, poorly drained and very poorly drained soil is on flood plains. Most areas are broad or long and narrow and range from 5 to 60 acres in size. Slopes are 0 to 2 percent.

Typically, the surface layer is grayish brown, mottled, friable silt loam about 5 inches thick. The substratum to a depth of about 60 inches is light brownish gray, grayish brown, light gray, and gray, mottled, firm and very firm silt loam and silty clay loam. In places the subsoil has more sand.

Included with this soil in mapping are small areas of Stendal and Orrville soils. Orrville soils are somewhat poorly drained. Orrville and Stendal soils are on the higher parts of flood plains. Also included are small areas of soils that are ponded most of the year. Included soils make up about 15 percent of most areas.

Permeability is slow in the Piopolis soil. The root zone is deep; however, it is restricted by the wetness. The available water capacity is high. Runoff is very slow or ponded. The potential for frost action is high. The seasonal high water table is near or above the surface during extended wet periods.

Most areas are used as woodland or pasture. Some are used as cropland or hayland.

If drained, this soil is moderately well suited to row crops. The flooding and the wetness are the major management concerns (fig. 8). Siltation and the flooding in winter and spring are detrimental to small grain; however, other crops, such as corn and soybeans, are seldom damaged by the flooding. Planting is delayed in most years because of the wetness. Surface drains can be used to remove excess surface water. If outlets are available, subsurface drains help to overcome the wetness. Drainage outlets are difficult to establish in many areas because the soil is so low on the landscape. If drained, the soil is well suited to no-till farming.

This soil is moderately well suited to pasture and forage crops. It is better suited to pasture than to hay in undrained areas. Forage yields can be increased if a subsurface drainage system is installed. The soil is poorly suited to grazing in early spring. Overgrazing or grazing when the soil is wet causes compaction and poor tilth. The soil is better suited to grasses and shallow-rooted legumes than to deep-rooted legumes.

This soil is moderately well suited to trees and to habitat for wetland wildlife. Tree species selected for planting should be those that can tolerate the wetness. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less

Figure 8.—Crop damage in an area of Piopolis silt loam, frequently flooded.

desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur. Logging can be done when the soil is frozen or during the drier parts of the year. Site preparation and planting can be done during dry periods.

This soil is generally unsuited to septic tank absorption fields because of the flooding, the wetness, and the slow permeability. Building dikes to control flooding is difficult.

This soil is generally unsuited to buildings because of the flooding and the wetness. Local roads can be constructed on fill material, above the normal level of flooding. Providing suitable base material helps to prevent the damage caused by frost action and low strength.

The land capability classification is IIIw. The woodland ordination symbol is 5W. The pasture and hayland suitability group is C-3.

Ps—Pits, sand and gravel. This map unit occurs as areas from which aggregate material is surface mined for use in construction. It is on outwash terraces along rivers. Typically, these areas are associated with soils that are underlain by outwash gravel and sand, such as the Wheeling soils. Most of the pits range from 5 to 70 acres in size. Actively mined pits are continually being enlarged. Most of the pits have a highwall on one or more sides.

The material that is mined consists of stratified layers of gravel and sand of varying thickness and orientation. The kind and grain size of the aggregate material are relatively uniform within any one layer but commonly differ from layer to layer. Some layers contain a significant amount of silt and sand. Selectivity in mining is commonly feasible. The material that remains after mining is poorly suited to plants. The organic matter content and available water capacity are low.

Most unused gravel pits can be developed as wildlife habitat or as recreational areas. Pits excavated to or below the level of the water table can be developed as habitat for wetland wildlife.

No land capability classification, woodland ordination symbol, or pasture and hayland suitability group is assigned.

Pv—Pope fine sandy loam, frequently flooded. This deep, well drained, nearly level soil is on flood plains. It is frequently flooded. Most areas are long and winding and range from 3 to 80 acres in size. Slopes range from 0 to 3 percent.

Typically, the surface layer is brown, friable fine sandy loam about 10 inches thick. The subsoil extends to a depth of about 50 inches. It is yellowish brown, friable fine sandy loam and silt loam. The substratum to a depth of about 70 inches is yellowish brown, friable sandy loam and loam. In some areas the subsoil has more sand. In other areas it has gray mottles.

Included with this soil in mapping are small areas of the somewhat poorly drained Orrville and Stendal soils. These soils are in depressions or in narrow bands adjacent to slope breaks below terraces or uplands. They make up about 10 percent of most areas.

Permeability is moderate or moderately rapid in the Pope soil. The root zone is deep. The available water capacity is high. Runoff is slow.

Most areas are used as cropland or pasture. This soil is well suited to corn, soybeans, and tobacco. Small grain, such as winter wheat, may be severely damaged by the flooding in winter and early spring. The flooding is generally of short duration. Streambank erosion is severe in many areas. Stabilizing eroded streambanks is difficult in most places; however, maintaining a vegetative cover helps to control erosion. Row crops can be grown year after year if the soil is managed intensively and flooding is controlled or the crops are planted after the normal period of flooding. Maintaining tilth and the organic matter content is a management concern. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain soil tilth, organic matter, and soil moisture.

This soil is well suited to hay and pasture. The flooding in spring generally leaves sediment on the forage. Overgrazing or grazing when the soil is wet can cause compaction, increased runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of fertilizer and lime help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Woodland harvesting and planting can be performed during the periods when flooding does not occur.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding. Dikes are not effective because the soil is subject to seepage. Roads can be constructed on fill material, above the normal level of flooding. Special measures are needed in places to control streambank erosion.

The land capability classification is IIw. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-5.

Px—Pope silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. It is occasionally flooded. Most areas are long and winding and range from 10 to 200 acres in size. Slopes range from 0 to 3 percent.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 30 inches thick. The upper part is yellowish brown, friable silt loam. The lower part is dark yellowish brown, friable loam. The substratum to a depth of about 80 inches is brown, dark yellowish brown, and yellowish brown, very friable sandy loam and loose loamy sand. In some areas the surface layer is loam. In other areas the upper part of the substratum is silt loam. In places the subsoil contains more silt.

Included with this soil in mapping are small areas of the somewhat poorly drained Orrville and Stendal soils. These soils are in depressions or in narrow bands adjacent to slope breaks to terraces or uplands. They make up about 10 percent of most areas.

Permeability is moderate or moderately rapid in the Pope soil. The root zone is deep. The available water capacity is high. Runoff is slow.

Most areas are used as pasture or for cultivated crops. A few are wooded.

Although the choice of crops is limited because of the flooding, this soil is well suited to corn and soybeans. Small grain, such as winter wheat, may be severely damaged by flooding in winter and early spring. The flooding is generally of short duration.

Streambank erosion is severe in many areas. Stabilizing eroded streambanks is difficult in most places; however, maintaining a vegetative cover helps to control erosion. Row crops can be grown year after year if the soil is intensively managed and flooding is controlled or the crops are planted after the normal period of flooding. A surface crust forms after heavy rains, especially in tilled areas. Shallow cultivation breaks up the crust.

This soil is well suited to grasses and legumes for pasture. The flooding in early spring generally leaves sediment on the forage. Pasture rotation, proper stocking rates, mowing for weed control, and timely applications of fertilizer and lime help to maintain the maximum stand of key forage species.

This soil is well suited to woodland. Woodland harvesting and planting can be performed during the periods when flooding does not occur.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding. Building dikes to control flooding is difficult. Roads can be constructed on fill material, above the normal level of flooding. The soil is well suited to picnic areas and hiking trails. Special measures are needed in places to control streambank erosion.

The land capability classification is IIw. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-5.

RbC2—Rarden-Gilpin silt loams, 8 to 15 percent slopes, eroded. These moderately deep, strongly sloping soils are on ridgetops and side slopes in the uplands. The Rarden soil is moderately well drained, and the Gilpin soil is well drained. Erosion has removed part of the original surface layer of the soils. The present surface layer is a mixture of the original surface layer and subsoil material. The areas on ridgetops are dominantly long and narrow or irregularly shaped, and the areas on side slopes are long and winding. The soils are in relatively narrow, alternating bands on side slopes. Most areas range from 2 to 140 acres in size. They are about 45 percent Rarden soil and 35 percent Gilpin soil; however, either soil may be dominant. The Rarden soil is in concave areas and saddles, and the Gilpin soil is on knolls and convex slopes. These soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically, the Rarden soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is about 21 inches thick. The upper part is strong brown, firm silt loam. The next part is yellowish red, firm silty clay loam and red, mottled, very firm silty clay. The lower part is strong brown, mottled, firm channery silty clay. Yellowish brown, weathered clay shale bedrock is at a depth of about 27 inches. In some places the subsoil does not have yellowish red colors. In other places the substratum is medium acid.

Typically, the Gilpin soil has a surface layer of mixed brown and yellowish brown, friable silt loam about 10 inches thick. The subsoil is about 16 inches thick. The upper part is yellowish brown and strong brown, firm silt loam and silty clay loam. The lower part is yellowish brown, firm channery silty clay loam. Yellowish brown siltstone bedrock is at a depth of about 26 inches.

Included with these soils in mapping are small areas of the deep Clymer and Coolville soils. Clymer soils are on small knolls. Coolville soils are in the middle of the broader ridgetops. Also included are small seepy areas on the lower part of slopes. Most areas of the included soils are less than 10 acres in size. Included soils make up about 20 percent of most areas.

Permeability is slow in the Rarden soil and moderate in the Gilpin soil. The root zone is moderately deep in both soils. The available water capacity is low. Runoff is rapid. The shrink-swell potential is high in the subsoil of the Rarden soil and low in the Gilpin soil. The potential for frost action is high in the Rarden soil. The Rarden soil has a perched seasonal high water table at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as pasture or woodland. A few are used as cropland.

These soils are poorly suited to cultivated crops and small grain and to grasses and legumes for hay. Controlling erosion is the major management concern. The surface layer crusts after hard rains. No-till farming or another system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, a cropping system that includes meadow crops, cover crops, and incorporation of crop residue into the plow layer help to prevent excessive soil loss and increase the rate of water infiltration.

These soils generally are moderately well suited to pasture. If the soils are overgrazed or if they are plowed during seedbed preparation, the hazard of erosion is severe. Reseeding by trash-mulch or no-till methods or growing cover crops or companion crops reduces the hazard of erosion. Proper stocking rates, pasture rotation, mowing to control weeds, and timely applications of lime and fertilizer help to maintain a good stand of key forage species. Controlling grazing in winter and other wet periods helps to prevent compaction.

These soils are moderately well suited to trees. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Rarden soil. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The bedrock can be ripped with construction equipment. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Cutting and filling to a more desirable slope can improve sites for log landings.

These soils are poorly suited to septic tank absorption fields. The depth to bedrock in both soils and the wetness of the Rarden soil are severe limitations. The bedrock can be ripped with heavy construction equipment. Installing perimeter drains around the absorption fields lowers the seasonal high water table in the Rarden soil. Installing septic tank absorption fields in suitable fill material helps to overcome the limited depth to bedrock and the poor filtering capacity. An aeration disposal system is used in some areas.

These soils are poorly suited to buildings. They are better suited to houses without basements than to houses with basements because of the limited depth to bedrock. The bedrock can be ripped with heavy construction equipment. Installing drains at the base of footings, backfilling with suitable material, and coating exterior walls minimize the damage caused by wetness and by shrinking and swelling of the Rarden soil. Properly landscaping building sites helps to keep surface water away from foundations. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. Installing a drainage system and providing suitable base material help to prevent the damage caused by low strength and frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 4C in areas of the Rarden soil and 4A in areas of the Gilpin soil. The pasture and hayland suitability group is F-1 in areas of both soils.

RbD2—Rarden-Gilpin silt loams, 15 to 25 percent slopes, eroded. These moderately deep, moderately steep soils are on ridgetops and side slopes in the uplands. The Rarden soil is moderately well drained, and the Gilpin soil is well drained. Erosion has removed part of the original surface layer of the soils. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are broad and irregularly shaped; however, some are long and winding and follow the contour of the landscape. Most areas range from 2 to 310 acres in size. They generally are about 45 percent Rarden soil and 35 percent Gilpin soil. In places they occur as relatively pure areas of either the Rarden soil or the Gilpin soil. The Rarden soil is in concave areas and saddles, and the Gilpin soil is on knolls and convex slopes. These soils are in relatively narrow, alternating bands on side slopes. They generally occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically, the Rarden soil has a surface layer of brown, friable silt loam about 7 inches thick. The subsoil is about 26 inches thick. The upper part is strong brown, firm silty clay loam. The next part is yellowish red and red, mottled, very firm silty clay. The lower part is yellowish red and brown, mottled, very firm silty clay. The substratum is yellowish red, mottled, very firm channery silty clay. Pale brown siltstone bedrock is at a depth of about 36 inches. In some areas the subsoil does not have yellowish red colors. In other areas the subsoil is medium acid.

Typically, the Gilpin soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is about 16 inches thick. The upper part is yellowish brown, firm silt loam and silty clay loam. The lower part is yellowish brown, firm channery silty clay loam. The substratum is yellowish brown, firm, very channery silt loam. Yellowish brown sandstone bedrock is at a depth of about 25 inches. In places the upper part of the subsoil has gray mottles.

Included with these soils in mapping are small areas of Clymer soils and soils that are moderately well drained. The Clymer soils and the moderately well drained soils are deep. They are in colluvial and seepy areas. Also included are areas having steep escarpments where shale and siltstone crop out. Inclusions make up about 20 percent of most areas.

Permeability is slow in the Rarden soil and moderate in the Gilpin soil. The root zone is moderately deep in both soils. The available water capacity is low. Runoff is very rapid. The shrink-swell potential is high in the subsoil of the Rarden soil and low in the Gilpin soil. The potential for frost action is high in the Rarden soil. The Rarden soil has a perched seasonal high water table at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as pasture or woodland. A few are used as hayland. Some areas of these soils that were pastured are reverting to brush and woodland.

These soils are generally unsuited to cultivated crops and small grain because of the slope and a very severe hazard of erosion. The hazard of erosion is greater on the Rarden soil than on the Gilpin soil.

These soils are poorly suited to pasture. If the soils are overgrazed or if they are plowed during seedbed preparation, erosion is a very severe hazard. Applying trash mulch or other methods of no-till seeding or growing cover crops or companion crops when pastures are reseeded helps to control erosion and reduce the rate of runoff. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain a good stand of key forage species. Limited grazing in winter and other wet periods helps to prevent compaction. Deep-rooted legumes are difficult to maintain in some areas. Maintaining pasture and harvesting hay are somewhat difficult because the slope hinders the operation of farm machinery.

These soils are moderately well suited to trees. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate on both soils. In addition, planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Rarden soil. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The bedrock can be ripped with construction equipment. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to septic tank absorption fields because of the slope, the limited depth to bedrock, and the wetness.

These soils are poorly suited to buildings. They are better suited to houses without basements than to houses with basements because of the limited depth to bedrock. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. Installing drains at the base of footings, backfilling with suitable material, and coating the exterior walls minimize the damage caused by wetness and by shrinking and swelling of the Rarden soil. Properly landscaping building sites helps to keep surface water away from foundations. Because slippage is a hazard in areas of the Rarden soil, foundations for all buildings should extend to the bedrock. Installing a drainage system and providing suitable base material help to prevent the damage caused by low strength and frost action in the Rarden soil. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 3R in areas of the Rarden soil and 4R in areas of the Gilpin soil. The pasture and hayland suitability group is F-1 in areas of both soils.

RtE—Rarden-Steinsburg association, steep. These moderately deep soils are on side slopes in the uplands. The Rarden soil is moderately well drained, and the Steinsburg soil is well drained. Slopes dominantly range from 25 to 40 percent. Areas are irregularly shaped and range from 20 to several hundred acres in size. Most are about 45 percent Rarden soil and 35 percent Steinsburg soil. The Rarden soil is on the gentler slopes of hillsides and on benches, and the Steinsburg soil is on shoulder slopes and on the steeper side slopes. Because of present and anticipated soil uses, it is not considered practical or necessary to map the soils separately.

Typically, the Rarden soil has a surface layer of brown, friable silt loam about 4 inches thick. The subsoil is about 28 inches thick. The upper part is strong brown, firm silty clay loam. The next part is reddish brown, mottled, very firm silty clay and clay. The lower part is strong brown, very firm channery silty clay. Light yellowish brown siltstone bedrock is at a depth of about 32 inches. In some areas the soil is deeper over bedrock. In other areas the subsoil is not so red.

Typically, the Steinsburg soil has a surface layer of dark grayish brown, very friable loam about 4 inches thick. The subsoil is yellowish brown, very friable sandy loam about 14 inches thick. The substratum is yellowish brown, very friable flaggy sandy loam and very flaggy loamy sand. Yellowish brown sandstone bedrock is at a depth of about 32 inches. In some of the steeper areas, the soil is less than 20 inches deep.

Included with these soils in mapping are small areas of Gilpin and Guernsey soils. Gilpin soils have less clay than the Rarden soil. They are on side slopes. Guernsey soils are deep. They are on benches. Individual areas of the included soils generally are less than 20 acres in size. Included soils make up about 20 percent of most areas.

Permeability is slow in the Rarden soil and moderately rapid in the Steinsburg soil. The root zone is moderately deep in both soils. The available water capacity is low in the Rarden soil and low or very low in the Steinsburg soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Rarden and low in the Steinsburg soil. The potential for frost action is high in the Rarden soil. The Rarden soil has a perched seasonal high water table at a depth of 18 to 36 inches during extended wet periods.

Most areas are used as woodland. Some are pastured. These soils are generally unsuited to crops, hay, and pasture because of the slope, a very severe hazard of erosion, the high content of clay in the subsoil of the Rarden soil, and droughtiness in the Steinsburg soil.

These soils are moderately well suited to trees. Most areas support native hardwoods. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Rarden soil. Applying mulch around seedlings reduces the seedling mortality rate on the Steinsburg soil. The windthrow hazard on the Rarden soil can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope, the limited depth to bedrock, and the wetness and hazard of slippage in areas of the Rarden soil, these soils are generally unsuited to buildings and sanitary facilities. Construction is very difficult in areas used for recreation and in rural and urban areas (fig. 9). The hazard of erosion is severe when the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible. Constructing roads on the contour helps to minimize the extent of cut and fill areas and prevent excessive soil loss. Seeding and applying mulch in roadside ditches help to prevent the formation of gullies.

The land capability classification is VIIe. The woodland ordination symbol is 3R in areas of the Rarden soil and 4R on north aspects and 3R on south aspects in areas of the Steinsburg soil. The pasture and hayland suitability group is F-2 in areas of both soils.

ScE—Steinsburg-Clymer association, steep. These well drained soils are on side slopes in the uplands. The Steinsburg soil is moderately deep, and the Clymer soil is deep. Slopes dominantly range from 25 to 50 percent. Most areas are irregularly shaped and range from 20 to several hundred acres in size. They are about 60 percent Steinsburg soil and 20 percent Clymer soil. The Steinsburg soil is on shoulder slopes and in the steeper areas on side slopes, and the Clymer soil is on the lower side slopes and in the more gently sloping areas. Because of present and anticipated soil uses, it is not considered practical or necessary to map the soils separately.

Typically, the Steinsburg soil has a surface layer of brown, friable sandy loam about 4 inches thick. The subsoil is yellowish brown and brownish yellow, friable sandy loam about 14 inches thick. The substratum is brownish yellow, very friable sandy loam. Brownish yellow sandstone bedrock is at a depth of about 29 inches. In places the soil is deeper over bedrock.

Typically, the Clymer soil has a surface layer of very dark grayish brown, very friable loam about 5 inches thick. The subsurface layer is brown, friable sandy loam about 5 inches thick. The subsoil is dark yellowish brown, friable and firm loam about 22 inches thick. The substratum is dark yellowish brown, firm channery sandy loam. Pale brown and yellowish brown, soft, weathered sandstone bedrock is at a depth of about 42 inches. In some areas the subsoil has less clay. In other areas it has gray colors. In places the soil is moderately deep to bedrock.

Included with these soils in mapping are small areas of Guernsey and Rarden soils. Guernsey and Rarden soils have more clay than the Steinsburg and Clymer soils. They are on benches and the lower side slopes. Individual areas of the included soils generally are less than 20 acres in size. Included soils make up about 20 percent of most areas.

Permeability is moderately rapid in the Steinsburg soil and moderate in the Clymer soil. The root zone is moderately deep in the Steinsburg soil and deep in the Clymer soil. The available water capacity is very low in the Steinsburg soil and low or moderate in the Clymer soil. Runoff is very rapid on both soils.

Most areas are used as woodland. A few are pastured. These soils are generally unsuited to crops, hay, and pasture because of the slope, a severe hazard of erosion, and droughtiness.

These soils are moderately well suited to trees. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Applying mulch around seedlings reduces the seedling mortality rate on the Steinsburg soil. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope and the limited depth to bedrock, these soils are generally unsuited to sanitary

Figure 9.—A pond used for recreational activities and as a source of livestock water in an area of Rarden-Steinsburg association, steep.

facilities and buildings. Construction is very difficult in areas used for recreation and in urban areas. The hazard of erosion is severe when the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible. Constructing roads on the contour helps to minimize the extent of cut and fill areas and prevent excessive soil loss. Seeding and applying mulch in roadside ditches help to prevent the formation of gullies.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects in areas of the Steinsburg soil and 4R in areas of the Clymer soil. The pasture and hayland suitability group is H-1 in areas of the Steinsburg soil and A-3 in areas of the Clymer soil.

SrF—Steinsburg-Rock outcrop association, very steep. This association occurs as areas of a moderately deep, well drained Steinsburg soil intermingled with areas of Rock outcrop. It is on the upper part of hillsides above the Guernsey, Gilpin, and Pinegrove soils and on hillsides along deeply dissected major drainageways. Slopes dominantly range from 50 to 70 percent. Most areas are long and narrow or irregularly shaped and range from 10 to 300 acres in size. They generally are about 60 percent Steinsburg soil and 15 percent Rock outcrop. Because of present and anticipated soil uses, it is not considered practical or necessary to map the Steinsburg soil and Rock outcrop separately.

Typically, the Steinsburg soil has a surface layer of brown, very friable sandy loam about 4 inches thick. The subsoil extends to a depth of about 17 inches. It is yellowish brown, very friable channery sandy loam. The substratum is yellowish brown, very friable very channery sandy loam. Yellowish brown sandstone bedrock is at a depth of about 26 inches. In some places the soil is shallow over bedrock. In other places the surface layer is channery.

The Rock outcrop is on vertical cliffs and ledges. The maximum height of the cliffs ranges from about 60 to 80 feet. In places the Rock outcrop makes up more than 15 percent of the map unit.

Included in this unit in mapping are small areas of Gilpin, Guernsey, and Rarden soils. These included soils have more clay than the Steinsburg soil. Gilpin soils are on mid slopes. Guernsey and Rarden soils are mostly on benches or the lower side slopes. Individual areas of the included soils generally are less than 10 acres in size. Included soils make up about 25 percent of most areas.

Permeability is moderately rapid in the Steinsburg soil. The root zone is moderately deep. The available water capacity is very low. Runoff is very rapid.

This association is used as woodland or supports brush. It is generally unsuited to crops, hay, and pasture because of the slope, a very severe hazard of erosion, and droughtiness.

This association is poorly suited to trees. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water capacity and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Applying mulch around seedlings reduces the seedling mortality rate. Harvest methods that do not leave the remaining trees isolated or widely spaced can reduce the windthrow hazard. Haul roads, log landings, and skid trails should not be located in areas of the Rock outcrop. The Rock outcrop interferes with site preparation and planting. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope and the limited depth to bedrock, this association is generally unsuited to sanitary facilities and buildings. Construction is very difficult in areas used for recreation and in urban areas. The hazard of erosion is very high when the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible. Constructing roads on the contour helps to minimize the extent of cut and fill areas and prevent excessive soil loss. Seeding and applying mulch in roadside ditches help to prevent the formation of gullies.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects in areas of the Steinsburg soil. The pasture and hayland suitability group is H-1 in areas of the Steinsburg soil. No woodland ordination system or pasture and hayland suitability group is assigned to the Rock outcrop.

St—Stendal silt loam, occasionally flooded. This deep, somewhat poorly drained, nearly level soil is on flood plains. It is occasionally flooded. Most areas are in narrow to wide bands adjacent to slope breaks to the uplands or stream terraces. Some areas are in abandoned stream channels and small drainageways. Most areas range from 4 to 30 acres in size. Slopes are 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The substratum to a depth of about 72 inches is light gray, light olive brown, and light brownish gray, mottled, friable and firm silt loam and silty clay loam. In some areas the substratum is medium acid. In other areas the subsoil has less silt and more sand.

Included with this soil in mapping are small areas of Cuba, Gallipolis, and Piopolis soils. Cuba soils are well drained. They are along streams. Gallipolis soils are moderately well drained. They are on knolls and terrace remnants. Piopolis soils are poorly drained and very poorly drained. They are in depressions and old stream meanders. Included soils make up about 15 percent of most areas.

Permeability is moderate in the Stendal soil. The root zone is deep; however, it is restricted by the wetness. The available water capacity is very high. Runoff is slow. The potential for frost action is high. The seasonal high water table is at a depth of 12 to 36 inches during extended wet periods.

Most areas are used for cultivated crops, hay, or pasture. Some are wooded.

If drained, this soil is well suited to row crops. It is only moderately well suited to row crops if it is not drained. The flooding and the wetness are the major management concerns. The surface layer crusts after hard rains. The flooding in winter and early spring and siltation are detrimental to small grain; however, other crops, such as corn, are seldom damaged by the flooding. Planting is delayed in some years because of the wetness. A surface drainage system helps to remove excess surface water. A subsurface drainage system and diversions at the base of slope breaks to the uplands and terraces help to overcome the wetness in areas where outlets are available. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain tilth and the organic matter content and minimize crusting. Planting cover crops helps to maintain the content of organic matter and protect the surface during flooding. Streambank erosion is severe in many areas. Stabilizing eroded streambanks is difficult in most places; however, maintaining a vegetative cover helps to control erosion.

This soil is moderately well suited to pasture and forage crops. It is better suited to pasture than to hay in undrained areas. Forage yields can be increased if a subsurface drainage system is installed. Overgrazing or grazing when the soil is wet causes compaction. Proper stocking rates, pasture rotation, timely deferment of grazing, applications of lime and fertilizer, and mowing to control weeds help to maintain key forage species.

This soil is well suited to trees. Some areas support native hardwoods. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Woodland harvesting and planting can be performed during the periods when flooding does not occur. Logging can be done when the soil is frozen or during the drier parts of the year. Site preparation and planting can be done during dry periods.

This soil is generally unsuited to septic tank absorption fields and to buildings because of the flooding and the wetness. Local roads can be constructed on fill material, above the normal level of flooding. Providing suitable base material minimizes the road damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 5W. The pasture and hayland suitability group is C-3.

TgA—Taggart silt loam, 0 to 3 percent slopes. This deep, somewhat poorly drained, nearly level soil is on terraces along the major streams. Most areas are wide and irregularly shaped and range from 4 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 56 inches thick. The upper part is yellowish brown, mottled, friable and firm silt loam. The lower part is light brownish gray and yellowish brown, mottled, firm silt loam and silty clay loam. In some areas the subsoil is browner.

Included with this soil in mapping are small areas of the Gallipolis and Peoga soils. Gallipolis soils are moderately well drained. They are on slight rises. Peoga soils are poorly drained. They are in depressions along small drainageways. Included soils make up about 15 percent of most areas.

Permeability is slow in the Taggart soil. The root zone is deep; however, it is restricted by the wetness. The available water capacity is high. Runoff is slow. The potential for frost action is high. The seasonal high water table is at a depth of 12 to 36 inches during extended wet periods.

Most areas are used as cropland or pasture. Some are used as woodland. Most areas of cropland are drained.

If drained, this soil is well suited to row crops and small grain. The wetness is the main limitation. In undrained areas, the soil warms up slowly and dries out late in the spring. As a result, planting is delayed. The surface layer crusts after hard rains. A subsurface drainage system lowers the water table in areas where outlets are available. A surface drainage system helps to overcome the wetness in some areas. Maintaining tilth and the organic matter content is a management concern. A conservation tillage system that leaves crop residue on the surface and incorporation of crop residue into the plow layer help to maintain tilth and the organic matter content and minimize crusting.

This soil is well suited to permanent pasture and forage crops. It is better suited to pasture than to cultivated crops in undrained areas. Stands of deep-rooted legumes are difficult to maintain. Overgrazing or grazing when the soil is wet causes compaction and reduced yields. Proper stocking rates, pasture rotation, timely deferment of grazing, timely applications of lime and fertilizer, and mowing to control weeds help to maintain key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Logging can be done when the soil is frozen or during the drier parts of the year. Site preparation and planting can be done during dry periods.

This soil is poorly suited to septic tank absorption fields. The wetness and the slow permeability are severe limitations. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. An aeration disposal system is used in some areas. Installing perimeter drains around the absorption field and backfilling with more permeable material lower the seasonal high water table. Outlets for perimeter drains are not available in some areas.

This soil is poorly suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings, backfilling with suitable material, and coating exterior basement walls minimize the damage caused by wetness. Properly landscaping building sites helps to keep surface water away from foundations. Installing a tile drainage system and providing suitable base material help to prevent the road damage caused by frost action and low strength.

The land capability classification is IIw. The woodland ordination symbol is 4A. The pasture and hayland suitability group is C-1.

UgC2—Upshur-Gilpin complex, 8 to 15 percent slopes, eroded. These well drained, strongly sloping soils are on ridgetops in the uplands. The Upshur soil is deep, and the Gilpin soil is moderately deep. Erosion has removed part of the original surface layer of the soils. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are 5 to 80 acres in size. They are about 40 percent Upshur soil and 40 percent Gilpin soil. They are long and narrow or irregularly shaped and follow the contour of the ridgetop. The Gilpin soil is on knolls and convex slopes, and the Upshur soil is in concave areas and saddles. Some hillside slips are in areas of the Upshur soil. These soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically, the Upshur soil has a surface layer of dark yellowish brown, firm silty clay loam about 9 inches thick. The subsoil is about 30 inches thick. The upper part is yellowish red, very firm silty clay. The lower part is red and dark red, very firm clay. The substratum is yellowish red, very firm silty clay. Weathered, strong brown, calcareous siltstone bedrock is at a depth of about 43 inches. In some areas the soil is moderately deep over bedrock. In other areas the surface layer is silty clay loam. In places the subsoil is not so red.

Typically, the Gilpin soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is about 30 inches thick. The upper part is yellowish brown, friable and firm silt loam and silty clay loam. The lower part is yellowish brown and strong brown, firm silty clay loam, channery silty clay loam, and channery silt loam. Weathered, light olive brown siltstone bedrock is at a depth of about 36 inches. In places the subsoil has gray mottles.

Included with these soils in mapping are small areas of Rarden and Wellston soils. Rarden soils are moderately well drained and moderately deep. They are on small knolls. Wellston soils are in gently sloping areas in the center of the broader ridgetops. They have less clay in the subsoil than the Upshur soil. Included soils make up about 20 percent of most areas.

Permeability is slow in the Upshur soil and moderate in the Gilpin soil. The root zone of the Upshur soil is deep; however, it is restricted by the high content of clay. The root zone of the Gilpin soil is moderately deep. The available water capacity is low in both soils. Runoff is rapid. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Gilpin soil.

Most areas are used as pasture or woodland (fig. 10). Some are used as cropland.

These soils are poorly suited to cultivated crops and small grain and to grasses and legumes for hay. Controlling erosion is the major management concern. The surface layer crusts after hard rains. No-till farming or another system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, a cropping system that includes meadow crops, cover crops, and incorporation of crop residue into the plow layer help to prevent excessive soil loss, minimize crusting, and increase the rate of water infiltration.

These soils are moderately well suited to pasture. If the soils are overgrazed or if they are plowed during seedbed preparation, the hazard of erosion is severe. Applying trash mulch or other no-till seeding methods or growing cover crops or companion crops when pastures are reseeded helps to control erosion. Proper stocking rates, pasture rotation, mowing to control weeds, and timely applications of lime and fertilizer help to maintain a good stand of key forage plants. Controlling grazing in winter and other wet periods helps to prevent compaction.

The Upshur soil is moderately well suited to woodland, and the Gilpin soil is well suited. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate on the Upshur soil. The windthrow hazard on the Upshur soil can be reduced by applying harvest methods that do not isolate the remaining trees or leave them widely spaced. The bedrock underlying the Gilpin soil can be ripped with construction equipment. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Cutting and filling to a more desirable slope can improve sites for log landings.

These soils are generally unsuited to septic tank absorption fields. They are poorly suited to buildings. Because it has a lower content of clay in the subsoil, the Gilpin soil is better suited to buildings than the Upshur soil. It is a better site for buildings without basements than for buildings with basements. Because

Figure 10.—A wooded area of Upshur-Gilpin complex, 8 to 15 percent slopes, eroded.

slippage is a hazard in areas of the Upshur soil, foundations for buildings should extend to the bedrock. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping. The bedrock underlying the soils generally can be ripped with heavy construction equipment. Backfilling along foundations with material that has a low shrink-swell potential minimizes the damage caused by shrinking and swelling of the Upshur soil. Installing drains at the base of footings helps to intercept water moving laterally in the Upshur soil. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. Extensive excavation generally is needed when local roads are built. The hazard of slippage is increased if roads are built in areas of the Upshur soil. Providing suitable base material helps to prevent the road damage caused by frost action in both soils and the shrinking and swelling in the Upshur soil.

The land capability classification is IVe. The woodland ordination symbol is 3C in areas of the Upshur soil and 4A in areas of the Gilpin soil. The pasture and hayland suitability group is F-5 in areas of the Upshur soil and F-1 in areas of the Gilpin soil.

UgD2—Upshur-Gilpin complex, 15 to 25 percent slopes, eroded. These well drained, moderately steep soils are on side slopes and ridgetops in the uplands. The Upshur soil is deep, and the Gilpin soil is moderately deep. Erosion has removed part of the original surface layer of the soils. The present surface layer is a mixture of the original surface layer and subsoil material. Areas on side slopes are commonly long and winding and are dissected by small drainageways. Areas on ridgetops follow the contour of the ridgetops and are commonly long and narrow. Most areas are 3 to several hundred acres in size. They are about 40 percent Upshur soil and 40 percent Gilpin soil. They are in relatively narrow, alternating bands on hillsides. The Gilpin soil is on knolls and convex slopes on the ridgetops, and the Upshur soil is in saddles and concave areas on the ridgetops. Some hillside slips are in areas of the Upshur soil. These soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically, Upshur soil has a surface layer of brown, firm silty clay loam about 3 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish red, firm silty clay loam. The next part is red and reddish brown, very firm silty clay and clay. The lower part is dark red and reddish brown, very firm clay. The substratum is dark reddish brown, very firm silty clay. Weathered, reddish brown, calcareous siltstone bedrock is at a depth of about 44 inches. In some areas the soil is moderately deep over bedrock. In other areas the surface layer is silt loam. In places the subsoil is not so red.

Typically, the Gilpin soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is about 28 inches thick. The upper part is yellowish brown, friable silt loam. The next part is strong brown, firm silty clay loam. The lower part is strong brown and yellowish brown, firm channery silty clay loam. The substratum is yellowish brown, firm very channery silt loam. Yellowish brown siltstone bedrock is at a depth of about 37 inches. In some areas bedrock is at a depth of 40 to 60 inches. In other areas the subsoil has more sand.

Included with these soils in mapping are small areas of Guernsey and Berks soils. Guernsey soils are moderately well drained. They are on narrow benches and ridgetops. Berks soils are on shoulder slopes. They have a higher content of coarse fragments in the subsoil than the Upshur and Gilpin soils. Included soils make up about 20 percent of most areas.

Permeability is slow in the Upshur soil and moderate in the Gilpin soil. The root zone is deep in the Upshur soil; however, it is restricted by the high content of clay. The root zone is moderately deep in the Gilpin soil. The available water capacity is low in both soils. Runoff is very rapid. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Gilpin soil. The Upshur soil is subject to slippage.

Most areas are used as pasture or woodland. These soils are generally unsuited to corn and small grain and poorly suited to hay and pasture. Erosion is a very severe hazard when these soils are cultivated, plowed, or overgrazed. Cover crops, companion crops, and no-till seeding help to control erosion when pastures are seeded. Proper stocking rates and pasture rotation help to prevent overgrazing and control erosion.

These soils are moderately well suited to woodland. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate on both soils. In addition, planting techniques that spread the roots of seeds and improve soil-root contact reduce the seedling mortality rate on the Upshur soil. The windthrow hazard on the Upshur soil can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The bedrock can be ripped with construction equipment. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to septic tank absorption fields because of the slope of both soils, the limited depth to bedrock in areas of the Gilpin soil, and the slow permeability and the hazard of slippage in areas of the Upshur soil.

These soils are poorly suited to buildings. Because it has a lower content of clay in the subsoil, the Gilpin soil is better suited to buildings than the Upshur soil. Because slippage is a hazard in areas of the Upshur soil, foundations for buildings should extend to the bedrock. Installing drains at the base of footings helps to intercept water moving laterally in the Upshur soil. Backfilling along foundations with material that has a low shrink-swell potential minimizes the damage caused by shrinking and swelling of the Upshur soil. Designing buildings so that they conform to the natural slope of the land minimizes cutting, filling, and land shaping.

Cutting and filling increase the hazard of slippage in areas of the Upshur soil. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

Local roads should be located on the Gilpin soil, if possible. Extensive excavation generally is needed when local roads are built. The hazard of slippage is increased if roads are built in areas of the Upshur soil. Providing suitable base material helps to prevent the damage caused by frost action in both soils and the shrinking and swelling of the Upshur soil.

The land capability classification is VIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects in areas of the Upshur soil and 4R in areas of the Gilpin soil. The pasture and hayland suitability group is F-5 in areas of the Upshur soil and F-1 in areas of the Gilpin soil.

UgE—Upshur-Gilpin complex, 25 to 50 percent slopes. These well drained, steep soils are on hillsides in the uplands. The Upshur soil is deep, and the Gilpin soil is moderately deep. Slopes are both smooth and benched. They dominantly range from 25 to 50 percent. These soils generally are in irregular bands around hillsides. Most areas range from 20 to several hundred acres in size. They are about 40 percent Upshur soil and 40 percent Gilpin soil. The Gilpin soil is commonly on the upper and middle parts of slopes on hillsides, and the Upshur soil is commonly on benches on the middle of slopes and on the lower part of back slopes. Hillside slips are in areas of the Upshur soil. These soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically, the Upshur soil has a surface layer of brown, friable silty clay loam about 6 inches thick. The subsoil is about 44 inches thick. The upper part is strong brown, firm silty clay loam. The next part is yellowish red and red, very firm silty clay. The lower part is red, yellowish red, and reddish brown, very firm clay. The substratum is dusky red and reddish brown, very firm silty clay. Dark reddish brown siltstone bedrock is at a depth of about 71 inches. In places the subsoil has gray mottles.

Typically, the Gilpin soil has a surface layer of dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 19 inches thick. The upper part is yellowish brown, firm silt loam. The lower part is yellowish brown and strong brown, firm channery silt loam and channery silty clay loam. The substratum is yellowish brown, firm very channery silt loam. Yellowish brown siltstone bedrock is at a depth of about 30 inches. In places the lower part of the soil has higher base saturation.

Included with these soils in mapping are small areas of Guernsey and Berks soils. Berks soils have a higher content of coarse fragments in the subsoil than the Upshur and Gilpin soils. They are on shoulder slopes and in dissected areas. Guernsey soils are moderately well drained. They are in scattered areas on benches and the lower part of slopes. Included soils make up about 20 percent of most areas.

Permeability is slow in the Upshur soil and moderate in the Gilpin soil. The root zone is deep in the Upshur soil; however, it is restricted by the high content of clay. The root zone is moderately deep in the Gilpin soil. The available water capacity is moderate in the Upshur soil and low in the Gilpin soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Gilpin soil.

Most areas are used as woodland. These soils are generally unsuited to cultivated crops, hay, and pasture because of the slope, a severe hazard of erosion, the limited depth to bedrock in the Gilpin soil, and the high content of clay in the subsoil of the Upshur soil.

These soils are moderately well suited to woodland and well suited to habitat for woodland wildlife. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate on both soils. In addition, planting techniques that spread the roots of seedlings and improve soil-root contact reduce the seedling mortality rate on the Upshur soil. The windthrow hazard on the Upshur soil can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings can be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope of both soils, the limited depth to bedrock in the Gilpin soil, and the slow permeability, the high shrink-swell potential, and the hazard of hillside slippage in areas of the Upshur soil, these soils are generally unsuited to septic tank absorption fields and to buildings. The hazard of erosion is severe when the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects in areas of the Upshur soil and 4R in areas of the Gilpin soil. The pasture and hayland suitability group is F-6 in areas of the Upshur soil and F-2 in areas of the Gilpin soil.

VaC2—Vandalia silty clay loam, 6 to 15 percent slopes, eroded. This deep, well drained, strongly sloping soil is on colluvial foot slopes. Erosion has removed some of the original surface layer of the soil. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are long and narrow and are dissected by a few small drainageways. They range from 5 to 15 acres in size. The soil is subject to hillside slippage.

Typically, the surface layer is dark brown, firm silty clay loam about 8 inches thick. It is mixed with reddish brown material from the subsoil. The subsoil is about 42 inches thick. The upper part is reddish brown, firm silty clay loam. The next part is yellowish red, very firm, channery silty clay. The lower part is yellowish red, brown, and reddish brown, firm clay and silty clay. The substratum to a depth of about 65 inches is dark red, mottled, firm channery silty clay. In places the lower part of the soil is not so red.

Included with this soil in mapping are small areas of Gilpin and Guernsey soils. Gilpin soils are moderately deep. They have less clay than the Vandalia soil. They are in landscape positions similar to those of the Vandalia soil. Guernsey soils are moderately well drained. They are in concave areas. Included soils make up about 20 percent of most areas.

Permeability is slow or moderately slow in the Vandalia soil. The root zone is deep; however, it is restricted by the high content of clay. The available water capacity is moderate. Runoff is rapid. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of 48 to 72 inches during extended wet periods.

Most areas are used as pasture. A few are used as cropland.

This soil is poorly suited to corn, soybeans, and small grain. It can be cropped, but the cropping system should include hay or pasture for long periods of time. Erosion is a severe hazard, especially if the slopes are long. Applying no-till farming or another system of conservation tillage that leaves crop residue on the surface, growing cover crops, tilling at the proper moisture content, and establishing grassed waterways help to control erosion, improve tilth, and maintain the organic matter content.

This soil is moderately well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Cover crops, companion crops, and no-till seeding help to control erosion when pastures are seeded. Proper stocking rates, pasture rotation, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to woodland. Erosion can be minimized by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips.

This soil is poorly suited to septic tank absorption fields because of the restricted permeability. Installing distribution lines for septic tank absorption fields on the contour helps to prevent seepage of effluent to the surface. Increasing the size of the absorption field improves the capacity of the field to absorb effluent. An aeration disposal system is used in some areas.

This soil is poorly suited to buildings. Properly designing foundations and footings helps to prevent the structural damage caused by shrinking and swelling of the soil. Excavations around walls and foundations should be backfilled with material that has a low shrink-swell potential. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Buildings should be designed so that they conform to the natural shape of the land. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. Installing a drainage system and providing suitable base material help to prevent damage to roads.

The land capability classification is IIIe. The woodland ordination symbol is 4C. The pasture and hayland suitability group is F-5.

VaD3—Vandalia silty clay loam, 15 to 25 percent slopes, severely eroded. This deep, well drained, moderately steep soil is on colluvial foot slopes. Erosion has removed most of the original surface layer of the soil. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are long and narrow and are dissected by small drainageways. They range from 5 to 100 acres in size. The soil is subject to hillside slippage.

Typically, the surface layer is yellowish red, firm silty clay loam about 8 inches thick. It is mixed with brown material from the subsoil. The subsoil is about 50 inches thick. The upper part is reddish brown, very firm channery silty clay and silty clay. The lower part is dark reddish brown and reddish brown, firm clay and channery silty clay. The substratum to a depth of about

65 inches is dark red, mottled, firm very channery silty clay. In places the lower part of the soil is not so red.

Included with this soil in mapping are small areas of Gilpin, Guernsey, and Steinsburg soils. Gilpin soils are moderately deep and have less clay than the Vandalia soil. They are in landscape positions similar to those of the Vandalia soil. Guernsey soils are moderately well drained. They are on narrow benches. Steinsburg soils are moderately deep. They are in sandy areas that have sandstone bedrock near the surface. Included soils make up about 20 percent of most areas.

Permeability is slow or moderately slow in the Vandalia soil. The root zone is deep; however, it is restricted by the high content of clay. The available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of 48 to 72 inches during extended wet periods.

Most areas are used as pasture or woodland. This soil is generally unsuited to cultivated crops and small grain and poorly suited to hay and pasture because of the moderately steep, uneven slopes and a very severe hazard of erosion. Erosion is a very severe hazard if the soil is plowed during seedbed preparation, cultivated, or overgrazed. Maintaining a permanent plant cover is the best means of controlling erosion. Cover crops, companion crops, and no-till seeding help to control erosion when pastures are seeded. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is moderately well suited to woodland. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate on south-facing slopes. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope, the hazard of hillside slippage, the restricted permeability, and the high shrink-swell potential, this soil is generally unsuited to septic tank absorption fields and to buildings. Construction is very difficult in areas used for recreation and in urban areas. Limiting the extent of cut and fill areas minimizes hillside slippage. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is F-5.

VnD3—Vandalia-Gilpin complex, 15 to 25 percent slopes, severely eroded. These well drained, moderately steep soils are on colluvial side slopes and the benches of foot slopes. The Vandalia soil is deep, and the Gilpin soil is moderately deep. Erosion has removed most of the original surface layer of the soils. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are long and narrow and are dissected by small drainageways. They are about 55 percent Vandalia soil and 35 percent Gilpin soil. They range from 5 to 100 acres in size. The Vandalia soil is subject to hillside slippage. These soils are in relatively narrow, alternating bands on colluvial foot slopes. Separating them in mapping is not practical.

Typically, the Vandalia soil has a surface layer of dark brown, friable silty clay loam about 6 inches thick. The subsoil is about 54 inches thick. The upper part is yellowish red and reddish brown, firm silty clay loam and channery silty clay. The lower part is dark red and reddish brown, very firm channery clay and clay. The substratum to a depth of about 64 inches is yellowish red, mottled, firm very channery silty clay. In some areas the subsoil has gray mottles and may not be so red. In other areas the soil is less than 40 inches deep over bedrock.

Typically, the Gilpin soil has a surface layer of brown, friable silt loam about 4 inches thick. The subsoil is brown and strong brown, firm channery silt loam and very channery loam about 16 inches thick. Weathered siltstone bedrock is at a depth of about 20 inches. In places the soil is more than 40 inches deep over bedrock.

Included with these soils in mapping are small areas of the moderately well drained Guernsey soils on narrow benches. Included soils make up about 10 percent of most areas.

Permeability is slow or moderately slow in the Vandalia soil and moderate in the Gilpin soil. The root zone is deep in the Vandalia soil; however, it is restricted by the high content of clay. The root zone is moderately deep in the Gilpin soil. The available water capacity is moderate in the Vandalia soil and very low in the Gilpin soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Vandalia soil and low in the Gilpin soil. The Vandalia soil has a perched seasonal high water table at a depth of 48 to 72 inches during extended wet periods.

Most areas are used as pasture or woodland. These soils are generally unsuited to cultivated crops and small grain and poorly suited to pasture. Erosion is a very severe hazard when the soils are cultivated, plowed during seedbed preparation, or overgrazed. Maintaining a permanent plant cover is the best means of controlling erosion. Cover crops, companion crops, and no-till seeding help to control erosion when pastures are seeded. Proper stocking rates and pasture rotation help to prevent overgrazing and erosion.

These soils are moderately well suited to woodland. Coves and north- and east-facing slopes are the best woodland sites. These sites have more available water and cooler temperatures because they are not so exposed to direct sunlight and to the prevailing wind. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Planting seedlings that have been transplanted once reduces the seedling mortality rate on south-facing slopes. The windthrow hazard on the Gilpin soil can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The bedrock underlying the Gilpin soil can be ripped with construction equipment. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength. Haul roads and log landings should not be located on active slips. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the susceptibility to hillside slippage, the restricted permeability, and the high shrink-swell potential in areas of the Vandalia soil, the limited depth to bedrock in areas of the Gilpin soil, and the slope of both soils, these soils are generally unsuited to sanitary facilities and buildings. Construction is very difficult in areas used for recreation and in urban areas. The hazard of erosion is very high when the vegetative cover is removed. Trails in recreational areas should be protected against erosion. They should be established across the slope, if possible. Cutting and filling on the Vandalia soil increases the hazard of hillside slippage. Constructing roads on the contour minimizes cutting and filling. Providing suitable base material helps to prevent the damage caused by low strength and by shrinking and swelling of the Vandalia soil. Roads are subject to slippage. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. Seeding and applying mulch in roadside ditches help to prevent the formation of gullies.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is F-5 in areas of the Vandalia soil and F-1 in areas of the Gilpin soil.

WeB—Wellston silt loam, 1 to 6 percent slopes. This deep, well drained, nearly level and gently sloping soil is on ridgetops in the uplands. Most areas are long and narrow or irregularly shaped and range from 2 to 15 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 36 inches thick. The upper part is yellowish brown, friable and firm silt loam. The lower part is yellowish brown, mottled, firm silty clay loam and channery silty clay loam. The substratum is yellowish brown, mottled, firm channery silt loam. Light gray and yellowish brown, soft, fine grained sandstone and siltstone bedrock is at a depth of about 50 inches.

Included with this soil in mapping are small areas of Gilpin and Zanesville soils. Gilpin soils are moderately deep. They are near the edge of ridgetops. Zanesville soils are in landscape positions similar to those of the Wellston soil. They have a fragipan. Included soils make up about 15 percent of most areas.

Permeability is moderate in the Wellston soil. The root zone is deep. The available water capacity is high. Runoff is slow or medium. The potential for frost action is high.

Most areas are used as cropland or pasture. A few are wooded.

This soil is well suited to corn, soybeans, and small grain. The hazard of erosion is moderate. Cultivated crops can be grown year after year if erosion is controlled and improved management practices are applied. The surface layer crusts after hard rains. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, incorporation of crop residue into the plow layer, contour tillage, stripcropping, and grassed waterways help to maintain tilth, minimize crusting, and control runoff and erosion.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is only moderately well suited to septic tank absorption fields because of the limited depth to bedrock. Increasing the size of septic tank absorption fields and installing them in suitable fill material help to overcome the limited depth to bedrock and the poor filtering capacity of the soil.

This soil is well suited to buildings. The limited depth to bedrock hinders excavation in some areas. Properly landscaping building sites helps to keep surface water away from foundations. Providing suitable base material helps to prevent the road damage caused by frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

WhA—Wheeling silt loam, 0 to 3 percent slopes. This deep, well drained, nearly level soil is on the highest terraces along major streams. It formed in silty and loamy alluvium and sandy material. The sandy material is at a depth of 40 or more inches. Most areas are long and narrow and range from 5 to 75 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 30 inches thick. The upper part is dark yellowish brown, friable silt loam and loam. The lower part is dark yellowish brown, friable gravelly loam. The substratum to a depth of about 80 inches is dark yellowish brown and yellowish brown, loose very gravelly loamy sand and extremely gravelly sand.

Included with this soil in mapping are small areas of Elkinsville soils. These soils are in landscape positions similar to those of the Wheeling soil. They have less sand and gravel in the subsoil than the Wheeling soil. They make up about 10 percent of most areas.

Permeability is moderate in the subsoil of the Wheeling soil and rapid in the substratum. The root zone is deep. The available water capacity is moderate. Runoff is slow.

Most areas are used for cultivated crops or forage crops. This soil is well suited to frequent cropping of corn, soybeans, tobacco, and small grain if improved management practices are applied. The surface layer crusts after hard rains. Returning crop residue to the soil and regularly adding other organic material help to improve fertility, minimize crusting, and increase the rate of water infiltration. Applying no-till or minimum tillage practices helps to reduce the amount of time needed to prepare the field, improve soil structure and tilth, minimize compaction, and prevent excessive soil loss.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, increased runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to septic tank absorption fields and to buildings. The ground water can become contaminated with effluent from sanitary facilities because of the rapid permeability in the substratum. This hazard commonly is overcome by installing an aeration disposal system. Providing suitable base material helps to prevent the road damage caused by frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. The soil is a probable source of sand and gravel for commercial and construction purposes.

The land capability classification is I. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

WhB—Wheeling silt loam, 3 to 6 percent slopes. This deep, well drained, gently sloping soil is on the highest terraces along major streams. It formed in silty and loamy alluvium and sandy material. The sandy material is at a depth of more than 40 inches. Most areas are long and narrow and range from 5 to 75 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 47 inches thick. The upper part is dark yellowish brown and yellowish brown, friable silt loam and loam. The lower part is dark yellowish brown, friable stratified gravelly sandy loam and loam. The substratum to a depth of about 70 inches is dark yellowish brown, friable fine sand that has strata of loamy sand.

Included with this soil in mapping are small areas of very gravelly or sandy soils on highly convex terraces. These areas generally are less than 5 acres in size and may be adjacent to sand pits or gravel pits. Also included are small areas of droughty soils along Raccoon Creek. The droughty soils have a surface layer of loamy fine sand or sand. Some of the lower areas of included soils are subject to rare flooding. Included soils make up about 15 percent of most areas.

Permeability is moderate in the subsoil of the

Wheeling soil and rapid in the substratum. The root zone is deep. The available water capacity is moderate. Runoff is medium.

This soil is used mostly for cultivated crops or forage crops. It is well suited to frequent cropping of corn, soybeans, tobacco, and small grain if the hazard of erosion is reduced and if improved management practices are applied. The surface layer crusts after hard rains. Returning crop residue to the soil and regularly adding other organic material help to improve fertility, minimize crusting, and increase the rate of water infiltration. Applying no-till or minimum tillage practices helps to reduce the amount of time needed to prepare the field, improve soil structure and tilth, minimize compaction, and prevent excessive runoff and soil loss.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to septic tank absorption fields and to buildings. The ground water can become contaminated with effluent from sanitary facilities because of the rapid permeability in the substratum. This limitation can be overcome by installing an aeration disposal system. Some included areas on the lower level of terraces are subject to rare flooding and are generally unsuited to septic tank absorption fields and to buildings. Providing suitable base material helps to prevent the road damage caused by frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. The soil is a probable source of sand and gravel for commercial and construction purposes.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

WhC—Wheeling silt loam, 6 to 15 percent slopes. This deep, well drained, strongly sloping soil is on the highest terraces along major streams. It formed in silty and loamy alluvium and sandy material. The sandy material is at a depth of more than 40 inches. Most areas are long and narrow and range from 2 to 25 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper part is dark yellowish brown and yellowish brown, friable silt loam and loam. The lower part is dark yellowish brown, very friable sandy loam. The substratum to a depth of about 70 inches is dark yellowish brown, loose loamy sand.

Included with this soil in mapping are small areas of Elkinsville soils, very gravelly soils, and sandy soils. Elkinsville soils have less sand and gravel in the subsoil than the Wheeling soil. They are in landscape positions similar to those of the Wheeling soil. The very gravelly soils and the sandy soils are on highly convex terraces or adjacent to sand pits or gravel pits. They generally are in areas that are less than 5 acres in size. Included soils make up about 15 percent of most areas.

Permeability is moderate in the subsoil of the Wheeling soil and rapid in the substratum. The root zone is deep. The available water capacity is moderate. Runoff is medium.

Most areas are used for cultivated crops or forage crops. This soil is moderately well suited to corn, soybeans, tobacco, and small grain. Controlling erosion and maintaining tilth and the organic matter content are management concerns. A conservation tillage system that leaves crop residue on the surface, grassed waterways, contour stripcropping, a cropping system that includes grasses and legumes, cover crops, and incorporation of crop residue into the plow layer help to prevent excessive soil loss, minimize crusting, control runoff, maintain tilth and the organic matter content, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Applying trash mulch or other no-till seeding methods or growing companion crops or cover crops when pastures are reseeded helps to control erosion. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Cutting and filling to a more desirable slope can improve sites for log landings.

This soil is well suited to septic tank absorption fields and to buildings. The slope is the main limitation. Installing distribution lines for absorption fields on the contour helps to prevent seepage of effluent to the surface. The ground water can become contaminated with effluent from sanitary facilities because of the rapid permeability in the substratum. The rapid permeability can be overcome by installing an aeration disposal system. Buildings should be designed so that they conform to the natural slope of the land. Constructing local roads on the contour minimizes the extent of cut and fill areas. Installing a drainage system and providing suitable base material help to prevent the road damage caused by frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion. The soil is a probable source of sand and gravel for commercial and construction purposes.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

WhE—Wheeling silt loam, 25 to 40 percent slopes. This deep, well drained, steep soil is on slope breaks between terrace levels or between terraces and flood plains. It formed in silty and loamy alluvium and sandy material. The sandy material is at a depth of more than 40 inches. Most areas are long and narrow and range from 5 to 25 acres in size.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil is yellowish brown, friable silt loam and loam about 55 inches thick. The substratum to a depth of about 70 inches is yellowish brown, loose loamy sand that has thin strata of sandy loam. In places the subsoil and substratum have more sand.

Included with this soil in mapping are small areas of Elkinsville soils on slope breaks. These soils have a thicker layer of silty material than the Wheeling soil. They do not have gravel in the subsoil. They make up about 15 percent of most areas.

Permeability is moderate in the subsoil of the Wheeling soil and rapid in the substratum. The root zone is deep. The available water capacity is moderate. Runoff is rapid.

Most areas are used as woodland. A few of the broader areas are pastured. This soil is generally unsuited to cultivated crops, hay, and pasture because of the slope and a very severe hazard of erosion.

This soil is moderately well suited to trees. The hazard of erosion can be reduced by laying out logging roads and skid trails on or nearly on the contour, establishing water bars or a vegetative cover, or applying other erosion-control measures. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Establishing haul roads and skid trails on the contour facilitates the use of equipment. Log landings should be located on less sloping soils nearby. Special equipment is needed for site preparation and planting.

Because of the slope and a hazard of seepage, this soil is generally unsuited to septic tank absorption fields and to buildings. Construction is difficult in areas used for recreation and in urban areas. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-3.

WoB—Woodsfield silt loam, 1 to 6 percent slopes. This deep, well drained, nearly level and gently sloping soil is on wide ridgetops. Most areas are smooth or slightly undulating in the center and convex at the edges. They are long and narrow and range from 3 to 25 acres in size.

Typically, the surface layer is yellowish brown, firm silt loam about 10 inches thick. The subsoil is about 34 inches thick. The upper part is strong brown, firm silty clay loam. The lower part is red and reddish brown, firm silty clay. The substratum is reddish brown, very dark grayish brown, and olive yellow, firm silty clay loam. Light yellowish brown shale bedrock is at a depth of about 68 inches. In places the lower part of the subsoil is not so red. In a few areas it has gray mottles.

Included with this soil in mapping are small areas of Upshur and Zanesville soils. Upshur soils are in the more sloping areas. Erosion has removed some of the silty mantle in areas of the Upshur soils. Zanesville soils have a thicker layer of silty material than that of the Woodsfield soil. They have a fragipan in the subsoil. Included soils make up about 10 percent of most areas.

Permeability is moderate in the upper part of the subsoil in the Woodsfield soil and slow in the lower part of the subsoil. The root zone is deep; however, it is restricted by the high content of clay. The available water capacity is moderate. Runoff is medium. The shrink-swell potential is high in the subsoil.

Most areas are used for cultivated crops, hay, or pasture. A few are used as woodland.

This soil is well suited to row crops and small grain. The hazard of erosion is moderate in cultivated areas. The surface layer crusts after hard rains. Row crops can be grown frequently if good management practices are applied. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, cover crops, incorporation of crop residue into the plow layer, and contour tillage help to minimize crusting, control erosion, improve tilth, and maintain the organic matter content.

This soil is well suited to hay and pasture. Overgrazing, grazing when the soil is wet, and maintaining the level of fertility are management concerns. Limited grazing in winter and other wet periods helps to prevent compaction. Proper stocking rates, pasture rotation, mowing to control weeds, and timely applications of lime and fertilizer help to maintain a good stand of key forage species. Applying trash mulch or other no-till seeding methods or growing cover crops or companion crops when pastures are reseeded helps to control erosion.

This soil is well suited to woodland. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce the seedling mortality rate. Harvest methods that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields because of the slow permeability. Increasing the size of the absorption field improves the capacity of the field to absorb effluent.

This soil is only moderately well suited to buildings because of the high shrink-swell potential. Properly designing foundations and footings and backfilling along foundations with suitable material help to prevent the structural damage caused by shrinking and swelling of the soil. Providing suitable base material helps to prevent the road damage caused by shrinking and swelling and by low strength. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4C. The pasture and hayland suitability group is A-1.

ZaB—Zanesville silt loam, 1 to 6 percent slopes. This deep, moderately well drained, nearly level and gently sloping soil is on wide ridgetops. Individual areas are long and narrow or irregularly shaped and range from 3 to 25 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 48 inches thick. The upper part is yellowish brown, firm silt loam. The next part is a fragipan of yellowish brown, very firm and brittle silt loam. The lower part is yellowish brown, firm silt loam. The subsoil is mottled below a depth of about 20 inches. Light yellowish brown siltstone and shale bedrock is at a depth of about 57 inches. In places the soil is well drained.

Included with this soil in mapping are small areas of Coolville and Wellston soils. These soils do not have a fragipan. They are in landscape positions similar to those of the Zanesville soil. They make up about 10 percent of most areas.

Permeability is moderate above the fragipan in the Zanesville soil and moderately slow or slow in the fragipan. The root zone is mainly restricted to the 23- to 32-inch zone above the fragipan. The available water capacity in this zone is low. Runoff is slow or medium on the soil. A perched seasonal high water table is at a depth of 24 to 36 inches during extended wet periods.

Most areas are used as cropland or pasture. A few are used as woodland.

This soil is well suited to corn, soybeans, tobacco, and small grain. If cultivated crops are grown, erosion is the main management concern. Cultivated crops can be grown year after year if erosion is controlled and improved management practices are applied. The surface layer crusts after hard rains. A conservation tillage system that leaves crop residue on the surface, a cropping system that includes grasses and legumes, incorporation of crop residue into the plow layer, contour tillage, and grassed waterways help to maintain tilth and the organic matter content, control runoff and erosion, and minimize crusting.

This soil is well suited to hay and pasture. Overgrazing or grazing when the soil is wet causes compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, mowing for weed control, and timely applications of lime and fertilizer help to maintain the maximum stand of key forage species.

This soil is well suited to trees. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Applying gravel or crushed stone on haul roads and log landings helps to prevent the damage caused by low strength.

This soil is poorly suited to septic tank absorption fields. The wetness and the moderately slow or slow permeability are severe limitations. An aeration disposal system is used in some areas.

This soil is moderately well suited to buildings. It is better suited to houses without basements than to houses with basements because of the wetness. Installing drains at the base of footings and coating exterior basement walls minimize the damage caused by wetness. Properly landscaping building sites helps to keep surface water away from foundations. Installing a drainage system and providing suitable base material help to prevent the damage caused by low strength and frost action. Maintaining a vegetative cover on the site as much as possible during construction helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4D. The pasture and hayland suitability group is F-3.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 46,980 acres in the survey area, or nearly 16 percent of the total acreage, meets the soil requirements for prime farmland. Most of this acreage is used for crops. Scattered areas of this land are throughout the county, but most are in general map units 5, 6, 7, and 8, which are described under the heading "General Soil Map Units."

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown under the heading "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

Patty Dyer, district conservationist, Natural Resources Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

In 1979, about 45,500 acres in the survey area was used for the production of agricultural crops *(10)*. Of this total, about 26,200 acres was used for cultivated crops, 13,100 acres for hay, and 6,200 acres for other crops. An additional 53,500 acres was used as pasture.

The acreage planted to row crops or hay fluctuates yearly. This variation reflects the greater profit potential of cash-grain crops over livestock during periods when cattle prices are low. When cattle prices are higher, the acreage in forage production increases.

Many of the soils in the county require lime or fertilizer, or both, for optimum crop production. The content of phosphorus in the soils is especially low. The amounts needed depend on the natural level of lime and plant nutrients in the soil as determined by laboratory analyses of soil samples, on the needs of the crop, and on the desired level of yields. Only general suggestions for applications of lime and fertilizer are given in this publication.

Most of the soils in the county do not have a high content of organic matter, and increasing the content of organic matter to a high level is not economically feasible. Adding barnyard manure, returning crop residue to the soil, and growing sod crops, cover crops, and green manure crops help to maintain or increase the organic matter content.

Tillage breaks down the structure of the soil. It should be limited to the amount needed to prepare the seedbed and to help control weeds. Maintaining the content of organic matter in the plow layer helps to maintain the structure of the soil. Some of the soils in the county have a surface layer of silt loam that is subject to crusting. The crust generally is hard after periods of heavy rainfall. Gallipolis, Chagrin, Omulga, Doles, Taggart, Wheeling, and Wellston soils are subject to crusting. Tillage in areas of these soils should ensure that the soils are aerated and plants can be established, but it should not be excessive.

The soils in Gallia County are dominantly well drained or moderately well drained; however, those on flood plains and on the level part of valley fills and terraces are somewhat poorly drained, poorly drained, or very poorly drained. Crop yields in cultivated areas of wet soils, such as the Piopolis, Orrville, Newark, and Peoga soils, can be improved by establishing open ditches or installing a subsurface drainage system. Subsurface drains are costly to install, but they generally provide for better drainage than open ditches. Doles, Omulga, and other soils that have a fragipan are difficult to drain; however, they can generally be drained if the tile is installed directly above the hard, dense layer instead of in the layer. Depth to the fragipan determines the feasibility of installing a subsurface drainage system. Open ditches are more effective if the ditches intercept the water as it moves horizontally on top of the fragipan. Some soils receive runoff from adjacent soils on uplands. Other soils receive water from seeps and springs on the nearby hillsides. All of the soils in the county can be drained if suitable outlets are available; however, outlets are not available in some places or they are difficult to maintain in other places.

All of the soils in the gently sloping and steeper areas of the county are subject to erosion if they are cultivated. The erodibility of a particular soil depends, in part, on the physical properties of the soil. For example, Omulga soils are more susceptible to erosion than Taggart soils, 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 time if the soil is not protected by a vegetative cover. For example, a soil in a cultivated area is more susceptible to erosion than one in a wooded area.

No-till planting that includes the control of weeds with chemicals is common in areas used for the production of corn. It is a good erosion-control practice on the more sloping soils and also is suited to the wetter soils that have a good drainage system. Runoff and erosion generally occur during the growing season or immediately after harvest. A cropping system that helps to control runoff and erosion and other erosion-control practices are needed in areas of easily erodible soils, such as Omulga silt loam, 1 to 6 percent slopes. The cropping system refers to the sequence in which crops are grown and other management practices, such as conservation tillage, mulch planting, crop residue management, cover crops, green manure crops, and applications of lime and fertilizer. The other erosion-control practices include contour farming, terraces, contour stripcropping, diversions, and grassed waterways. 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. Assistance in planning an effective combination of these practices can be obtained at the local office of the Natural Resources Conservation Service.

About 23 percent of the acreage in the county is used for hay or pasture. The commonly grown pasture and hay plants are alfalfa, red clover, orchardgrass, blue grass, ladino clover, tall fescue, timothy, and brome.

The ability of a pasture to produce forage and protect the soils is affected by the number of livestock, the length of time that the livestock graze, and the availability of water. Good pasture management practices include applying proper planting rates to maintain key forage species, applying a system of pasture rotation and of deferred grazing, grazing only during the proper season, mowing for weed control, applying appropriate amounts of lime and fertilizer, and ensuring that an ample supply of water is strategically located.

Controlling erosion is a major management concern because some of the soils used for pasture are moderately steep or steep. It is particularly important when pastures are seeded. Mulch seeding or growing small grain as a companion crop helps to prevent further erosion. When established pastures are reseeded, applying a system of no-till seeding that includes control of weeds with chemicals helps to control erosion.

The need for lime and fertilizer should be determined on the basis of information derived from soil tests. Adequate amounts of lime and fertilizer should be applied to meet the needs of the crop being grown.

If pastures are grazed when the soils are wet, soil compaction is a management concern. It can greatly reduce the vigor of pasture plants. It is particularly a hazard in areas of the Rarden, Guernsey, Licking, and Taggart soils.

At the end of each map unit description, the soil has been assigned to a pasture and hayland suitability group. These groups are based primarily on the suitability of the soil for certain pasture species, management needs, and potential productivity. Detailed interpretations for each pasture and hayland suitability group in the county are provided in the "Technical Guide," which is available in the local office of the Natural Resources Conservation Service.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

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. The classes are 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 or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that 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.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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 hazard is the 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 very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Pasture and Hayland Suitability Groups

Table 6 can be used by farmers, farm managers, conservationists, and extension agents in planning the use of the soil for pasture and hay crops. Soils that have a slope of more than 25 percent are generally not suitable for pasture or hayland. Soils that are assigned the same suitability group symbol require the same general management and have about the same potential productivity. The suitability groups are based on soil characteristics and limitations.

Most of the soils in group A have few limitations affecting the management and growth of climatically adapted plants. Those in group A-1 are deep and are well drained or moderately well drained. They have a surface layer of loam or silt loam. Slopes range from 0 to 15 percent. Plants on these soils respond favorably to additions of lime and fertilizer. Frequent applications may be needed.

The soils in group A-2 are deep and are well drained or moderately well drained. They have a surface layer of loam or silt loam. Slopes range from 15 to 25 percent. Plants on these soils respond favorably to additions of lime. Frequent applications may be needed. The slope limits the mechanical application of lime and fertilizer. It also limits clipping, mowing, and spraying for weed control.

The soils in group A-3 are deep and well drained. They have a surface layer of silty clay loam, loam, or silt loam. Slopes range from 25 to 40 percent. These soils generally are not suited to pasture or hay because of the slope.

The soils in group A-5 are deep and are well drained or moderately well drained. They are on flood plains and are subject to frequent or occasional flooding. They have a surface layer of fine sandy loam or silt loam. Slopes range from 0 to 3 percent. The flooding limits the suitability for grazing during periods of stream overflow, and the deposition of sediment by floodwater lowers the quality of the forage.

The soils in group A-6 are deep and are well drained or moderately well drained. They are subject to frost action. They have a surface layer of silt loam. Slopes range from 1 to 15 percent.

The soils in group B are limited by droughtiness. Those in group B-1 are deep and well drained. They have a surface layer of channery silty clay loam. Slopes range from 1 to 25 percent. These droughty soils are suited to such warm-season grasses as switchgrass, big bluestem, indiangrass, and Caucasian bluestem. Plants on these soils respond favorably to additions of lime. Frequent applications may be needed to maintain an adequate pH level.

The soils in group B-2 are deep and well drained. They have a surface layer of channery silty clay loam. Slopes range from 25 to 40 percent. These soils generally are not suited to pasture or hay because of the slope.

The soils in group C generally are wet or saturated during the growing season. Those in group C-1 are deep and somewhat poorly drained. They have a surface layer of silt loam. Slopes range from 0 to 3 percent. Frost action can damage legumes, but including grasses in the seeding mixture minimizes the damage caused by frost heaving. A seasonal high water table limits the rooting depth of deep-rooted forage plants. Shallow-rooted species grow best on these soils. Plants on these soils respond favorably to additions of lime. Frequent applications may be needed to maintain an adequate pH level. A subsurface drainage system helps to remove excess water from these soils.

The soils in group C-2 are deep and are somewhat poorly drained or poorly drained. They have a surface layer of silt loam. Slopes range from 0 to 6 percent. A seasonal high water table limits the rooting depth of deep-rooted forage plants. Shallow-rooted species grow best on these soils. A subsurface drainage system helps to remove excess water from these soils, but the effectiveness of such a system is limited by restricted permeability in the subsoil or by the low position of the soils on the landscape.

The soils in group C-3 are deep and are somewhat poorly drained, poorly drained, or very poorly drained. They have a surface layer of silt loam or loamy sand. Slopes are 0 to 2 percent. These soils are on flood plains and are subject to frequent or occasional flooding. The flooding limits the suitability for grazing during periods of stream overflow, and the deposition of sediment by floodwater lowers the quality of the forage. Frost action can damage legumes, but including grasses in the seeding mixture minimizes the damage caused by frost heaving. A seasonal high water table limits the rooting depth of deep-rooted forage plants. Shallow-rooted species grow best on these soils. A subsurface drainage system helps to remove excess water from these soils, but the effectiveness of such a system is limited by the low position of the soils on the landscape.

The soils in group E are shallow. The root zone is less than 20 inches deep. Because of the shallow root zone, forage species that have a fibrous root system are better suited to these soils than shallow-rooted species.

The soils in group E-3 are shallow and well drained. They have a surface layer of channery clay loam. Slopes range from 8 to 25 percent. These droughty soils have a low pH level and a large amount of coarse fragments in the substratum. They are suited to such warm-season grasses as switchgrass, big bluestem, indiangrass, and Caucasian bluestem.

The soils in group F have a root zone that is only 20 to 40 inches thick. They are better suited to forage species that do not have a taproot because the root zone is limited.

The soils in group F-1 are moderately deep and are well drained or moderately well drained. They have a surface layer of silt loam, loam, or sandy loam. Slopes range from 8 to 25 percent. These droughty soils are suited to such warm-season grasses as switchgrass, big bluestem, indiangrass, and Caucasian bluestem. Plants on these soils respond favorably to additions of lime. Frequent applications may be needed to maintain an adequate pH level.

The soils in group F-2 are moderately deep or deep and are well drained or moderately well drained. They have a surface layer of silt loam or loam. Slopes range from 25 to 40 percent. These soils generally are not suited to pasture or hay because of the slope.

The soils in group F-3 are moderately well drained and deep. The root zone, however, is only moderately deep because it is restricted by a fragipan. Slopes range from 1 to 15 percent. The soils have a surface layer of silt loam or loam. They are better suited to forage species that do not have a taproot because the root zone is limited. Plants on these soils respond favorably to additions of lime. Frequent applications may be needed to maintain an adequate pH level.

The soils in group F-5 are deep and well drained. The root zone is restricted because the subsoil has a high content of clay. The soils have a surface layer of silty clay loam or silt loam. Slopes range from 8 to 25 percent. Plants on these soils respond favorably to additions of lime. Frequent applications may be needed to maintain an adequate pH level.

The soils in group F-6 are deep and well drained. The root zone is restricted because the subsoil has high bulk density and a high content of clay. Slopes range from 25 to 50 percent. The soils have a surface layer of silty clay loam. They generally are not suited to pasture or hay because of the slope.

The soils in group H-1 are not suited to pasture or hay because they are toxic or because the slope is more than 40 percent.

The average yields per acre that can expected of pasture and grass-legume hay mixtures under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Grass yields are dependent upon the amount of actual nitrogen applied. These yields cannot be achieved without this nitrogen fertilization.

Woodland Management and Productivity

About 153,500 acres, or more than 50 percent of the county, is forest land. Most of this land is privately owned. The remaining acreage of forest land is publicly owned. Wayne National Forest makes up most of the publicly owned forest land in the county. About 11,408 acres of the forest is in the southwestern part of the county. Most of this acreage is in Greenfield, Perry, and Walnut Townships. The acreage of state-owned forest land in the county is rather small. It consists mainly of the Tycoon Lake Wildlife Area. The acreage of county-owned forest land also is rather small. It consists mainly of the O.O. McIntyre Park District.

The most extensive areas of forest land are in the southwestern and southern parts of the county. Most of the woodland on steep slopes in the western part of the county is in areas of Rarden-Steinsburg association, steep; Steinsburg-Clymer association, steep; and Gilpin-Rarden association, steep (fig. 11). Most of the woodland on ridgetops in the western part of the county is in areas of Rarden-Gilpin silt loams, 8 to 15 percent slopes, eroded; Rarden-Gilpin silt loams, 15 to 25 percent slopes, eroded; and Lily silt loam, 8 to 15 percent slopes. Most of the woodland on steep slopes in the eastern part of the county is in areas of Gilpin-Steinsburg-Upshur association, steep, and Upshur-Gilpin complex, 25 to 50 percent slopes. However, the woodland on the very steep slopes in the southeastern part of the county is in areas of Berks-Upshur association, very steep. Most of the woodland on ridgetops in the eastern part of the county is in areas of Upshur-Gilpin complex, 8 to 15 percent slopes, eroded; Upshur-Gilpin complex, 15 to 25 percent slopes, eroded; and Lily-Upshur complex, 15 to 25 percent slopes. Most of the woodland on steep and very steep slopes in the northeastern part of the county is in areas of Guernsey-Gilpin association, steep; Upshur-Gilpin complex, 25 to 50 percent slopes; and Steinsburg-Rock outcrop association, very steep.

The trees in the county are hardwoods. Many different species of trees occur. The major forest types in the county include oak/hickory, Virginia pine/pitch pine, and oak/pine. Oak/hickory types are the most common timber types. They grow on well drained soils on uplands and alluvial flood plains. Some oak/sugar

Figure 11.—An area of Rarden-Steinsburg association, steep, which is moderately well suited to trees.

maple types are in areas of the Omulga and Monongahela soils in preglacial valleys in the central part of the county. Scattered small tracts of native conifers are in areas of the Steinsburg and Clymer soils in protected coves in the southwestern part of the county.

Much of the woodland is on steep and very steep soils that formed in material weathered from the underlying siltstone, sandstone, or shale bedrock. The acreage of woodland in the county has increased in recent years, particularly in those areas where the soils formed in residuum and colluvium derived from the underlying bedrock. These areas are poorly suited or generally unsuited to cropland, hayland, and pasture and are reverting to woodland.

Some of the woodland in the county shows results of poor management. Heavy cutting of the timber and poor logging practices occurred in the past, resulting in severe erosion in some areas. Erosion is most evident on logging roads where erosion-control measures were not applied. The best trees have been harvested, while culls and low-value trees have been left to occupy valuable growing space on excellent woodland soils. Grazing by livestock has damaged some woodland by destroying leaf litter and seedlings, damaging roots, and compacting soil. Applying good management techniques and proper erosion-control measures can substantially increase the level of production in wooded areas.

The acreage of forest land in the county is increasing. Fields that are marginal or unsuited to cropland or pasture are being abandoned and are gradually reverting to woodland. This shift in land use has been brought about largely because of current agricultural trends.

Soils differ greatly in productivity for woodland. The factors influencing tree growth are almost the same as those influencing the production of annual crops and pasture. They are slope, ponding, wetness, rock fragments in the soil, clayey textures in the subsoil, the presence of a fragipan, and a limited rooting depth. The major difference is that tree roots utilize more of the soil, especially around rock fragments in the lower part of the soil. The direction of exposure, or aspect, and the position of the soil on the landscape also are important. Other properties to be considered in evaluating a soil for woodland are the degree of past erosion, the acidity, and the natural fertility.

Aspect is the direction that the slope faces. North aspects are those slopes that have an azimuth of 355 to 93 degrees, and south aspects are those that have an azimuth of 96 to 354 degrees *(6)*. Trees grow better on north and east aspects because of less exposure to the prevailing winds and the sun and because of more abundant soil moisture. Some of the factors that make south and west aspects less productive are the higher soil temperature resulting from more direct sunlight, the higher evaporation rate caused by the prevailing winds, earlier melting of snow, and a greater degree of freezing and thawing.

Concave slopes are better sites for trees than convex slopes where water may drain away more rapidly. The shape of the slope also is related to the position of the slope on the landscape because ridges and the upper slopes generally are convex and the lower slopes and foot slopes are more commonly concave.

The position of the soil on the slope also influences the moisture supply available for tree growth. Soil moisture increases as elevation decreases, partly because of seepage downslope. On the lower part of slopes, the soils are generally deeper than those on the upper part, the loss of soil moisture by evaporation is less, and the soil temperature is somewhat lower.

Slope is an important factor in woodland management. The equipment limitation is severe on steep and very steep slopes. As the 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. When erosion is severe, the more porous surface layer is removed and the subsoil, which commonly is less porous, is exposed. As a result, the rate of runoff is increased and the rate of water intake is decreased *(9)*.

The growth and natural regeneration of trees also are adversely affected by erosion. In some steep and very steep areas of the county, trees are clearcut because selectively cutting trees is not economically feasible. Proper erosion-control measures should by applied to minimize soil loss during and after harvest. Erosion generally is severe along logging trails in forested areas. It commonly can be controlled by constructing water bars on the logging trails to reduce the length of the slope and by reseeding to establish a protective vegetative cover.

The natural fertility and the reaction of soils affect the growth of different kinds of trees. For example, black walnut grows well on Chagrin, Nolin, Elkinsville, and other soils having a natural content of lime in the subsoil that is favorable for tree growth *(5)*. Growth is slower on soils that are low in natural fertility.

More detailed information about the woodland in the county and woodland management is available from the local service forester of the Ohio Department of Natural Resources, Division of Forestry, or at the local office of the Natural Resources Conservation Service.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *N*, snowpack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Woodland Harvesting and Regeneration Activities

Table 9 gives the degree and kinds of limitations that affect the operation of equipment used in tree harvesting and in the regeneration of woodland. Ratings are given for haul roads, log landings, skid trails and logging areas, and site preparation and planting. The limitations are considered *slight* if the physical site characteristics impose little or no limitations on the kind of equipment or time of operation; *moderate* if physical site characteristics impose some limitations on the kind of equipment or the time of operation; and *severe* if physical site conditions are such that special equipment or special logging techniques are needed or the time of efficient operation is very limited.

Haul roads are access roads leading from log landings to primary or surfaced roads. Generally, these are unpaved roads that are not graveled. The ratings are based on soil properties, site features, and observed performance of the soils. Wetness, rockiness, depth to hard bedrock, stoniness, soil strength, slope, soil texture, and flooding should be considered in selecting routes for haul roads. Wetness and flooding affect the duration of use. Rock outcrops, stones, and boulders, which are difficult to move, hinder the construction when cutting and filling is needed. Soil strength, as inferred from the AASHTO group index and AASHTO group, is a measure of the traffic-supporting capacity of the soil. Slope affects the use of equipment and the cutting and filling requirements of the site.

Log landings are areas where logs are assembled for transportation. The best sites for landings require little or no surface preparation, which consists of cutting and filling. Considerable soil compaction can be expected in these areas. The ratings are based on soil properties, site features, and observed performance of the soils. Wetness, flooding, rockiness, stoniness, slope, depth to hard bedrock, soil strength, soil texture, and coarse fragments should be considered in selecting sites for log landings. Wetness and flooding affect the duration of use. Rock outcrops, stones, and boulders, which are difficult to move, affect the use of equipment and affect the configuration and location of landings. The depth to hard bedrock is a problem where cutting and filling are needed. Slope affects the equipment use and cutting and filling requirements of the site. Soil texture affects trafficability. Soil strength, as inferred from the AASHTO group index and AASHTO group, is a measure of the traffic-supporting capacity of the soil.

Skid trails and *logging areas* include the areas from the stumps to the log landings that are partially or completely logged with rubber-tired equipment. Other types of log-moving equipment can sometimes be used to minimize or overcome the site limitations. The ratings are based on soil properties, site features, and observed performance of the soils. Wetness, flooding, rockiness, stoniness, texture, and slope affect the use of logging equipment. Deferring logging activities during periods when the soil is saturated at or near the surface helps to minimize environmental damage. Special equipment is usually required during these periods. Soils that are subject to flooding of long duration should be not be logged because logging activities can damage the equipment or the environment, or both. Surface stones, boulders, and rock outcrops limit the efficient and safe use of equipment. As slope gradients increase, traction problems worsen. Traction is a problem on clayey soils during wet periods and on sandy soils during dry periods. Unless frozen, organic soils are severely damaged by the use of rubber-tired or tracked equipment.

Site preparation and *planting* are mechanized operations. The ratings are based on the limitations affecting the efficient use of equipment and on the hazards that can result on the site when the equipment is used. It is assumed that the operating techniques used do not displace or remove topsoil from the site or create channels in which storm runoff can concentrate. Wetness, flooding, rockiness, stoniness, the content of coarse fragments, depth to hard bedrock, texture, and slope affect the use of site preparation and planting equipment. Deferring site preparation and planting during periods when the soil is saturated at or near the surface helps to minimize environmental damage. Special equipment is usually required during these periods. Equipment should not be used on soils that are subject to flooding of long duration. Surface stones, boulders, and rock outcrops limit the efficient and safe use of equipment. Coarse fragments and hard bedrock at very shallow depths can interfere with equipment used in site preparation and planting. As slope gradients increase, traction problems worsen. Traction is a problem on clayey soils during wet periods and on sandy soils during dry periods. Unless frozen, organic soils are severely damaged by the use of rubber-tired or tracked equipment.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 10 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 10 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from a commercial nursery or from local offices of the Natural Resources Conservation Service; the Ohio Department of Natural Resources, Division of Forestry; or the Cooperative Extension Service.

Recreation

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 11, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 11 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 14 and interpretations for dwellings without basements and for local roads and streets in table 13.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Wildlife is one of the major natural resources in the county. The most common species are white-tailed deer, ruffed grouse, fox squirrel, gray squirrel, skunk, opossum, red fox, gray fox, raccoon, muskrat, beaver, cottontail rabbit, bobwhite quail, mourning dove, crow, hawk, and a variety of songbirds.

The main surface water resources in the county that provide a feeding place for waterfowl are the Ohio River, Tycoon Lake, Raccoon Creek, and Symmes Creek. They support a variety of ducks, geese, and other waterfowl.

One of the important wildlife areas in the county is Tycoon Lake State Wildlife Area. This area, which is owned by the State, is 684 acres in size. It provides opportunities for fishing and hunting to the public (fig. 12).

The welfare of wildlife species depends largely on the amount and distribution of food, shelter, and water *(1)*. If any of these elements are missing, inadequate, or inaccessible, the species is not present or is scarce. The kinds of wildlife are closely related to land use, to the resulting kinds and patterns of vegetation, and to the supply and distribution of water. These factors, in turn, are generally related to the kind of soils.

The soils in the county are favorable for wildlife habitat development if the habitat is managed properly and if soil erosion is kept to a minimum. Wildlife inhabit field borders, fence rows, hedgerows, ponds, woodlots, cropland, and idle fields of brush that were once farmed. Where food, water, or cover is lacking or in short supply, it can be provided by planting food patches, planting trees and shrubs for food and cover, leaving crop residue on the surface, building brush piles, constructing ponds, clearcutting small plots in wooded areas, or harvesting hay and other crops in a timely manner.

Additional information on managing or improving wildlife habitat can be obtained from the Division of Wildlife, Ohio Department of Natural Resources, and at the local office of the Agricultural Extension Service or the Natural Resources Conservation Service.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and

Figure 12.—Wetland wildlife habitat in Tycoon Lake State Wildlife Area. Peoga silt loam is in the adjacent areas.

abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, brome, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, ragweed, smartweed, and fescue.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and black walnut. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, duckweed, reed canarygrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or *for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 13 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 14 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 14 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 14 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 15 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 15, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 16 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 20.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 17 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(3)* and the system adopted by the American Association of State Highway and Transportation Officials *(2)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 18 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH levels of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of rock fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 19 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 19, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 19 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 19 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 19.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

Many of the soils in Gallia County were sampled and laboratory data determined by the Soil Characterization

Laboratory, Department of Agronomy, the Ohio State University, Columbus, Ohio. The physical and chemical data obtained from most of the samples include particle-size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations.

These data were used in classifying and correlating the soils and in evaluating their behavior under various land uses. Six of the profiles were selected as representative of their respective series and are described in this survey. These series and their laboratory identification numbers are Lily (GL-1), Doles (GL-2), Zanesville (GL-3), Pinegrove (GL-4), Steinsburg (GL-5), and Gallipolis (GL-6).

In addition to the Gallia County data, laboratory data are also available from nearby counties in southern Ohio. All of these data are on file at the Department of Agronomy, the Ohio State University, Columbus, Ohio, and the Natural Resources Conservation Service, State Office, Columbus, Ohio.

Engineering Index Test Data

Table 20 shows engineering test data for three pedons sampled at selected sites in the survey area. The soils were analyzed for engineering properties by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section, Columbus, Ohio. Engineering test data also are available from nearby counties that have many of the same soils. These data are on file at the Department of Agronomy, the Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Soil and Water Conservation, Columbus, Ohio; and the Natural Resources Conservation Service, State Office, Columbus, Ohio.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(17)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Ultisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udult (*Ud*, meaning humid, plus *ult*, from Ultisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludults (*Hapl*, meaning minimal horizonation, plus *udult*, the suborder of the Ultisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludults.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Hapludults.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(18)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(17)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aaron Series

The Aaron series consists of deep, moderately well drained, slowly permeable soils on upland ridgetops. These soils formed in loess and in the underlying residuum of interbedded limestone, calcareous shale, and siltstone bedrock. Slope ranges from 8 to 15 percent.

Aaron soils are similar to Guernsey soils and are commonly adjacent to Gilpin, Rarden, Upshur, and Woodsfield soils. Guernsey soils have a higher content of coarse fragments in the upper part of the solum than the Aaron soils. Gilpin and Rarden soils are moderately deep over bedrock. Upshur and Woodsfield soils have redder colors in the subsoil than the Aaron soils. Gilpin, Rarden, and Upshur soils are in landscape positions similar to those of the Aaron soils. Woodsfield soils are in gently sloping areas on ridgetops.

Typical pedon of Aaron silt loam, 8 to 15 percent slopes, about 2.3 miles west-southwest of Kyger, in Cheshire Township; about 975 feet south and 400 feet west of the northeast corner of sec. 33, T. 5 N., R. 14 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale yellow (2.5YR 7/4) dry; moderate medium and coarse granular structure; friable; common fine and medium and few coarse roots; strongly acid; abrupt smooth boundary.

BA—8 to 12 inches; yellowish brown (10YR 5/4) silt loam; weak fine and medium subangular blocky structure; firm; few fine and medium roots; few distinct very pale brown (10YR 7/4) silt coatings and common distinct brown (10YR 4/3) organic coatings on faces of peds; strongly acid; clear wavy boundary.

2Bt1—12 to 20 inches; yellowish brown (10YR 5/6) silty clay loam; moderate fine and medium subangular blocky structure; firm; few fine and medium roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; about 10 percent siltstone fragments; strongly acid; clear wavy boundary.

2Bt2—20 to 24 inches; yellowish brown (10YR 5/6) silty clay; common fine prominent light brownish gray (2.5Y 6/2) mottles; moderate medium subangular blocky structure; very firm; few fine and medium roots; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; about 4 percent siltstone fragments; strongly acid; clear wavy boundary.

2Bt3—24 to 32 inches; yellowish brown (10YR 5/4) silty clay; common medium and coarse distinct grayish brown (2.5Y 5/2) mottles; moderate medium and coarse subangular blocky structure; very firm; few medium and coarse roots; common distinct light olive brown (2.5YR 5/4) clay films on faces of peds; about 2 percent siltstone fragments; strongly acid; clear wavy boundary.

2Bt4—32 to 39 inches; yellowish brown (10YR 5/6) clay; common medium prominent light brownish gray (2.5Y 6/2) mottles; weak medium and coarse subangular blocky structure; very firm; few fine and medium roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; about 3 percent siltstone fragments; strongly acid; clear wavy boundary.

2BC—39 to 48 inches; yellowish brown (10YR 5/6) channery clay; many medium and coarse prominent light brownish gray (2.5Y 6/2) mottles; weak coarse subangular blocky structure; very firm; few fine roots; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; about 15 percent siltstone fragments; strongly acid; clear wavy boundary.

2C—48 to 53 inches; gray (2.5Y 6/1) shaly silty clay; common medium prominent brown (10YR 5/3) and many medium and coarse prominent yellowish brown (10YR 5/6) mottles; massive; firm; about 20 percent soft siltstone fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Cr—53 to 55 inches; light olive brown (2.5Y 5/4) calcareous clay shale bedrock.

The thickness of the solum ranges from 36 to 50 inches. The depth to bedrock ranges from 40 to 60 inches. The thickness of the loess ranges from 0 to 15 inches. The content of coarse fragments, which are mostly small, flat fragments of siltstone, shale, or limestone, ranges from 0 to 5 percent in the Ap and BA horizons, from 0 to 14 percent in the 2Bt horizon, and from 5 to 30 percent in the 2BC and 2C horizons.

The Ap horizon has chroma of 2 or 3. It typically is silt loam, but the range includes silty clay loam. Some pedons have a thin A horizon, which has value of 3 or 4 and chroma of 2 or 3. The 2Bt horizon has hue of 2.5Y or 10YR and value of 4 to 6. It is silty clay loam, silty clay, or clay. The 2BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. The 2BC and 2C horizons are silty clay loam, silty clay, clay, or the channery analogs of those textures.

Allegheny Series

The Allegheny series consists of deep, well drained, moderately permeable soils on terraces in dissected preglacial valleys. These soils formed in old loamy alluvium derived largely from acid sandstone and shale. Slope ranges from 3 to 25 percent.

Allegheny soils are similar to Gallia soils and are commonly adjacent to Monongahela and Omulga soils. Gallia soils are redder in the subsoil than the Allegheny soils. Monongahela and Omulga soils have a fragipan. They are in landscape positions similar to those of the Allegheny soils.

Typical pedon of Allegheny loam, 8 to 15 percent slopes, about 3.9 miles southwest of Rodney, in Perry Township; about 280 feet south and 2,640 feet west of the northeast corner of sec. 14, T. 5 N., R. 16 W.

Ap—0 to 8 inches; brown (10YR 4/3) loam, light yellowish brown (10YR 6/4) dry; moderate fine and medium granular structure; friable; many fine and few medium roots; about 2 percent sandstone fragments; strongly acid; abrupt smooth boundary.

BA—8 to 11 inches; yellowish brown (10YR 5/6) loam; weak fine and medium subangular blocky structure; firm; few fine roots; few distinct brown (10YR 4/3) organic coatings on faces of peds; strongly acid; clear wavy boundary.

Bt1—11 to 22 inches; strong brown (7.5YR 5/6) loam; moderate medium subangular blocky structure; firm; few fine roots; few distinct brown (7.5YR 5/4) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—22 to 32 inches; yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; firm; few fine roots; few distinct brown (7.5YR 4/4) clay films on faces of peds; very strongly acid; gradual wavy boundary.

BC—32 to 47 inches; strong brown (7.5YR 5/6) sandy loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; very strongly acid; gradual wavy boundary.

C1—47 to 58 inches; yellowish brown (10YR 5/6) sandy loam; massive; friable; few fine roots; very strongly acid; gradual wavy boundary.

C2—58 to 70 inches; yellowish brown (10YR 5/4) loamy sand; massive; very friable; very strongly acid; clear wavy boundary.

C3—70 to 82 inches; yellowish brown (10YR 5/6) sandy loam; single grain; loose; about 5 percent water-worked sandstone fragments; very strongly acid.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments ranges from 0 to 5 percent in the Ap horizon, from 0 to 15 percent in the Bt horizon, and from 0 to 35 percent in the C horizon. The fragments are mostly rounded sandstone and quartz pebbles.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. It typically is loam, but the range includes silt loam. The Bt and BC horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The Bt horizon typically is loam, clay loam, or sandy clay loam. The BC horizon is loam, sandy clay loam, sandy loam, or the gravelly analogs of those textures. The C horizon has hue of 10YR or 7.5YR and chroma of 4 to 8. It is sandy loam, loamy sand, or the gravelly analogs of those textures.

Berks Series

The Berks series consists of moderately deep, well drained soils on hillsides in the uplands. These soils formed in material weathered from siltstone and fine-grained sandstone bedrock. Permeability is moderate or moderately rapid. Slope ranges from 50 to 70 percent.

Berks soils are commonly adjacent to Gilpin, Steinsburg, Upshur, and Vandalia soils. Gilpin and Steinsburg soils have a lower content of coarse fragments in the subsoil than the Berks soils. Steinsburg soils are in landscape positions similar to those of the Berks soils. Upshur and Vandalia soils are deep over bedrock. Gilpin and Upshur soils are on ridgetops and hillsides. Vandalia soils are on colluvial foot slopes.

Typical pedon of Berks channery silt loam, in an area of Berks-Upshur association, very steep, about 0.9 mile southwest of Bladen, in Ohio Township; about 840 feet south and 600 feet east of the northwest corner of sec. 23, T. 1 N., R. 14 W.

A—0 to 4 inches; brown (10YR 4/3) channery silt loam, very pale brown (10YR 7/3) dry; weak fine granular structure; friable; common fine and medium and few coarse roots; about 20 percent coarse fragments; very strongly acid; clear smooth boundary.

Bw1—4 to 9 inches; brown (7.5YR 5/4) channery silt loam; weak fine subangular blocky structure; friable; common medium and coarse and few fine roots; about 25 percent coarse fragments; very strongly acid; clear wavy boundary.

Bw2—9 to 17 inches; brown (7.5YR 5/4) very channery silt loam; weak fine and medium subangular blocky structure; friable; few fine and medium roots; common distinct red (2.5YR 4/6) silt coatings on faces of peds; about 35 percent coarse fragments; very strongly acid; clear wavy boundary.

Bw3—17 to 27 inches; brown (7.5YR 5/4) very flaggy silt loam; weak medium and coarse subangular blocky structure; friable; few fine roots; common faint reddish brown (5YR 5/4) silt coatings on faces of peds; about 55 percent coarse fragments; strongly acid; clear wavy boundary.

BC—27 to 33 inches; brown (7.5YR 5/4) extremely flaggy silt loam; weak coarse subangular blocky structure; friable; few medium roots; about 80 percent coarse fragments; strongly acid; abrupt wavy boundary.

R—33 to 35 inches; brown (7.5YR 5/4) and light olive brown (2.5Y 5/6) interbedded fine grained sandstone and shale bedrock.

The thickness of the solum ranges from 18 to 38 inches. The depth to bedrock ranges from 20 to 40 inches. The bedrock is rippable siltstone or fine grained sandstone. The content of coarse fragments ranges from 15 to 30 percent in the A horizon, from 15 to 75 percent in the individual subhorizons of the B horizon, and from 35 to 90 percent in the BC horizon. The fragments are siltstone or fine grained sandstone.

The A horizon has value of 4 or 5 and chroma of 3 or 4. It typically is channery silt loam, but the range includes silt loam and channery loam. The Bw horizon has hue of 10YR to 5YR, value of 4 to 6, and chroma of 3 to 6. It is the channery, very channery, extremely channery, flaggy, very flaggy, or extremely flaggy analogs of silt loam or loam.

Bethesda Series

The Bethesda series consists of deep, well drained, moderately slowly permeable soils. These soils formed in a mixture of partly weathered fine earth and fragments of shale, sandstone, and siltstone. They are in areas surface mined for coal. Slope ranges from 8 to 70 percent.

Bethesda soils are similar to Fairpoint soils and are commonly adjacent to Fairpoint and Pinegrove soils. Fairpoint soils are less acid in the substratum than the Bethesda soils. Pinegrove soils do not have so many coarse fragments throughout the profile as the Bethesda soils. Fairpoint and Pinegrove soils are in landscape positions similar to those of the Bethesda soils.

Typical pedon of Bethesda channery clay loam, 40 to 70 percent slopes, about 1.5 miles north of Mercerville, in Harrison Township; about 960 feet south and 2,560 feet east of the northwest corner of sec. 7, T. 4 N., R. 15 W.

Ap—0 to 6 inches; 70 percent brown (10YR 5/3) and 30 percent pale brown (10YR 6/3) variegated channery clay loam, light brownish gray (10YR 6/2) and very pale brown (10YR 7/3) dry; weak fine granular structure; firm; common fine and coarse roots; about 20 percent siltstone and 10 percent shale fragments; very strongly acid; gradual smooth boundary.

C1—6 to 18 inches; brown (10YR 5/3) very channery clay loam; massive; firm; few fine roots; about 40 percent shale fragments and few fragments of coal; extremely acid; clear wavy boundary.

C2—18 to 33 inches; 60 percent light yellowish brown (10YR 6/4), 30 percent gray (10YR 6/1), and 10 percent reddish yellow (7.5YR 6/6) variegated extremely channery silty clay loam; massive; firm; few fine roots; about 45 percent siltstone and 20 percent shale fragments and few fragments of coal; extremely acid; clear smooth boundary.

C3—33 to 45 inches; 70 percent pale brown (10YR 6/3), 20 percent gray (10YR 6/1), and 10 percent reddish yellow (7.5YR 6/6) variegated very channery silty clay loam; massive; firm; few fine roots; about 20 percent siltstone and 20 percent shale fragments and few fragments of coal; extremely acid; clear smooth boundary.

C4—45 to 63 inches; 90 percent grayish brown (10YR 5/2) and 10 percent reddish yellow (7.5YR 6/6) variegated extremely channery silty clay loam; massive; firm; about 45 percent siltstone and 20 percent shale fragments and few fragments of coal; extremely acid.

The content of coarse fragments ranges from 15 to 35 percent in the Ap horizon and from 25 to 80 percent in the C horizon. The Ap horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is dominantly channery clay loam, but the range includes channery loam and channery silty clay loam. The C horizon has value of 3 to 6 and chroma of 1 to 8. It is the channery, very channery, or extremely channery analogs of clay loam, loam, silty clay loam, or silt loam.

Chagrin Series

The Chagrin series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 3 percent.

Chagrin soils are similar to Pope soils and are commonly adjacent to Kanawha, Lindside, Nolin, Orrville, and Stendal soils. Pope soils have less clay in the solum than the Chagrin soils. Kanawha soils have an argillic horizon. They are on terraces. Lindside soils are moderately well drained. They are on flood plains, in landscape positions similar to those of the Chagrin soils. Nolin soils have more silt and less sand in the solum than the Chagrin soils. Orrville and Stendal soils are somewhat poorly drained. They are in the lower areas on flood plains.

Typical pedon of Chagrin silt loam, frequently flooded, about 2.4 miles south of Mercerville, in Guyan Township; about 820 feet north and 2,790 feet east of the southwest corner of sec. 16, T. 3 N., R. 15 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; moderate fine and medium granular structure; friable; many fine roots; about 1 percent sandstone fragments and few fragments of coal; medium acid; abrupt smooth boundary.

Bw1—8 to 16 inches; dark yellowish brown (10YR 4/4) loam; weak medium and coarse granular structure; friable; few fine and medium roots; about 5 percent sandstone fragments and few fragments of coal; medium acid; clear wavy boundary.

Bw2—16 to 28 inches; dark yellowish brown (10YR 4/4) loam; weak fine and medium subangular blocky structure; firm; few fine roots; dark brown (10YR 4/3) organic coatings in worm channels; medium acid; clear wavy boundary.

Bw3—28 to 36 inches; brown (7.5YR 4/4) loam; weak medium and coarse subangular blocky structure; firm; few fine roots; medium acid; gradual wavy boundary.

BC—36 to 46 inches; brown (7.5YR 5/4) loam; weak very coarse subangular blocky structure; firm; few fine roots; medium acid; gradual wavy boundary.

C1—46 to 65 inches; dark yellowish brown (10YR 4/4) and brown (7.5YR 4/4) silt loam; massive; firm; few fine roots; brown (7.5YR 4/4) organic coatings in worm channels; medium acid; gradual wavy boundary.

C2—65 to 77 inches; brown (7.5YR 5/4) silt loam; massive; friable; few fine dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; about 5 percent coarse fragments; medium acid.

The thickness of the solum ranges 24 to 48 inches. The content of coarse fragments, which are mostly pebbles, ranges from 0 to 5 percent in the A horizon, from 0 to 10 percent in the B horizon, and from 0 to 20 percent in the C horizon.

The Ap horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It typically is silt loam, but the range includes loam. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, loam, or silty clay loam. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is silt loam, loam, gravelly loam, fine sandy loam, or sandy loam. Some pedons have subhorizons of loamy sand below a depth of 40 inches.

Clymer Series

The Clymer series consists of deep, well drained, moderately permeable soils on hillsides and ridgetops in the uplands. These soils formed in residuum and colluvium derived from sandstone bedrock. Slope ranges from 3 to 50 percent.

Clymer soils are similar to Gilpin and Lily soils and commonly are adjacent to Gilpin, Lily, Rarden, and Steinsburg soils. Gilpin, Lily, Rarden, and Steinsburg soils are moderately deep over bedrock. Gilpin, Lily, and Rarden soils are in landscape positions similar to those of the Clymer soils. Steinsburg soils are on hillsides.

Typical pedon of Clymer loam, in an area of Steinsburg-Clymer association, steep, about 1.4 miles west of Gallia, in Greenfield Township; about 2,560 feet south and 2,480 feet west of the northeast corner of sec. 17, T. 6 N., R. 17 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, pale brown (10YR 6/3) dry; moderate fine granular structure; very friable; many fine, common medium, and few coarse roots; about 5 percent coarse fragments; strongly acid; clear wavy boundary.

AB—5 to 10 inches; brown (10YR 4/3) sandy loam; moderate medium granular structure; friable; common fine and few coarse roots; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in pores; about 5 percent coarse fragments; very strongly acid; clear wavy boundary.

BA—10 to 16 inches; dark yellowish brown (10YR 4/4) loam; weak medium and coarse subangular blocky structure; friable; common fine roots; common distinct dark brown (10YR 4/3) organic coatings on faces of peds and in pores; about 5 percent coarse fragments; very strongly acid; clear smooth boundary.

Bt1—16 to 23 inches; dark yellowish brown (10YR 4/6) loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; about 5 percent coarse fragments; very strongly acid; clear smooth boundary.

Bt2—23 to 32 inches; dark yellowish brown (10YR 4/6) loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; about 8 percent coarse fragments; very strongly acid; clear smooth boundary.

C—32 to 42 inches; dark yellowish brown (10YR 4/6) channery sandy loam; weak coarse subangular blocky structure; firm; about 18 percent coarse fragments; very strongly acid; abrupt wavy boundary.

Cr—42 to 48 inches; pale brown (10YR 6/3) and yellowish brown (10YR 5/6), soft, weathered sandstone bedrock.

R—48 to 50 inches; hard sandstone bedrock.

The thickness of the solum ranges from 30 to 40 inches. The depth to bedrock ranges from 40 to 60 inches. The content of coarse fragments ranges from 5 to 20 percent in the Bt horizon and from 10 to 20 percent in the C horizon.

The A horizon has value of 3 or 4 and chroma of 2 or 3. It typically is silt loam, but the range includes loam and sandy loam. Some pedons have a BE horizon. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, loam, clay loam, sandy loam, or the channery analogs of those textures. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 6 to 8. It is loam, sandy loam, or the channery analogs of those textures.

Coolville Series

The Coolville series consists of deep, moderately well drained soils on ridgetops in the uplands. These soils formed in a mantle of loess and in the underlying material weathered from acid shale. Permeability is moderate in the loess and slow or very slow in the underlying residuum. Slope ranges from 1 to 6 percent.

Coolville soils are similar to Woodsfield soils and commonly are adjacent to Gilpin, Rarden, Wellston, and Zanesville soils. Woodsfield and Wellston soils are well drained. Gilpin and Rarden soils are moderately deep over bedrock. Zanesville soils have a fragipan. Gilpin and Rarden soils are on ridgetops and side slopes. Wellston and Zanesville soils are in landscape positions similar to those of the Coolville soils.

Typical pedon of Coolville silt loam, 1 to 6 percent slopes, about 1.2 miles north of Thurman, in Raccoon Township; about 600 feet south and 60 feet east of the northwest corner of sec. 18, T. 6 N., R. 16 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; few medium and coarse and many fine roots; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in pores; very strongly acid; abrupt smooth boundary.

BE—9 to 12 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; few medium and many fine roots; common distinct brown (10YR 4/3) organic coatings in root channels; many faint brown (10YR 5/3) silt coatings on faces of peds; very strongly acid; clear smooth boundary.

Bt1—12 to 16 inches; yellowish brown (10YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; common fine roots; common distinct brown (7.5YR 5/4) clay films and common faint brown (10YR 5/3) silt coatings on faces of peds; very strongly acid; clear smooth boundary.

Bt2—16 to 20 inches; strong brown (7.5YR 5/6) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; many distinct brown (7.5YR 5/4) clay films and common distinct brown (10YR 5/3) silt coatings on faces of peds; very strongly acid; abrupt wavy boundary.

2Bt3—20 to 24 inches; yellowish red (5YR 5/6) silty clay; common fine and medium prominent light brownish gray (10YR 6/2) mottles; strong medium and coarse subangular blocky structure; firm; few fine roots; many distinct reddish brown (5YR 4/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt4—24 to 31 inches; red (2.5YR 4/6) silty clay; common medium prominent light brownish gray (10YR 6/2) mottles; strong medium and coarse subangular blocky structure; very firm; few fine roots; many distinct reddish brown (2.5YR 4/4) clay films on faces of peds; very strongly acid; clear wavy boundary.

2Bt5—31 to 37 inches; red (2.5YR 4/6) silty clay; many medium and coarse prominent gray (10YR 6/1) mottles; strong medium and coarse subangular blocky structure; very firm; few fine roots; many distinct reddish brown (2.5YR 4/4) and many prominent light gray (10YR 6/1) clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt6—37 to 42 inches; reddish brown (5YR 4/4) silty clay; many medium prominent light brownish gray (2.5Y 6/2) mottles; moderate medium and coarse subangular blocky structure; very firm; many distinct reddish brown (2.5YR 4/4) and many prominent light gray (10YR 6/1) clay films on faces of peds; about 5 percent coarse fragments; very strongly acid; abrupt smooth boundary.

2Cr—42 to 45 inches; yellowish brown (10YR 5/6), soft shale bedrock.

The thickness of the solum ranges from 36 to 48 inches. The depth to paralithic contact ranges from 40 to 60 inches. The thickness of the loess mantle ranges from 14 to 20 inches. The content of coarse fragments ranges from 0 to 5 percent in the A and Bt horizons and from 0 to 10 percent in the 2Bt horizon.

The Bt horizon has value of 4 or 5 and chroma of 4 to 6. The 2Bt horizon is silty clay or clay.

Cuba Series

The Cuba series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in acid alluvium. Slope ranges from 0 to 3 percent.

Cuba soils are similar to Lindside and Nolin soils and are commonly adjacent to Orrville, Piopolis, and Stendal soils. Lindside soils are moderately well drained. Nolin soils are less acid in the subsoil than the Cuba soils. Orrville and Stendal soils are somewhat poorly drained. Piopolis soils are poorly drained and very poorly drained. Orrville, Stendal, and Piopolis soils are in the lower areas on flood plains.

Typical pedon of Cuba silt loam, occasionally flooded, about 1.2 miles northeast of McDaniel Crossroad, in Walnut Township; about 625 feet south and 180 feet west of the northeast corner of sec. 1, T. 5 N., R. 17 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; weak fine and medium granular structure; friable; many fine and medium roots; brown (10YR 4/3) wormcasts; few coarse fragments; medium acid; abrupt smooth boundary.

Bw1—7 to 15 inches; yellowish brown (10YR 5/6) silt loam; weak fine and medium subangular blocky structure; friable; few medium and many fine roots; common distinct yellowish brown (10YR 5/4) silt coatings on faces of peds; brown (10YR 4/3) wormcasts; few coarse fragments; strongly acid; clear wavy boundary.

Bw2—15 to 27 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few medium and common fine roots; common distinct yellowish brown (10YR 5/4) and pale brown (10YR 6/3) silt coatings on faces of peds; yellowish brown (10YR 5/4) wormcasts; few coarse fragments; strongly acid; clear wavy boundary.

Bw3—27 to 32 inches; yellowish brown (10YR 5/6) silt loam; weak fine and medium subangular blocky structure; friable; common fine roots; few distinct yellowish brown (10YR 5/4), pale brown (10YR 6/3), and strong brown (7.5YR 5/6) silt coatings on faces of peds; few fine and medium black (10YR 2/1) stains and concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

Bw4—32 to 39 inches; dark yellowish brown (10YR 4/4) silt loam; few medium distinct brown (7.5YR 5/4) and common medium distinct pale brown (10YR 6/3) mottles; weak medium and coarse subangular blocky structure; friable; common fine roots; common distinct yellowish brown (10YR 5/4) silt coatings on faces of peds; many fine black (10YR 2/1) stains and concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

C1—39 to 50 inches; dark yellowish brown (10YR 4/4) silt loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; friable; about 2 percent coarse fragments; strongly acid; clear wavy boundary.

C2—50 to 60 inches; yellowish brown (10YR 5/6) silt loam; common fine and medium prominent light brownish gray (10YR 6/2) and common fine distinct strong brown (7.5YR 5/6) mottles; massive; very friable; common medium and coarse very dark grayish brown (10YR 3/2) stains and concretions of iron and manganese oxide; about 3 percent coarse fragments; strongly acid; clear wavy boundary.

C3—60 to 71 inches; yellowish brown (10YR 5/6) loam; common medium prominent light brownish gray (10YR 6/2) and common medium distinct strong brown (7.5YR 5/6) mottles; massive; very friable; few medium black (10YR 2/1) stains and concretions of iron and manganese oxide; about 2 percent coarse fragments; strongly acid; clear wavy boundary.

C4—71 to 83 inches; yellowish brown (10YR 5/6) loam; common medium and coarse prominent gray (10YR 6/1) and common medium distinct strong brown (7.5YR 5/8) mottles; massive; very friable; strongly acid.

The thickness of the solum ranges from 20 to 40 inches. The Ap horizon has value of 4 or 5 and chroma of 3 or 4. The Bw and C horizons have chroma of 3 to 6.

Doles Series

The Doles series consists of deep, somewhat poorly drained, slowly permeable soils on flats in abandoned, preglacial valleys. These soils formed in loess, silty colluvium, or old alluvium. Slope ranges from 0 to 3 percent.

The Doles soils in this county have a lower base saturation in the lower part of the profile than is typical for the series. This difference, however, does not affect use and management.

Doles soils are commonly adjacent to Monongahela and Omulga soils. Monongahela and Omulga soils are moderately well drained. They are in the more sloping areas.

Typical pedon of Doles silt loam, 0 to 3 percent slopes, about 0.6 mile southwest of Bidwell, in Springfield Township; about 1,700 feet north and 2,490 feet west of the southeast corner of sec. 29, T. 6 N., R. 15 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, light gray (10YR 7/2) dry; moderate fine and medium granular structure; friable; common fine roots; few coarse black (10YR 2/1) concretions and stains of iron and manganese oxide; slightly acid; abrupt smooth boundary.

BE—10 to 13 inches; yellowish brown (10YR 5/4) silt loam; common distinct light brownish gray (2.5Y

6/2) silt coatings on faces of peds; few fine prominent strong brown (7.5YR 5/8) and common fine and medium distinct yellowish brown (10YR 5/6) and light gray (10YR 7/2) mottles; moderate fine and medium subangular blocky structure; friable; few fine roots; brown (10YR 4/3) wormcasts; few fine brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; very strongly acid; abrupt wavy boundary.

Bt1—13 to 18 inches; yellowish brown (10YR 5/4) silt loam; many distinct light gray (2.5Y 7/2) silt coatings on faces of peds; many fine and medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; firm; few fine roots; common distinct light brownish gray (10YR 6/2) clay films on faces of peds; few fine brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

Bt2—18 to 24 inches; yellowish brown (10YR 5/4) silt loam; many prominent light gray (2.5Y 7/2) silt coatings on faces of peds; common fine and medium prominent light gray (10YR 7/2) mottles; moderate fine and medium subangular blocky structure; firm; few fine roots; common prominent light brownish gray (10YR 6/2) clay films on faces of peds; few fine dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

Btx1—24 to 32 inches; light brownish gray (10YR 6/2) silt loam; common medium and coarse prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) mottles; moderate coarse and very coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle; few fine roots between faces of peds; common prominent light brownish gray (10YR 6/2) clay films and few faint light gray (10YR 7/2) silt coatings on faces of peds; few fine brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

Btx2—32 to 43 inches; yellowish brown (10YR 5/6) silt loam; common medium and coarse prominent light gray (10YR 6/1) and common medium prominent strong brown (7.5YR 5/8) mottles; moderate very coarse prismatic structure parting to moderate thin and medium platy; very firm and brittle; few fine roots between faces of peds; common distinct light brownish gray (10YR 6/2) clay films and few prominent light gray (5Y 7/1) silt coatings on faces of peds; few fine dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; very strongly acid; gradual wavy boundary.

Btx3—43 to 54 inches; yellowish brown (10YR 5/6) silt loam; many medium and coarse prominent light gray (5Y 6/1) mottles; moderate very coarse prismatic structure parting to moderate medium and thick platy; very firm and brittle; common distinct light brownish gray (10YR 6/2) clay films and few prominent light brownish gray (2.5Y 6/2) silt coatings on faces of peds; few fine brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; very strongly acid; gradual wavy boundary.

Btx4—54 to 61 inches; yellowish brown (10YR 5/6) silt loam; common medium prominent light brownish gray (10YR 6/2) mottles; moderate very coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle; common distinct light brownish gray (10YR 6/2) clay films and few prominent light gray (10YR 6/1) silt coatings on faces of peds; few fine and medium black (10YR 2/1) concretions and stains of iron and manganese oxide; very strongly acid; gradual wavy boundary.

Bt'—61 to 70 inches; yellowish brown (10YR 5/4) clay loam; common medium and coarse distinct light gray (10YR 7/2) mottles; moderate medium subangular blocky structure; very firm; common distinct light brownish gray (10YR 6/2) clay films and few distinct light gray (10YR 7/1) silt coatings on faces of peds; few fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; very strongly acid.

The thickness of the solum ranges from 55 to 85 inches. Depth to the fragipan ranges from 20 to 30 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. Some pedons have an E horizon. The Btx horizon has chroma of 2 to 6.

Elkinsville Series

The Elkinsville series consists of deep, well drained, moderately permeable soils on terraces along the major streams. These soils formed in alluvium. Slope ranges from 1 to 6 percent.

Elkinsville soils are similar to Gallipolis soils and are commonly adjacent to Gallipolis, Licking, Taggart, and Wheeling soils. Gallipolis and Licking soils are moderately well drained. They are in landscape positions similar to those of the Elkinsville soils. Taggart soils are somewhat poorly drained. They are on the lower terraces. Wheeling soils have more sand in the subsoil than the Elkinsville soils. They are on the higher terraces.

Typical pedon of Elkinsville silt loam, 1 to 6 percent slopes, about 0.9 mile east of Northup, in Green

Township; about 1,510 feet north and 180 feet east of the southwest corner of sec. 8, T. 5 N., R. 15 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium and coarse granular structure; friable; common fine roots; about 5 percent coarse fragments; medium acid; abrupt smooth boundary.

Bt1—10 to 14 inches; dark yellowish brown (10YR 4/6) silt loam; weak fine and medium subangular blocky structure; friable; few fine roots; few distinct dark yellowish brown (10YR 4/6) clay films and few distinct dark yellowish brown (10YR 4/4) silt coatings on faces of peds; brown (10YR 4/3) wormcasts; strongly acid; clear wavy boundary.

Bt2—14 to 21 inches; dark yellowish brown (10YR 4/6) silt loam; moderate fine and medium subangular blocky structure; firm; few fine roots; common distinct strong brown (7.5YR 4/6) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt3—21 to 32 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine and medium subangular blocky structure; firm; few fine roots; common distinct strong brown (7.5YR 4/6) and few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt4—32 to 40 inches; yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; friable; few fine roots; many distinct dark brown (10YR 4/3) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt5—40 to 46 inches; yellowish brown (10YR 5/6) loam; few fine and medium distinct brown (10YR 5/3) mottles; weak medium and coarse subangular blocky structure; friable; few fine and medium roots; few distinct strong brown (7.5YR 4/6) clay films on faces of peds; few very fine black (10YR 2/1) stains and concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

2Bt6—46 to 54 inches; yellowish brown (10YR 5/6) loam; few medium distinct pale brown (10YR 6/3) mottles; weak coarse subangular blocky structure; friable; few distinct yellowish brown (10YR 5/6) clay films on faces of peds; brown (10YR 4/3) wormcasts; few very fine black (10YR 2/1) stains and concretions of iron and manganese oxide; very strongly acid; clear wavy boundary.

2C—54 to 74 inches; strong brown (7.5YR 5/6) sandy loam; massive; very friable; very strongly acid.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments in the 2Bt and 2C horizons ranges from 0 to 5 percent.

The Ap horizon has chroma of 3 or 4. The 2Bt and 2C horizons have hue of 10YR or 7.5YR. The 2C horizon is loam or sandy loam.

Fairpoint Series

The Fairpoint series consists of deep, well drained, moderately slowly permeable soils in areas surfaced mined for coal. These soils formed in partly weathered fine-earth material that contains fragments of shale, sandstone, and siltstone. Slope ranges from 1 to 40 percent.

Fairpoint soils are similar to Bethesda soils and are commonly adjacent to Bethesda, Gilpin, Pinegrove, Rarden, and Upshur soils. Bethesda and Pinegrove soils are more acid than the Fairpoint soils. They are in landscape positions similar to those of the Fairpoint soils. Gilpin, Rarden, and Upshur soils have fewer coarse fragments in the subsoil than the Fairpoint soils. They are in areas on ridgetops and hillsides that have not been surface mined.

Typical pedon of Fairpoint channery silty clay loam, 8 to 25 percent slopes, about 2.2 miles south-southeast of Thivener, in Clay Township; about 2,050 feet north and 625 feet east of the southwest corner of sec. 33, T. 2 N., R. 14 W.

A—0 to 3 inches; 70 percent dark grayish brown (10YR 4/2) and 30 percent yellowish brown (10YR 5/4) variegated channery silty clay loam, light gray (10YR 7/2) and very pale brown (10YR 7/4) dry; weak very fine granular structure; firm; common fine roots; about 12 percent shale and 3 percent sandstone fragments and a few fragments of coal; slightly acid; clear wavy boundary.

C1—3 to 20 inches; 45 percent strong brown (7.5YR 5/6), 35 percent yellowish brown (10YR 5/4), and 20 percent light brownish gray (2.5Y 6/2) variegated very channery silty clay loam; massive; firm; few fine and medium roots; about 20 percent shale and 15 percent sandstone fragments and a few fragments of coal; slightly acid; clear wavy boundary.

C2—20 to 52 inches; 50 percent brown (10YR 5/3), 35 percent strong brown (7.5YR 5/6), and 15 percent grayish brown (2.5Y 5/2) variegated very channery silty clay loam; massive; firm; few fine roots; about 25 percent shale and 10 percent sandstone fragments and a few fragments of coal; medium acid; clear wavy boundary.

C3—52 to 80 inches; 60 percent yellowish brown (10YR 5/4), 20 percent dark yellowish brown (10YR 4/4), and 20 percent gray (10YR 5/1) variegated very channery silty clay loam; massive; firm; about 30 percent shale and 10 percent sandstone fragments and a few fragments of coal; slightly acid.

The content of coarse fragments, which are mainly shale or sandstone, ranges from 15 to 25 percent in the A horizon and from 35 to 65 percent in the C horizon. The A horizon has hue of 10YR, value of 4 or 5, and chroma 2 to 4. It typically is channery silty clay loam, but the range includes channery silt loam. The C horizon has hue of 7.5YR to 5Y, value of 3 to 6, and chroma of 1 to 6. It is the channery, very channery, or extremely channery analogs of silty clay loam, clay loam, or loam.

Gallia Series

The Gallia series consists of deep, well drained, moderately permeable soils on terrace remnants in dissected preglacial valleys. These soils formed in stratified old alluvium. Slope ranges from 8 to 15 percent.

Gallia soils are similar to Allegheny soils and are commonly adjacent to Monongahela and Omulga soils. Allegheny soils are not so red in the subsoil as the Gallia soils. Monongahela and Omulga soils have a fragipan. They are in landscape positions similar to those of the Gallia soils.

Typical pedon of Gallia loam, 8 to 15 percent slopes, eroded, about 0.6 mile west of Kerr, in Springfield Township; about 1,440 feet south and 2,120 feet east of the northwest corner of sec. 14, T. 6 N., R. 15 W.

Ap—0 to 7 inches; brown (7.5YR 4/4) loam, reddish yellow (7.5YR 7/6) dry; moderate fine and medium granular structure; friable; common fine and few medium roots; mixed areas of reddish brown (5YR 4/4) subsoil material; about 5 percent coarse fragments; medium acid; clear smooth boundary.

Bt1—7 to 15 inches; reddish brown (5YR 4/4) clay loam; moderate fine and medium subangular blocky structure; firm; common fine roots; common faint reddish brown (5YR 4/3) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—15 to 22 inches; dark reddish brown (2.5YR 3/4) clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; many faint reddish brown (2.5YR 4/4) and common distinct reddish brown (5YR 5/3) clay films on faces of peds; about 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt3—22 to 31 inches; reddish brown (2.5YR 4/4) loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; common faint reddish brown (2.5YR 4/4 and 5YR 4/4) clay films on faces of peds; about 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt4—31 to 37 inches; red (2.5YR 4/6) loam; few medium prominent brownish yellow (10YR 6/6) mottles; weak medium and coarse angular blocky structure; firm; common distinct reddish brown (5YR 5/4) and dark reddish brown (2.5YR 3/4) clay films on faces of peds; about 5 percent coarse fragments; very strongly acid; clear wavy boundary.

Bt5—37 to 45 inches; dark reddish brown (5YR 3/4) loam; weak medium and coarse angular blocky structure; firm; few distinct reddish brown (2.5YR 4/4) and common faint dark reddish brown (5YR 5/3) clay films on faces of peds; about 5 percent coarse fragments; very strongly acid; clear wavy boundary.

Bt6—45 to 56 inches; reddish brown (5YR 4/4) loam; weak coarse angular blocky structure; friable; common distinct reddish brown (5YR 5/3) clay films on faces of peds; about 5 percent coarse fragments; very strongly acid; clear wavy boundary.

BC—56 to 68 inches; reddish brown (5YR 4/4) sandy loam; weak medium and coarse subangular blocky structure; friable; few faint reddish brown (5YR 5/4) clay films bridging sand grains; about 10 percent black (10YR 2/1), hard segregations of iron and manganese oxide on horizontal faces of peds; very strongly acid; clear wavy boundary.

C—68 to 80 inches; strong brown (7.5YR 5/6), stratified gravelly loamy sand and sandy loam; single grain; loose; black (10YR 2/1) stains of iron and manganese oxide on pebbles; about 20 percent coarse fragments; very strongly acid.

The thickness of the solum ranges from 60 to 90 inches. The content of coarse fragments, which consist of gravel, commonly ranges from 0 to 10 percent in the Ap horizon, from 0 to 15 percent in the Bt horizon, and from 0 to 25 percent in the C horizon.

The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It typically is loam, but the range includes silt loam. Some pedons have a BE horizon. The Bt horizon has hue of 2.5YR to 7.5YR, value of 3 to 5, and chroma of 4 to 6. It is mainly loam, clay loam, or sandy clay loam. In some pedons, the upper part of the Bt horizon is silt loam or the lower part has thin subhorizons of silty clay loam. The BC horizon has value of 4 or 5 and chroma of 4 to 6. The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is stratified loamy sand, sandy loam, or the gravelly analogs of those textures.

Gallipolis Series

The Gallipolis series consists of deep, moderately well drained, moderately slowly permeable soils on terraces along the major streams. These soils formed in old alluvium and, in places, in the underlying lacustrine sediment. Slope ranges from 1 to 15 percent.

Gallipolis soils are similar to Elkinsville soils and are commonly adjacent to Elkinsville, Licking, Peoga, Taggart, and Wheeling soils. Elkinsville and Wheeling soils are well drained. Licking soils contain more clay in the subsoil than the Gallipolis soils. Elkinsville, Licking, and Wheeling soils are on terraces, in landscape positions similar to those of the Gallipolis soils. Peoga soils are poorly drained. Taggart soils are somewhat poorly drained. Peoga and Taggart soils are in the lower areas on terraces.

Typical pedon of Gallipolis silt loam, 1 to 6 percent slopes, about 2.8 miles northeast of Gallipolis, in Gallipolis Township; about 2,425 feet south and 2,520 feet west of the northeast corner of sec. 18, T. 3 N., R. 14 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate medium and coarse granular structure; friable; common fine roots; few fine and medium dark brown (7.5YR 3/2) stains and concretions of iron and manganese oxide; specks of yellowish brown (10YR 5/4) subsoil material; slightly acid; abrupt smooth boundary.

Bt1—10 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine and medium subangular blocky structure; firm; few fine roots; few faint brown (7.5YR 4/4) clay films, few distinct light yellowish brown (10YR 6/4) silt coatings, and common distinct brown (10YR 4/3) organic coatings on faces of peds; few fine very dark grayish brown (10YR 3/2) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Bt2—16 to 21 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct brown (7.5YR 4/4) clay films and few distinct pale brown (10YR 6/3) silt coatings on faces of peds; few fine and medium very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

Bt3—21 to 30 inches; brown (7.5YR 5/4) silty clay loam; common fine and medium prominent grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct brown (7.5YR 4/4) clay films and common prominent light brownish gray (10YR 6/2) silt coatings on faces of peds; few fine and medium very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; very strongly acid; gradual wavy boundary.

Bt4—30 to 42 inches; brown (7.5YR 5/4) silty clay loam; common medium and coarse prominent light brownish gray (10YR 6/2) mottles; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few fine roots; common distinct brown (7.5YR 4/4) clay films on faces of peds; few distinct pale brown (10YR 6/3) silt coatings on faces of prisms; few fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

Bt5—42 to 52 inches; brown (7.5YR 4/4) silty clay loam; common fine and medium prominent grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few distinct brown (10YR 5/3) clay films on faces of peds; few fine and medium black (10YR 2/1) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

BC—52 to 60 inches; brown (7.5YR 4/4) silt loam; few medium and coarse prominent light brownish gray (10YR 6/2) mottles; weak coarse and very coarse subangular blocky structure; firm; few fine very dark grayish brown (10YR 3/2) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

C—60 to 74 inches; brown (7.5YR 4/4) silty clay loam; common medium prominent grayish brown (10YR 5/2) mottles; massive; firm; few fine dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; very strongly acid.

The thickness of the solum ranges from 48 to 80 inches. The soils generally do not contain coarse fragments; however, in places the Ap, A, and E horizons contain as much as 2 percent coarse fragments and the Bt and C horizons contain as much as 5 percent coarse fragments. The coarse fragments generally are waterworn and are derived from fine grained sandstone or quartzite.

The Ap horizon has value of 3 to 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 3 to 6. It generally is silt loam, but the range in the lower part includes loam that has a high percentage of very fine sand. In some pedons a thin, slightly brittle layer is in the lower part of the Bt horizon. The BC and C horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. They are dominantly silt loam or silty clay loam, but the C horizon in some pedons has lenses of loam or fine sandy loam.

Gilpin Series

The Gilpin series consists of moderately deep, well drained, moderately permeable soils on hillsides and ridgetops in the uplands. These soils formed in material weathered from interbedded shale, siltstone, and sandstone. Slope ranges from 8 to 50 percent.

Gilpin soils are similar to Clymer and Lily soils and are commonly adjacent to Guernsey, Rarden, Steinsburg, Upshur, and Vandalia soils. Clymer, Lily, and Steinsburg soils have a higher content of sand in the subsoil than the Gilpin soils. Steinsburg soils are on hillsides. Guernsey and Rarden soils are moderately well drained. They are on ridgetops and side slopes. Upshur and Vandalia soils are deep over bedrock. Upshur soils are on ridgetops and side slopes. Vandalia soils are on foot slopes and benches.

Typical pedon of Gilpin silt loam, in an area of Gilpin-Rarden association, steep, about 0.5 mile southeast of Rio Grande, in Raccoon Township; about 2,500 feet south and 360 feet west of the northeast corner of sec. 27, T. 6 N., R. 16 W.

Oi—1 inch to 0; leaves and twigs.

A—0 to 4 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; common fine and medium and few coarse roots; specks of very dark grayish brown (10YR 3/2) material; about 5 percent coarse fragments; strongly acid; clear wavy boundary.

BE—4 to 8 inches; yellowish brown (10YR 5/4) silt loam; weak fine and medium subangular blocky structure; firm; few medium and coarse roots; common distinct brown (10YR 5/3) silt coatings on faces of peds; few distinct brown (10YR 4/3) organic coatings in root channels; about 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt1—8 to 14 inches; yellowish brown (10YR 5/4) silt loam; moderate medium subangular blocky structure; firm; few fine and medium roots; common distinct yellowish brown (10YR 5/6) clay films on faces of peds; few distinct brown (10YR 4/3) organic coatings in root channels; about 10 percent coarse fragments; strongly acid; clear wavy boundary.

Bt2—14 to 22 inches; yellowish brown (10YR 5/6) channery silty clay loam; moderate medium and coarse subangular blocky structure; firm; few fine and medium roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; about 20 percent coarse fragments; strongly acid; clear wavy boundary.

Bt3—22 to 29 inches; strong brown (7.5YR 5/6) channery silty clay loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; many distinct brown (7.5YR 5/4) clay films on faces of peds; about 25 percent coarse fragments; strongly acid; clear wavy boundary.

Bt4—29 to 35 inches; yellowish brown (10YR 5/6) very channery silty clay loam; weak coarse subangular blocky structure; firm; few fine roots; few distinct strong brown (7.5YR 5/6) clay films on faces of peds; about 40 percent coarse fragments; strongly acid; abrupt wavy boundary.

R—35 to 37 inches; light olive brown (2.5Y 5/4), fractured siltstone bedrock.

The thickness of the solum ranges from 20 to 36 inches. The depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments ranges from 5 to 10 percent in the Ap or A horizon and from 5 to 40 percent in individual subhorizons of the B horizon.

The A horizon has value of 3 to 5 and chroma of 2 or 3. It typically is silt loam or loam. Some pedons have an Ap or E horizon. The Bt horizon is silt loam, silty clay loam, loam, or the channery or very channery analogs of those textures. Some pedons have a C horizon, which has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. This horizon is the channery or very channery analogs of silt loam, loam, or silty clay loam.

Guernsey Series

The Guernsey series consists of deep, moderately well drained soils on shoulder slopes, side slopes, and ridgetops in the uplands. These soils formed in local colluvium and in the underlying material weathered from interbedded shale, siltstone, and limestone bedrock. Permeability is moderately slow or slow. Slope ranges from 8 to 50 percent.

Guernsey soils are similar to Aaron soils and are commonly adjacent to Gilpin, Rarden, Upshur, and Woodsfield soils. Aaron soils have a lower content of coarse fragments in the solum than the Guernsey soils. Gilpin and Rarden soils are moderately deep over bedrock. Upshur and Woodsfield soils are redder in the subsoil than the Guernsey soils. Gilpin, Rarden, and Upshur soils are in landscape positions similar to those of the Guernsey soils. Woodsfield soils are commonly in gently sloping areas on ridgetops.

Typical pedon of Guernsey silt loam, in an area of Guernsey-Gilpin silt loams, 8 to 15 percent slopes, about 2.3 miles southeast of Centerpoint, in Perry Township; about 150 feet north and 1,450 feet west of the southeast corner of sec. 8, T. 5 N., R. 16 W.

Ap—0 to 5 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; many fine roots; about 2 percent rock fragments; medium acid; abrupt smooth boundary.

BE—5 to 10 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and medium subangular blocky structure; firm; few fine roots; many distinct very pale brown (10YR 7/3) silt coatings and few distinct dark brown (10YR 4/3) organic coatings on faces of peds; few fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; about 5 percent rock fragments; strongly acid; clear wavy boundary.

Bt1—10 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; few distinct yellowish brown (10YR 5/6) clay films and common distinct light yellowish brown (10YR 6/4) silt coatings on faces of peds; few fine dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; about 5 percent rock fragments; strongly acid; clear wavy boundary.

Bt2—16 to 22 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and common fine and medium distinct light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common prominent reddish brown (5YR 5/4) clay films and few distinct very pale brown (10YR 7/3) silt coatings on faces of peds; about 5 percent rock fragments; medium acid; clear wavy boundary.

Bt3—22 to 32 inches; yellowish brown (10YR 5/6) silty clay; common fine and medium distinct strong brown (7.5YR 5/6) and common fine and medium prominent light brownish gray (2.5Y 6/2) mottles; moderate coarse and very coarse prismatic structure parting to moderate medium angular and subangular blocky; very firm; few fine roots; common distinct brown (7.5YR 5/4) and common prominent gray (N 6/0) clay films and few prominent gray (10YR 6/1) silt coatings on faces of peds; about 10 percent coarse fragments; strongly acid; clear wavy boundary.

2BC—32 to 42 inches; yellowish brown (10YR 5/4) channery silty clay; many medium and coarse distinct yellowish brown (10YR 5/6) and common medium distinct gray (10YR 6/1) mottles; weak medium and coarse subangular blocky structure; very firm; few fine roots; few distinct brown (7.5YR 5/4) clay films on faces of peds; about 20 percent rock fragments; strongly acid; clear wavy boundary.

2C—42 to 51 inches; light olive brown (2.5Y 5/4) channery silty clay; many medium and coarse prominent gray (10YR 6/1) and common fine and medium distinct yellowish brown (10YR 5/6) mottles; massive with some weak coarse platy fragments in lower part of horizon; very firm; few fine roots; about 30 percent rock fragments; strongly acid; abrupt smooth boundary.

2Cr—51 to 53 inches; light yellowish brown (2.5Y 6/4), weathered shale bedrock.

The thickness of the solum ranges from 36 to 60 inches. The depth to bedrock is more than 50 inches. The depth to free carbonates is more than 30 inches. The content of rock fragments, which are mostly small, flat fragments of siltstone or sandstone, ranges from 2 to 10 percent in the Ap, A, and BE horizons, from 2 to 20 percent in the Bt horizon, and from 15 to 30 percent in the BC and C horizons.

The Ap horizon has value of 3 to 5 and chroma of 2 to 4. It typically is silt loam or silty clay loam. The Bt horizon has hue of 2.5Y, 10YR, or 7.5YR and value and chroma of 4 to 6. It is silty clay loam, silty clay, or the channery analogs of those textures. The 2BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. The 2BC and 2C horizons are the channery analogs of silty clay loam, silty clay, or clay.

Kanawha Series

The Kanawha series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in alluvium derived from sandstone, siltstone, and shale bedrock. Slope ranges from 1 to 8 percent.

Kanawha soils are similar to Wheeling soils and are commonly adjacent to Chagrin, Licking, and Nolin soils. Wheeling soils have less silt and clay below a depth of 40 inches than the Kanawha soils. Chagrin and Nolin soils do not have an argillic horizon. They are on alluvial flood plains. Licking soils are moderately well drained. They are on silty lacustrine terraces.

Typical pedon of Kanawha silt loam, 1 to 8 percent slopes, 0.4 mile north of Leaper, in Harrison Township; about 800 feet north and 1,500 feet east of the southwest corner of sec. 8, T. 4 N., R. 15 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; moderate medium granular structure; friable; common fine and few medium roots; few fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; about 5 percent rock fragments; medium acid; abrupt smooth boundary.

BA—10 to 15 inches; brown (7.5YR 4/4) silt loam; weak fine and medium subangular blocky structure; firm; few fine roots; common faint brown (10YR 4/3) organic coatings on faces of peds; about 5 percent rock fragments; medium acid; clear wavy boundary.

Bt1—15 to 19 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few fine roots; common faint brown

(7.5YR 4/4) clay films on faces of peds; about 10 percent rock fragments; medium acid; clear wavy boundary.

Bt2—19 to 27 inches; yellowish red (5YR 4/6) gravelly clay loam; moderate medium subangular blocky structure; firm; few fine roots; common faint reddish brown (5YR 4/4) clay films on faces of peds; about 20 percent rock fragments; medium acid; clear wavy boundary.

BC1—27 to 33 inches; yellowish red (5YR 4/6) gravelly loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct reddish brown (5YR 4/4) clay films on faces of peds; about 30 percent rock fragments; medium acid; gradual wavy boundary.

BC2—33 to 42 inches; yellowish red (5YR 4/6) very gravelly loam; weak medium and coarse subangular blocky structure; firm; few fine roots; about 40 percent rock fragments; medium acid; gradual wavy boundary.

C1—42 to 52 inches; reddish brown (5YR 4/4) very gravelly sandy loam; weak coarse subangular blocky structure; friable; few fine roots; about 50 percent rock fragments; medium acid; clear wavy boundary.

C2—52 to 60 inches; strong brown (7.5YR 5/6) extremely gravelly sandy loam; single grain; loose; about 60 percent rock fragments; medium acid.

The thickness of the solum ranges from 40 to 70 inches. The content of rock fragments, which are mainly pebbles, ranges from 0 to 10 percent in the Ap horizon, from 5 to 20 percent in the Bt horizon, and from 30 to 60 percent in the C horizon.

The Ap horizon has hue of 10YR or 7.5YR and chroma of 2 to 4. It typically is silt loam, but the range includes loam. The Bt and BC horizons have hue of 10YR to 5YR, value of 4 or 5, and chroma of 4 to 6. The Bt horizon is commonly loam, clay loam, sandy clay loam, or the gravelly analogs of those textures. The BC horizon is the gravelly or very gravelly analogs of loam or clay loam. The C horizon has hue of 10YR to 5YR. It is the gravelly or very gravelly analogs of sandy loam or loam.

Kyger Series

The Kyger series consists of deep, very poorly drained, moderately permeable or moderately rapidly permeable soils on flood plains. These soils formed in stratified sandy and loamy overwash consisting of spoil from strip mines and in buried alluvial material. Slope ranges from 0 to 2 percent.

Kyger soils are commonly adjacent to Newark and Orrville soils. Newark and Orrville soils are somewhat poorly drained. They have less sand in the upper part of the profile than the Kyger soils. They are in landscape positions similar to those of the Kyger soils.

Typical pedon of Kyger loamy sand, frequently flooded, about 2.5 miles southeast of Eno, in Morgan Township; about 1,720 feet north and 1,175 feet west of the southeast corner of sec. 1, T. 7 N., R. 15 W.

C1—0 to 9 inches; brownish yellow (10YR 6/6) loamy sand, yellow (10YR 7/6) dry; single grain; loose; few fine and medium roots; about 5 percent rock fragments; extremely acid; abrupt smooth boundary.

C2—9 to 13 inches; strong brown (7.5YR 5/8) loam; many medium and coarse prominent gray (10YR 5/1) mottles; massive; very friable; common medium roots; about 2 percent rock fragments; extremely acid; abrupt wavy boundary.

C3—13 to 18 inches; yellowish brown (10YR 5/8), stratified loamy sand, sandy loam, and silt loam; few medium prominent gray (10YR 5/1) mottles; single grain or massive; loose or friable; common medium roots; about 2 percent rock fragments; very strongly acid; abrupt wavy boundary.

Cg1—18 to 28 inches; dark gray (5Y 4/1) silt loam; massive; friable; few fine and medium roots; medium acid; clear wavy boundary.

Cg2—28 to 35 inches; dark gray (5Y 4/1) silt loam; common medium prominent brownish yellow (10YR 6/6) mottles; massive; friable; few fine and medium roots; high content of black (10YR 2/1), partially decomposed plant residue; slightly acid; clear wavy boundary.

Cg3—35 to 44 inches; dark grayish brown (10YR 4/2) silt loam; few fine and medium distinct grayish brown (2.5Y 5/2) mottles; massive; friable; few fine and medium roots; high content of black (10YR 2/1), partially decomposed plant residue; neutral; clear wavy boundary.

2Ab—44 to 48 inches; dark grayish brown (10YR 4/2) loam; weak fine and medium subangular blocky structure; friable; about 5 percent coarse fragments; slightly acid; clear wavy boundary.

2C1—48 to 57 inches; dark yellowish brown (10YR 4/4) loam; weak medium and coarse subangular blocky structure; friable; about 5 percent coarse fragments; medium acid; clear wavy boundary.

2C2—57 to 80 inches; strong brown (7.5YR 4/6) sandy loam; massive; very friable; about 10 percent rock fragments; medium acid.

The layer of recently deposited sediments ranges from 40 to 72 inches in thickness. The content of rock fragments ranges from 0 to 15 percent in the upper 10 inches of the C horizon, from 0 to 35 percent in the lower part of the C horizon, from 0 to 15 percent in the Cg and 2Ab horizons, and from 0 to 35 percent in the 2C horizon. The content of clay in the control section is less than 18 percent.

The C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 8. It is silt loam, loam, sandy loam, loamy sand, or the gravelly analogs of those textures. The Cg horizon has hue of 5Y to 10YR or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It is sandy loam, loam, or silt loam. The 2Ab horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It is loam or silt loam. Some pedons have a 2Cg horizon, which has chroma of 1 or 2. The 2C horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 to 6. It typically ranges from silt loam to loamy sand. In some pedons it has thin subhorizons of silty clay loam, clay loam, or the gravelly analogs of those textures.

Licking Series

The Licking series consists of deep, moderately well drained, slowly permeable soils on terraces along the major streams. These soils formed in a mantle of silt and in the underlying fine textured lacustrine sediments. Slope ranges from 1 to 25 percent.

Licking soils are commonly adjacent to Elkinsville, Gallipolis, McGary, Peoga, and Taggart soils. Elkinsville and Gallipolis soils have less clay in the subsoil than the Licking soils. They are on terraces, in landscape positions similar to those of the Licking soils. McGary and Taggart soils are somewhat poorly drained. They are in the lower areas on terraces. Peoga soils are poorly drained. They are on the lower terraces.

Typical pedon of Licking silt loam, 6 to 15 percent slopes, eroded, about 1.6 miles southwest of Northup, in Green Township; about 1,620 feet north and 300 feet east of the southwest corner of sec. 19, T. 5 N., R. 15 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; weak fine and medium granular structure; friable; many fine and common coarse roots; brown (10YR 4/3) wormcasts; specks of yellowish brown (10YR 5/6) subsoil material; about 2 percent rock fragments; slightly acid; abrupt smooth boundary.

BE—7 to 14 inches; yellowish brown (10YR 5/6) silty clay loam; weak medium subangular blocky structure; friable; common fine roots; common distinct brown (10YR 4/3) silt coatings on faces of peds; strongly acid; clear wavy boundary.

Bt1—14 to 21 inches; yellowish brown (10YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; common fine roots; few distinct yellowish brown (10YR 5/4) clay films and common distinct yellowish brown (10YR 5/6) silt coatings on faces of peds; strongly acid; clear wavy boundary.

2Bt2—21 to 28 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common prominent light brownish gray (10YR 6/2) and few distinct yellowish brown (10YR 5/4) clay films on faces of peds; common distinct yellowish brown (10YR 5/6) silt coatings on faces of peds; strongly acid; clear wavy boundary.

2Bt3—28 to 41 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; very firm; few fine roots; many distinct grayish brown (10YR 5/2) and common prominent light gray (10YR 6/1) clay films on faces of peds; common fine black (10YR 2/1) concretions and stains of iron and manganese oxide; slightly acid; clear smooth boundary.

2BC—41 to 60 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct gray (10YR 5/1) and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; very firm; few fine roots; few distinct grayish brown (10YR 5/2) clay films and common prominent light gray (10YR 7/1) silt coatings on faces of peds; few fine black (10YR 2/1) concretions and stains of iron and manganese oxide; neutral; clear wavy boundary.

2C—60 to 72 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; many fine black (10YR 2/1) concretions and stains of iron and manganese oxide; common lenses of silt loam and silty clay loam; common accumulations of secondary lime; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 36 to 70 inches. The thickness of the silty mantle ranges from 12 to 22 inches. The content of rock fragments is 0 to 2 percent in the solum.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. The Bt and 2Bt horizons have chroma of 4 to 6. The Bt horizon is silt loam or silty clay loam. The 2Bt horizon typically is silty clay or clay. It has thin strata of silty clay loam in some pedons. The 2C horizon has hue of 10YR or 2.5Y. It is silty clay or clay and has thin strata of silty clay loam or silt loam in some pedons.

Lily Series

The Lily series consists of moderately deep, well drained, moderately rapidly permeable soils on side slopes and ridgetops in the uplands. These soils formed in material weathered from sandstone. Slope ranges from 8 to 25 percent.

Lily soils are similar to Clymer and Gilpin soils and are commonly adjacent to Rarden, Steinsburg, and Upshur soils. Clymer soils are deep over bedrock. Gilpin soils contain less sand in the solum than the Lily soils. Rarden and Upshur soils have more clay and less sand in the solum than the Lily soils. They are on ridgetops and hillsides. Steinsburg soils have less clay in the solum than the Lily soils. They are on shoulder slopes.

Typical pedon of Lily silt loam, 8 to 15 percent slopes, about 1.4 miles southeast of Thurman, in Raccoon Township; about 775 feet north and 1,850 feet east of the southwest corner of sec. 20, T. 6 N., R. 16 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, light gray (10YR 7/2) dry; moderate fine and medium granular structure; friable; common fine roots; strongly acid; abrupt smooth boundary.

Bt1—6 to 10 inches; brown (7.5YR 5/4) loam; weak fine and medium subangular blocky structure; firm; few fine roots; common distinct brown (7.5YR 5/4) clay films and few distinct brown (10YR 4/3) organic coatings on faces of peds; about 5 percent sandstone fragments; very strongly acid; clear wavy boundary.

Bt2—10 to 20 inches; strong brown (7.5YR 5/6) loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; about 10 percent sandstone fragments; very strongly acid; clear wavy boundary.

Bt3—20 to 26 inches; strong brown (7.5YR 5/6) fine sandy loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; about 10 percent soft sandstone fragments; very strongly acid; clear wavy boundary.

BC—26 to 32 inches; strong brown (7.5YR 5/6) channery fine sandy loam; weak medium and coarse subangular blocky structure; firm; few fine roots; few distinct brown (7.5YR 5/4) clay films on faces of peds; about 20 percent soft sandstone fragments; very strongly acid; abrupt wavy boundary.

Cr—32 to 50 inches; yellowish brown (10YR 5/4), soft sandstone bedrock; few distinct brown (7.5YR 5/4) clay films on faces of rock fragments.

R—50 to 52 inches; hard sandstone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of coarse fragments, which are mostly sandstone, ranges from 0 to 15 percent in the Ap and Bt horizons and from 10 to 35 percent in the BC and C horizons.

The Ap horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is loam, silt loam, or sandy loam. Some pedons have an E horizon. The Bt horizon has hue of 7.5YR or 10YR and chroma of 4 to 8. The upper part of the Bt horizon is loam, clay loam, or sandy clay loam. The lower part is fine sandy loam or loam. The BC and C horizons have hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. They are fine sandy loam, sandy loam, channery fine sandy loam, channery sandy loam, or channery loamy sand.

The Lily soil in Lily-Rarden complex, 15 to 25 percent slopes, has slightly less clay than is typical for the series. This difference, however, does not affect the use and management of the soil.

Lindside Series

The Lindside series consists of deep, moderately well drained, moderately permeable or moderately slowly permeable soils on flood plains. These soils formed in silty alluvium. Slope ranges from 0 to 3 percent.

Lindside soils are similar to Cuba and Nolin soils and are commonly adjacent to Chagrin, Newark, Nolin, and Orrville soils. Chagrin, Cuba, and Nolin soils are well drained. Chagrin and Nolin soils are in the slightly higher areas on flood plains. Newark and Orrville soils are somewhat poorly drained. They are in the slightly lower areas on flood plains.

Typical pedon of Lindside silt loam, occasionally flooded, about 0.1 mile southeast of Sand Fork, in Walnut Township; about 400 feet north and 550 feet east of the southwest corner of sec. 23, T. 4 N., R. 16 W.

Ap—0 to 8 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak fine and medium granular structure; friable; many fine roots; about 1 percent rock fragments; medium acid; abrupt smooth boundary.

BE—8 to 16 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine and medium subangular blocky structure; firm; few fine roots; common distinct brown (10YR 5/3) silt coatings on faces of peds; medium acid; clear wavy boundary.

Bw1—16 to 20 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few fine and medium brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

Bw2—20 to 30 inches; brown (7.5YR 4/4) silty clay loam; common fine and medium prominent light brownish gray (10YR 6/2) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; few medium and coarse dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

C1—30 to 42 inches; brown (7.5YR 5/4) silty clay loam; common fine and medium prominent grayish brown (2.5Y 5/2) mottles; massive; firm; few fine roots; common medium and coarse dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; about 5 percent rock fragments; medium acid; clear wavy boundary.

C2—42 to 54 inches; yellowish brown (10YR 5/4) silt loam; many fine and medium distinct light gray (10YR 7/2) and common fine and medium distinct strong brown (7.5YR 5/6) mottles; massive; firm; few fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

C3—54 to 62 inches; dark yellowish brown (10YR 4/4) loam; common medium and coarse distinct light brownish gray (10YR 6/2) and common medium distinct strong brown (7.5YR 5/6) mottles; massive; firm; common medium and coarse dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; about 5 percent rock fragments; medium acid; clear wavy boundary.

C4—62 to 70 inches; brown (7.5YR 5/4) silty clay loam; many fine and medium prominent light gray (10YR 6/1) and common fine and medium distinct strong brown (7.5YR 5/6) mottles; massive; firm; common medium and coarse dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; slightly acid; gradual wavy boundary.

C5—70 to 80 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct grayish brown (10YR 5/2) and many fine and medium distinct strong brown (7.5YR 5/6) mottles; massive; firm; few medium and coarse dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; slightly acid.

The thickness of the solum ranges from 25 to 40 inches. The content of coarse fragments ranges from 0 to 5 percent in the Ap and C horizons.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam. The C horizon has hue of 10YR or 7.5YR. It typically is silt loam, silty clay loam, or loam. In some pedons it has thin subhorizons of fine sandy loam.

McGary Series

The McGary series consists of deep, somewhat poorly drained, slowly permeable or very slowly permeable soils on terraces along the major streams. These soils formed in lacustrine deposits. Slope ranges from 1 to 6 percent.

McGary soils are commonly adjacent to Allegheny, Gallipolis, Licking, and Taggart soils. Allegheny soils are well drained. Gallipolis and Licking soils are moderately well drained. Taggart soils have less clay in the solum than the McGary soils. They are on terraces, in landscape positions similar to those of the McGary soils. Allegheny, Gallipolis, and Licking soils are in the slightly higher areas on terraces.

Typical pedon of McGary silt loam, 1 to 6 percent slopes, about 0.6 mile southeast of Rio Grande, in Raccoon Township; about 2,400 feet south and 1,760 feet east of the northwest corner of sec. 26, T. 6 N., R. 16 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; moderate fine and medium granular structure; friable; many fine and few medium roots; common faint brown (10YR 4/3) silt coatings on faces of peds; many fine dark yellowish brown (10YR 3/4) concretions and stains of iron and manganese oxide; neutral; clear wavy boundary.

BE—6 to 9 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct light brownish gray (10YR 6/2) and few medium distinct strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; common fine and few medium roots; many faint yellowish brown (10YR 5/4) and common distinct gray (10YR 6/1) silt coatings on faces of peds; few fine black (10YR 2/1) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

Bt—9 to 16 inches; yellowish brown (10YR 5/4) silty clay; many fine distinct light brownish gray (10YR 6/2) and few fine distinct strong brown (7.5YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; common fine roots; many distinct light brownish gray (10YR 6/2) and common faint yellowish brown (10YR 5/4) clay films on faces of peds; common fine brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

Btg1—16 to 22 inches; gray (10YR 6/1) silty clay;

common medium and coarse prominent strong brown (7.5YR 5/8) mottles; weak medium and coarse subangular blocky structure; very firm; common fine roots; common faint gray (10YR 6/1) clay films on faces of peds; common fine black (10YR 2/1) concretions and stains of iron and manganese oxide; neutral; clear smooth boundary.

Btg2—22 to 29 inches; gray (10YR 6/1) silty clay; moderate coarse prismatic structure parting to moderate medium subangular blocky; very firm; few fine roots; common distinct yellowish brown (10YR 5/4) clay films and common medium strong brown (7.5YR 5/8) stains of iron and manganese oxide on faces of peds; neutral; clear smooth boundary.

BC—29 to 40 inches; brown (10YR 5/3) silty clay loam; few fine and medium distinct gray (10YR 6/1) and common medium distinct strong brown (7.5YR 5/8) mottles; moderate coarse prismatic structure; firm; few fine roots; common distinct gray (10YR 6/1) clay films on faces of peds; common fine and medium very dark grayish brown (10YR 3/2) concretions and stains of iron and manganese oxide; about 5 percent nodules and concretions of secondary lime; strong effervescence; mildly alkaline; clear wavy boundary.

C—40 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; few fine and medium distinct gray (10YR 6/1) mottles; massive with widely spaced vertical partings; firm; few coarse strong brown (7.5YR 5/8) and many fine very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; about 5 percent accumulations of secondary lime on vertical partings; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 32 to 40 inches. The depth to carbonates ranges from 29 to 40 inches.

The Ap horizon has chroma of 2 or 3. The Bt horizon has chroma of 4 to 6. It is silty clay loam or silty clay. The Btg horizon has hue of 10YR or 2.5Y and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y and chroma of 3 or 4. It is silty clay loam or silty clay.

Monongahela Series

The Monongahela series consists of deep, moderately well drained soils on terrace remnants in dissected parts of preglacial valleys. These soils formed in old loamy alluvium derived largely from acid sandstone, shale, and siltstone bedrock. They have a fragipan. Permeability is moderate above the fragipan and slow in the fragipan. Slope ranges from 8 to 15 percent.

Monongahela soils are similar to Omulga soils and are commonly adjacent to Allegheny, Doles, Gallia, and Omulga soils. Omulga soils have less sand in the solum than the Monongahela soils. They are in landscape positions similar to those of the Monongahela soils and in gently sloping areas of preglacial valleys. Allegheny and Gallia soils are well drained. They are in dissected preglacial valleys, in landscape positions similar to those of the Monongahela soils. Doles soils are somewhat poorly drained. They are on flats in abandoned preglacial valley terraces.

Typical pedon of Monongahela loam, 8 to 15 percent slopes, about 1.9 miles southwest of Vinton, in Huntington Township; about 1,525 feet north and 1,710 feet west of the southeast corner of sec. 27, T. 7 N., R. 16 W.

Ap—0 to 8 inches; brown (10YR 4/3) loam, light yellowish brown (10YR 6/4) dry; weak medium and coarse granular structure; friable; many fine roots; 20 percent yellowish brown (10YR 5/6) subsoil material; about 5 percent rock fragments; medium acid; abrupt wavy boundary.

Bt1—8 to 13 inches; yellowish brown (10YR 5/6) loam; weak fine and medium subangular blocky structure; firm; common fine roots; few distinct yellowish brown (10YR 5/4) clay films on faces of peds; many fine black (10YR 2/1) concretions of iron and manganese oxide; brown (10YR 4/3) wormcasts; about 5 percent rock fragments; strongly acid; clear wavy boundary.

Bt2—13 to 19 inches; yellowish brown (10YR 5/6) loam; common medium distinct pale brown (10YR 6/3) and few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm and some brittleness; few fine roots; common faint yellowish brown (10YR 5/4) clay films and few distinct pale brown (10YR 6/3) silt coatings on faces of peds; common medium black (10YR 2/1) concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

Btx1—19 to 27 inches; yellowish brown (10YR 5/4) loam; common medium distinct light gray (10YR 7/2) and strong brown (7.5YR 5/8) mottles; weak very coarse prismatic structure parting to weak medium and coarse subangular blocky; very firm and brittle; common faint yellowish brown (10YR 5/4) and few distinct brown (7.5YR 5/4) clay films and common distinct yellowish brown (10YR 5/6) silt coatings on faces of peds; many fine and medium black (10YR 2/1) concretions of iron and manganese oxide; very strongly acid; clear wavy boundary.

Btx2—27 to 46 inches; yellowish brown (10YR 5/4) loam; common medium prominent light gray (10YR

7/2) and strong brown (7.5YR 5/8) mottles; weak very coarse prismatic structure parting to weak medium subangular blocky; very firm and brittle; common distinct gray (10YR 6/2) clay films on faces of peds; common fine and medium black (10YR 2/1) concretions and stains of iron and manganese oxide; very strongly acid; clear smooth boundary.

Btx3—46 to 55 inches; yellowish brown (10YR 5/4) loam; many medium distinct light gray (10YR 7/2) and few medium prominent strong brown (7.5YR 5/8) mottles; weak very coarse prismatic structure parting to weak medium and coarse subangular blocky; firm and brittle; common distinct light brownish gray (10YR 6/2) clay films on faces of peds; very strongly acid; clear wavy boundary.

Cg1—55 to 64 inches; light gray (10YR 7/2) sandy clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; very strongly acid; clear wavy boundary.

Cg2—64 to 68 inches; light gray (10YR 7/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/4) and few medium prominent strong brown (7.5YR 5/8) mottles; massive; firm; very strongly acid; abrupt smooth boundary.

C—68 to 72 inches; strong brown (7.5YR 5/8) clay loam; few medium prominent pale brown (10YR 6/3) mottles; massive; firm; very strongly acid.

The thickness of the solum ranges from 40 to 72 inches. Depth to the fragipan ranges from 18 to 30 inches. The content of rock fragments ranges from 0 to 5 percent in the Ap and Bt horizons, from 0 to 10 percent in the Btx horizon, and from 0 to 20 percent in C horizon.

The Ap horizon has value of 4 or 5. It typically is loam, but the range includes silt loam. Some pedons have a BE horizon. The Bt horizon has hue of 10YR or 7.5YR and chroma of 4 to 6. It is loam or silt loam. The Btx horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 6. It is loam or clay loam. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 2 to 8. It is silt loam, silty clay loam, clay loam, sandy loam, sandy clay loam, or the gravelly analogs of those textures.

Newark Series

The Newark series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Newark soils are similar to Orrville and Stendal soils and are commonly adjacent to Kyger, Lindside, and Nolin soils. Orrville soils have more sand in the solum than the Newark soils. Stendal soils are more acid in the substratum than the Newark soils. Kyger soils are very poorly drained. They are on low flood plains. They formed in overwash consisting of spoil from strip mines. Lindside soils are moderately well drained. Nolin soils are well drained. Lindside and Nolin soils are in the slightly higher areas on flood plains.

Typical pedon of Newark silt loam, frequently flooded, about 2.7 miles south-southwest of Mercerville, in Guyan Township; about 350 feet south and 1,240 feet east of the northwest corner of sec. 15, T. 3 N., R. 15 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; many fine roots; few fine dark brown (7.5YR 4/4) concretions of iron and manganese oxide; about 5 percent rock fragments; slightly acid; abrupt smooth boundary.

Bwg—10 to 16 inches; grayish brown (10YR 5/2) silt loam; common fine and medium distinct brown (10YR 4/3) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct pale brown (10YR 6/3) silt coatings on faces of peds; few fine dark brown (7.5YR 3/2 and 4/4) concretions and stains of iron and manganese oxide; slightly acid; clear wavy boundary.

Bw—16 to 24 inches; dark yellowish brown (10YR 4/4) silt loam; common medium distinct dark grayish brown (10YR 4/2) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; few fine strong brown (7.5YR 5/6) and few fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

Cg1—24 to 32 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; few fine roots; few fine very dark brown (10YR 2/2) and brown (7.5YR 5/4) concretions of iron and manganese oxide; medium acid; gradual wavy boundary.

Cg2—32 to 52 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium prominent brown (7.5YR 4/4) mottles; massive; firm; few fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

Cg3—52 to 62 inches; dark grayish brown (10YR 4/2) loam; many medium and coarse distinct dark yellowish brown (10YR 4/4) and few fine faint gray (10YR 5/1) mottles; massive; firm; few fine and medium very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; about 5 percent rock fragments; medium acid.

The thickness of the solum ranges from 22 to 40 inches. The content of rock fragments, which are mainly pebbles, ranges from 0 to 5 percent throughout the profile.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It typically is silt loam, but the range includes silty clay loam. The B horizon has chroma of 2 to 4. It typically is silt loam, but the range includes silty clay loam. The Cg horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It typically is silt loam, loam, or silty clay loam. In some pedons the lower part of the Cg horizon has thin subhorizons of silty clay.

Nolin Series

The Nolin series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slope ranges from 0 to 3 percent.

Nolin soils are similar to Cuba and Lindside soils and are commonly adjacent to Chagrin, Kanawha, and Lindside soils. Cuba soils are more acid in the subsoil than the Nolin soils. Lindside soils are moderately well drained. They are in the slightly lower areas on flood plains. Chagrin soils have more sand in the solum than the Nolin soils. They are in landscape positions similar to those of the Nolin soils. Kanawha soils have more sand and gravel in the solum than the Nolin soils. They are on terraces.

Typical pedon of Nolin silt loam, occasionally flooded, about 3.9 miles east of Crown City, in Ohio Township; about 150 feet south and 1,550 feet west of the northeast corner of sec. 25, T. 1 N., R. 14 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and coarse granular structure; friable; many fine and few coarse roots; about 5 percent rock fragments; slightly acid; abrupt smooth boundary.

AB—10 to 17 inches; brown (10YR 4/3) silt loam; weak fine and medium subangular blocky structure; friable; common fine roots; common faint dark brown (10YR 3/3) wormcasts; about 5 percent rock fragments; slightly acid; clear wavy boundary.

BA—17 to 27 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; few fine roots; common faint dark brown (10YR 3/3) wormcasts; few faint brown (10YR 4/3) organic coatings on faces of peds; medium acid; clear wavy boundary.

Bw—27 to 50 inches; brown (7.5YR 4/4) silty clay loam; moderate medium and coarse subangular blocky structure parting to weak coarse subangular blocky; firm; few fine roots; many faint brown (10YR 4/3) silt coatings on faces of peds; few distinct black (10YR 2/1) organic stains; medium acid; gradual wavy boundary.

C—50 to 82 inches; brown (7.5YR 4/4), stratified silty clay loam and silt loam; massive; firm; about 5 percent rock fragments; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The content of rock fragments ranges from 0 to 5 percent in the solum.

The Ap horizon has chroma of 2 or 3. It typically is silt loam, but the range includes silty clay loam. The Bw horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It is silt loam or silty clay loam. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam, silty clay loam, or loam.

Omulga Series

The Omulga series consists of deep, moderately well drained soils in broad areas of abandoned preglacial valleys and on dissected valley fill remnants in the valleys. These soils formed in loess, silty colluvium, or old alluvium and, in most areas, in the underlying lacustrine sediments. They have a fragipan. Permeability is moderate above the fragipan and slow in the fragipan. Slope ranges from 1 to 15 percent.

Omulga soils are similar to Monongahela soils and are commonly adjacent to Allegheny, Doles, Gallia, and Monongahela soils. Monongahela, Allegheny, and Gallia soils have more sand in the solum than the Omulga soils. They are on dissected remnants of abandoned preglacial valleys. Doles soils are somewhat poorly drained. They are on flats in abandoned preglacial valleys.

Typical pedon of Omulga silt loam, 1 to 6 percent slopes, about 1.4 miles northwest of Rio Grande, in Raccoon Township; about 2,550 feet north and 2,400 feet east of the southwest corner of sec. 21, T. 6 N., R. 16 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; weak fine and medium granular structure; friable; many fine roots; few fine dark brown (7.5YR 3/2) stains and concretions of iron and manganese oxide; medium acid; abrupt smooth boundary.

BE—8 to 11 inches; yellowish brown (10YR 5/6) silt loam; weak fine and medium subangular blocky structure; firm; few fine roots; few distinct light yellowish brown (10YR 6/4) silt coatings and few distinct dark yellowish brown (10YR 4/4) organic coatings on faces of peds; strongly acid; clear wavy boundary.

Bt1—11 to 21 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct yellowish brown (10YR 5/4) clay films and few distinct pale brown (10YR 6/3) silt coatings on faces of peds; strongly acid; clear wavy boundary.

Bt2—21 to 26 inches; yellowish brown (10YR 5/6) silt loam; common fine prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) clay films and few distinct pale brown (10YR 6/3) silt coatings on faces of peds; few fine dark brown (7.5YR 4/4) stains and concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

2Btx1—26 to 34 inches; yellowish brown (10YR 5/6) silt loam; common fine prominent grayish brown (10YR 5/2) mottles; moderate coarse and very coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle; few fine roots between faces of prisms; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; many prominent light gray (10YR 7/2) silt coatings on faces of prisms; yellowish brown (10YR 5/8) rind between the coating and the interior of the prisms; few fine and medium dark brown (7.5YR 4/4) stains and concretions of iron and manganese oxide; strongly acid; gradual wavy boundary.

2Btx2—34 to 46 inches; yellowish brown (10YR 5/6) silt loam; common fine and medium prominent light brownish gray (10YR 6/2) mottles; moderate coarse and very coarse prismatic structure parting to moderate medium and coarse subangular blocky; very firm and brittle; few fine roots between faces of prisms; common distinct brown (10YR 5/3) clay films and many prominent light gray (10YR 7/2) silt coatings on faces of prisms; yellowish brown (10YR 5/8) rind between the coating and the interior of the prisms; few fine dark brown (7.5YR 4/4) stains and concretions of iron and manganese oxide; about 5 percent coarse fragments; very strongly acid; clear wavy boundary.

2B't—46 to 59 inches; yellowish brown (10YR 5/6) clay loam; common fine prominent light brownish gray (10YR 6/2) and common medium and coarse faint strong brown (7.5YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; common distinct brown (7.5YR 5/4) clay films on faces of peds; few fine and medium dark brown (7.5YR 3/2) stains and concretions of iron and manganese oxide; about 5 percent rounded quartz fragments; strongly acid; clear wavy boundary.

2BC—59 to 70 inches; strong brown (7.5YR 5/6) silty clay loam; common medium prominent light olive gray (5Y 6/2) and common medium and coarse faint yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; few distinct brown (7.5YR 5/4) clay films on faces of peds; few fine and medium dark brown (7.5YR 3/2) stains and concretions of iron and manganese oxide; about 5 percent rounded quartz fragments; medium acid; clear wavy boundary.

3C—70 to 82 inches; strong brown (7.5YR 5/6) silty clay; common fine prominent gray (10YR 6/1) and common medium and coarse faint yellowish red (5YR 5/6) mottles; massive; very firm; neutral.

The thickness of the solum ranges from 50 to 90 inches. Depth to the fragipan ranges from 18 to 34 inches. The content of coarse fragments ranges from 0 to 5 percent in the 2Btx, 2B't, 2BC, and 3C horizons.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. Some pedons have a BA horizon. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. It is silt loam or silty clay loam. The 2Btx horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It typically is silt loam or silty clay loam. It has subhorizons of clay loam below a depth of 40 inches. The 3C horizon typically has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. In some pedons it has hue of 5YR and value of 4 or 5 below a depth of 70 inches. It is silty clay, clay, silty clay loam, or sandy loam.

Orrville Series

The Orrville series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Orrville soils are similar to Newark and Stendal soils and are commonly adjacent to Chagrin, Kyger, and Pope soils. Newark soils have less sand in the subsoil than the Orrville soils. Stendal soils have less sand in the substratum than the Orrville soils. Chagrin and Pope soils are well drained. They are in the slightly higher areas on the flood plains. Kyger soils are very poorly drained. They are in the lower areas on the flood plains. They formed in overwash consisting of spoil from strip mines.

Typical pedon of Orrville silt loam, frequently flooded, about 1.3 miles northwest of Peniel, in Greenfield Township; about 2,185 feet south and 2,625 feet east of the northwest corner of sec. 20, T. 6 N., R. 17 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light gray (2.5Y 7/2) dry; common medium distinct light brownish gray (10YR 6/2) mottles; weak fine and medium granular structure; friable; common fine roots; common fine very dark brown

(10YR 2/2) stains and concretions of iron and manganese oxide; slightly acid; abrupt smooth boundary.

Bg—10 to 23 inches; grayish brown (2.5Y 5/2) silt loam; many fine and medium distinct brown (10YR 5/3) and few fine prominent strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; few fine roots; few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; common fine and medium yellowish red (5YR 5/6) stains of iron and manganese oxide; medium acid; clear wavy boundary.

Bw—23 to 33 inches; brown (10YR 5/3) silt loam; common medium distinct light brownish gray (2.5Y 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; common medium yellowish red (5YR 5/6) stains and many fine black (10YR 2/1) concretions of iron and manganese oxide; medium acid; clear wavy boundary.

Bg'—33 to 41 inches; light brownish gray (10YR 6/2) loam; common medium distinct yellowish brown (10YR 5/4) and few fine and medium prominent strong brown (7.5YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; few very fine roots; few distinct grayish brown (10YR 5/2) silt coatings on faces of peds; common medium very dark grayish brown (10YR 3/2) stains and concretions of iron and manganese oxide; medium acid; clear wavy boundary.

BCg—41 to 49 inches; light brownish gray (2.5Y 6/2) sandy loam; many fine prominent strong brown (7.5YR 5/6) and few fine and medium distinct gray (10YR 6/1) mottles; weak coarse subangular blocky structure; friable; few medium dark brown (7.5YR 4/4) stains and concretions of iron and manganese oxide; medium acid; clear wavy boundary.

Cg1—49 to 55 inches; light brownish gray (2.5Y 6/2) sandy loam; common medium and coarse prominent strong brown (7.5YR 5/6) and few fine and medium distinct gray (10YR 6/1) mottles; massive; friable; few fine dark brown (7.5YR 4/4) stains and concretions of iron and manganese oxide; medium acid; clear wavy boundary.

Cg2—55 to 66 inches; gray (10YR 6/1) silt loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; firm; few fine black (10YR 2/1) stains of iron and manganese oxide; medium acid; abrupt smooth boundary.

Cg3—66 to 80 inches; light brownish gray (10YR 6/2) loamy sand; common medium distinct yellowish brown (10YR 5/4) and few fine and medium faint light gray (10YR 7/1) mottles; massive; loose; about 5 percent coarse fragments; slightly acid.

The thickness of the solum ranges from 28 to 50 inches. The content of rock fragments ranges from 0 to 5 percent in the Ap, Bg, and Bw horizons, from 0 to 15 percent in the BC horizon, and from 0 to 25 percent in the C and Cg horizons.

The Ap horizon typically is silt loam, but the range includes loam. The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The Bw horizon has chroma of 3 to 6. The Bg and Bw horizons typically are silt loam or loam, but in some pedons they have thin subhorizons of sandy loam, clay loam, silty clay loam, or the gravelly analogs of those textures. The C and Cg horizons have hue of 10YR or 2.5Y and value of 4 to 6. The C horizon has chroma of 3 to 6. The C and Cg horizons typically are sandy loam, silt loam, loam, or the gravelly analogs of those textures. In some pedons they have thin subhorizons of silty clay loam or clay loam. Some pedons have loamy sand or gravelly loamy sand below a depth of 40 inches.

Peoga Series

The Peoga series consists of deep, poorly drained, slowly permeable soils on low terraces along the major streams. These soils formed in silty lacustrine material. Slope ranges from 0 to 2 percent.

Peoga soils are commonly adjacent to Gallipolis and Taggart soils. Gallipolis soils are moderately well drained. Taggart soils are somewhat poorly drained. Gallipolis and Taggart soils are on the higher terraces.

Typical pedon of Peoga silt loam, about 1.9 miles northeast of Gallipolis, in Gallipolis Township; about 125 feet south and 700 feet west of the northeast corner of sec. 23, T. 3 N., R. 14 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; moderate medium and coarse granular structure; friable; common fine roots; few fine very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; medium acid; abrupt smooth boundary.

Bg—9 to 14 inches; gray (10YR 5/1) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct light gray (10YR 7/1) silt coatings on faces of peds; few fine dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; medium acid; clear wavy boundary.

Btg1—14 to 17 inches; gray (10YR 6/1) silty clay loam; few fine and medium prominent strong brown (7.5YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films and few distinct light gray (10YR 7/1) silt coatings on faces of peds; few fine and medium dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Btg2—17 to 25 inches; gray (10YR 5/1) silty clay loam; common fine and medium prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds and prisms; few fine and medium dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Btg3—25 to 35 inches; gray (10YR 6/1) silty clay loam; common medium and coarse prominent strong brown (7.5YR 5/6) mottles; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct gray (10YR 5/1) clay films on faces of peds and prisms; common fine and medium dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Btg4—35 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine and medium faint gray (10YR 6/1) and many medium and coarse prominent strong brown (7.5YR 5/6) mottles; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Bt—46 to 58 inches; light brownish gray (10YR 6/2) silty clay loam; many medium and coarse prominent strong brown (7.5YR 5/6) and common fine and medium faint gray (5Y 6/1) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common medium and coarse very dark grayish brown (10YR 3/2) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

BCt—58 to 70 inches; yellowish brown (10YR 5/4) silty clay loam; common medium and coarse distinct strong brown (7.5YR 5/6) and common fine and medium distinct gray (10YR 6/1) mottles; weak medium and coarse subangular blocky structure; firm; few very fine roots; few distinct light brownish gray (10YR 6/2) clay films on faces of peds; common fine and medium dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; strongly acid; gradual wavy boundary.

C—70 to 84 inches; yellowish brown (10YR 5/4) silty clay loam; common medium and coarse distinct strong brown (7.5YR 5/6) and common medium and coarse prominent gray (5Y 6/1) mottles; massive; firm; common fine and medium very dark grayish brown (10YR 3/2) concretions and stains of iron and manganese oxide; medium acid.

The thickness of the solum ranges from 48 to 72 inches. The Ap horizon has value of 4 or 5 and chroma of 1 or 2. The Btg horizon has value of 5 or 6. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4.

Pinegrove Series

The Pinegrove series consists of deep, excessively drained, rapidly permeable soils. These soils formed in a mixture of acid, partially weathered, sandy fine-earth material and fragments of sandstone and shale. They are in areas surface mined for coal. Slope ranges from 1 to 70 percent.

Pinegrove soils are commonly adjacent to Bethesda soils. Bethesda soils have more clay and less sand throughout the profile than the Pinegrove soils. They are in landscape positions similar to those of the Pinegrove soils where less sandstone bedrock was encountered in mining.

Typical pedon of Pinegrove sand, 25 to 70 percent slopes, about 2.7 miles southeast of Eno, in Cheshire Township; about 525 feet north and 195 feet east of the southwest corner of sec. 26, T. 5 N., R. 14 W.

A—0 to 8 inches; yellowish brown (10YR 5/4) sand, very pale brown (10YR 7/3) dry; weak coarse granular structure; very friable; few coarse and many fine and medium roots; about 2 percent shale and 6 percent sandstone fragments; extremely acid; abrupt smooth boundary.

C1—8 to 15 inches; 85 percent yellowish brown (10YR 5/6) and 15 percent very dark grayish brown (10YR 3/2) variegated loamy coarse sand; single grain; loose; few fine and coarse roots; about 12 percent sandstone fragments; extremely acid; clear wavy boundary.

C2—15 to 30 inches; yellowish brown (10YR 5/8) channery loamy coarse sand; single grain; loose; few coarse roots; many soft sandstone fragments; about 10 percent shale and hard sandstone fragments; extremely acid; clear wavy boundary.

C3—30 to 43 inches; yellowish brown (10YR 5/8) channery loamy coarse sand; single grain; loose; few coarse roots; about 15 percent hard sandstone fragments; extremely acid; clear wavy boundary.

C4—43 to 60 inches; 80 percent yellowish brown (10YR 5/6) and 20 percent brown (10YR 4/3) variegated channery loamy coarse sand; single grain; loose; few fine and coarse roots; about 12 percent shale and many soft sandstone fragments; thin strata of channery sandy loam; extremely acid.

The depth to bedrock is more than 60 inches. The content of rock fragments ranges from 0 to 25 percent in the A horizon, from 10 to 30 percent in the upper 40 inches of the C horizon, and from 10 to 60 percent in the lower part of the C horizon.

The A horizon has value of 4 or 5 and chroma of 3 to 6. It typically is sand, but the range includes sandy loam. The C horizon has hue of 7.5YR or 10YR, value of 3 to 6, and chroma of 2 to 8. It typically is loamy coarse sand or channery loamy coarse sand, but the range includes loamy sand, loamy fine sand, sand, and the channery analogs of those textures above a depth of 40 inches and the channery and very channery analogs of loamy coarse sand and sand below a depth of 40 inches.

Piopolis Series

The Piopolis series consists of deep, poorly drained or very poorly drained, slowly permeable soils on flood plains. These soils formed in silty alluvium. Slope ranges from 0 to 2 percent.

Piopolis soils are commonly adjacent to Cuba, Orrville, Pope, and Stendal soils. Cuba, Orrville, Pope, and Stendal soils are better drained than the Piopolis soils. They are in the slightly higher areas on the flood plains.

Typical pedon of Piopolis silt loam, frequently flooded, about 2.4 miles south of Centerpoint, in Greenfield Township; about 985 feet north and 1,640 feet west of the southeast corner of sec. 13, T. 6 N., R. 17 W.

Oi—2 inches to 0; brown (10YR 4/3) leaf litter.

A—0 to 5 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; few fine prominent yellowish red (5YR 4/6) mottles; weak fine and medium subangular blocky structure; friable; many fine, medium, and coarse roots; common distinct brown (10YR 4/3) silt coatings on faces of peds; common medium strong brown (7.5YR 5/6) and many fine black (10YR 2/1) stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Cg1—5 to 12 inches; light brownish gray (10YR 6/2) silt loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; firm; few coarse and common fine and medium roots; common distinct gray (10YR 6/1) silt coatings on faces of peds; many fine dark brown (7.5YR 4/4) stains and common fine very dark grayish brown (10YR 3/2) concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

Cg2—12 to 24 inches; gray (10YR 6/1) silty clay loam; many medium prominent reddish yellow (7.5YR 6/6) mottles; weak very coarse subangular blocky structure parting to moderate coarse subangular blocky; firm; common fine and medium roots; many distinct gray (10YR 6/1) and common distinct yellowish brown (10YR 5/4) silt coatings on faces of peds; many fine very dark grayish brown (10YR 3/2) stains and concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

Cg3—24 to 37 inches; light gray (10YR 7/1) silty clay loam; weak very coarse subangular blocky structure; very firm; few fine and medium roots; many distinct gray (10YR 6/1) silt coatings on faces of peds; common medium and coarse very dark grayish brown (10YR 3/2) stains and concretions and few coarse black (10YR 2/1) concretions of iron and manganese oxide; very strongly acid; clear wavy boundary.

Cg4—37 to 48 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; very firm; few fine roots; common medium and coarse very dark grayish brown (10YR 3/2) stains and concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

Cg5—48 to 60 inches; light gray (10YR 7/1) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; very firm; common medium and coarse very dark grayish brown (10YR 3/2) stains and concretions and common medium and coarse black (10YR 2/1) concretions of iron and manganese oxide; strongly acid.

The A or Ap horizon has value of 4 or 5. It typically is silt loam, but the range includes silty clay loam. The Cg horizon has hue of 10YR to 5Y.

Pope Series

The Pope series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 3 percent.

Pope soils are similar to Chagrin soils and are commonly adjacent to Chagrin, Orrville, Piopolis, and Stendal soils. Chagrin soils have more clay in the subsoil than the Pope soils. They are in landscape positions similar to those of the Pope soils. Orrville and Stendal soils are somewhat poorly drained. They are in the lower areas on flood plains. Piopolis soils are poorly drained or very poorly drained. They are in the lowest areas on flood plains.

Typical pedon of Pope silt loam, occasionally flooded, 0.2 mile southeast of Vinton, in Huntington Township; about 1,300 feet north and 1,800 feet east of the southwest corner of sec. 24, T. 7 N., R. 16 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; weak fine and medium granular structure; friable; many fine roots; strongly acid; abrupt smooth boundary.

Bw1—8 to 14 inches; yellowish brown (10YR 5/4) silt loam; weak fine and medium subangular blocky structure; friable; few fine roots; strongly acid; clear wavy boundary.

Bw2—14 to 24 inches; yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; friable; few fine roots; strongly acid; clear wavy boundary.

Bw3—24 to 32 inches; yellowish brown (10YR 5/4) silt loam; weak medium and coarse subangular blocky structure; friable; few fine roots; very strongly acid; clear wavy boundary.

Bw4—32 to 38 inches; dark yellowish brown (10YR 4/4) loam; weak coarse subangular blocky structure; friable; few fine roots; very strongly acid; clear wavy boundary.

C1—38 to 46 inches; brown (10YR 4/3) sandy loam; massive; very friable; strongly acid; clear wavy boundary.

C2—46 to 54 inches; yellowish brown (10YR 5/4) sandy loam; massive; very friable; very strongly acid; clear wavy boundary.

C3—54 to 80 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) loamy sand; single grain; loose; about 5 percent coarse fragments; strongly acid.

The thickness of the solum ranges from 30 to 50 inches. The Ap horizon has chroma of 3 or 4. It typically is silt loam or fine sandy loam, but the range includes loam and sandy loam. The B horizon has hue of 10YR or 7.5YR. It is silt loam, loam, sandy loam, or fine sandy loam. The C horizon has hue of 10YR or 7.5YR. It is loam, fine sandy loam, sandy loam, or loamy sand. The content of rock fragments ranges from 0 to 5 percent, by volume, in the C horizon.

Rarden Series

The Rarden series consists of moderately deep, moderately well drained, slowly permeable soils on ridgetops, benches, and hillsides in the uplands. These soils formed in material weathered from acid clay shale and siltstone. Slope ranges from 8 to 40 percent.

Rarden soils are commonly adjacent to Coolville, Gilpin, Guernsey, Lily, and Steinsburg soils. Coolville and Guernsey soils are deep over bedrock. Gilpin, Lily, and Steinsburg soils have more sand and less clay in the subsoil than the Rarden soils. Coolville soils are in gently sloping and concave areas on ridgetops. Gilpin and Guernsey soils are on ridgetops and side slopes, in landscape positions similar to those of the Rarden soils. Lily soils are on the knolls and rises of ridgetops. Steinsburg soils are on hillsides.

Typical pedon of Rarden silt loam, in an area of Rarden-Gilpin silt loams, 15 to 25 percent slopes, eroded, about 1.1 miles west of Vinton, in Huntington Township; about 2,600 feet north and 975 feet east of the southwest corner of sec. 23, T. 7 N., R. 16 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; many fine roots; common fine and medium very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; about 5 percent siltstone fragments; specks of strong brown (7.5YR 5/6) subsoil material; strongly acid; abrupt smooth boundary.

Bt1—7 to 11 inches; strong brown (7.5YR 5/6) silty clay loam; weak fine and medium subangular blocky structure; firm; few fine roots; few distinct brown (7.5YR 5/4) clay films on faces of peds; few distinct pale brown (10YR 6/3) silt coatings in worm channels; strongly acid; clear wavy boundary.

Bt2—11 to 15 inches; yellowish red (5YR 5/6) silty clay; few fine prominent light gray (10YR 7/2) and common fine and medium prominent pale brown (10YR 6/3) mottles; moderate medium and coarse angular and subangular blocky structure; very firm; few fine roots; common distinct reddish brown (5YR 5/4) clay films on faces of peds; about 5 percent siltstone fragments; strongly acid; clear wavy boundary.

Bt3—15 to 22 inches; red (2.5YR 4/8) silty clay; common medium and coarse prominent light gray (10YR 7/2) and common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium and coarse angular and subangular blocky structure; very firm; few fine roots; common distinct red (2.5YR 4/6) clay films on faces of peds; about 5 percent siltstone fragments; strongly acid; clear wavy boundary.

Bt4—22 to 28 inches; yellowish red (5YR 5/6) and brown (7.5YR 5/4) silty clay; many medium distinct light gray (10YR 7/2) mottles; moderate medium and coarse angular and subangular blocky structure; very firm; few fine roots; common distinct yellowish red (5YR 5/6) clay films on faces of peds; strongly acid; clear wavy boundary.

BC—28 to 33 inches; brown (7.5YR 5/4) silty clay; many medium prominent light gray (10YR 7/2) mottles; weak medium and coarse subangular blocky structure; very firm; few fine roots; few distinct brown (7.5YR 5/4) clay films and common prominent gray (5Y 6/1) silt coatings on faces of peds; about 10 percent siltstone fragments; very strongly acid; clear wavy boundary.

C—33 to 36 inches; yellowish red (5YR 5/6) channery silty clay; common medium and coarse prominent light gray (10YR 6/1) and common medium faint strong brown (7.5YR 5/6) mottles; massive; very firm; few fine roots; about 30 percent siltstone fragments; very strongly acid; abrupt smooth boundary.

Cr—36 to 38 inches; pale brown (10YR 6/3) siltstone bedrock.

The thickness of the solum and the depth to paralithic contact range from 20 to 40 inches. The content of rock fragments is commonly less than 15 percent throughout the solum, but it increases to 30 percent directly above the paralithic contact in some pedons.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. Some pedons have an A horizon, which has value of 3 or 4 and chroma of 2 or 3. Some pedons have an E horizon. The Bt horizon typically has hue of 5YR or 2.5YR, but in many pedons it has thin subhorizons that have hue of 7.5YR or 10YR. The Bt horizon typically has value of 4 to 7 and chroma of 4 to 8. The subhorizons in the lower part of the Bt horizon have variegations and mottles with chroma of 2 or less. The Bt horizon typically is silty clay or clay. It has thin subhorizons of channery clay loam in the upper part. The C horizon has hue of 7.5YR to 2.5YR, value of 5 or 6, and chroma of 4 to 6. It is silty clay loam, silty clay, clay, or the shaly analogs of those textures. The bedrock is partially weathered clay shale or siltstone.

Steinsburg Series

The Steinsburg series consists of moderately deep, well drained, moderately rapidly permeable soils on hillsides in the uplands. These soils formed in residuum weathered from sandstone bedrock. Slope ranges from 25 to 70 percent.

Steinsburg soils are commonly adjacent to Berks, Clymer, Gilpin, Rarden, and Upshur soils. Berks soils have a higher content of coarse fragments in the subsoil than the Steinsburg soils. They are in landscape positions similar to those of the Steinsburg soils and in very steep areas. Clymer, Gilpin, Rarden, and Upshur soils have more clay in the subsoil than the Steinsburg soils. They are on ridgetops and steep side slopes.

Typical pedon of Steinsburg sandy loam, in an area of Gilpin-Steinsburg-Upshur association, steep, about 1.1 miles northwest of Sand Fork, in Walnut Township; 1,550 feet south and 1,100 feet east of the northwest corner of sec. 22, T. 4 N., R. 16 W.

Oi—1 inch to 0; very dark brown (10YR 2/2), partly decomposed leaf litter.

A—0 to 4 inches; brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; common fine and medium roots; 5 percent sandstone fragments; extremely acid; clear wavy boundary.

BA—4 to 9 inches; yellowish brown (10YR 5/6) sandy loam; weak fine and medium subangular blocky structure; friable; common fine and few medium and coarse roots; few distinct brown (10YR 4/3) organic coatings on faces of peds; 10 percent sandstone fragments; extremely acid; clear wavy boundary.

Bw1—9 to 16 inches; yellowish brown (10YR 5/6) sandy loam; weak medium and coarse subangular blocky structure; friable; few fine and medium roots; 10 percent sandstone fragments; extremely acid; clear wavy boundary.

Bw2—16 to 20 inches; brownish yellow (10YR 6/6) channery sandy loam; weak medium and coarse subangular blocky structure; friable; few fine and medium roots; 20 percent sandstone fragments; extremely acid; clear wavy boundary.

C—20 to 24 inches; yellowish brown (10YR 5/6) channery sandy loam; single grain; loose; few fine roots; 30 percent sandstone fragments; extremely acid; abrupt wavy boundary.

R—24 inches; strong brown (7.5YR 5/6), weakly cemented sandstone bedrock.

The thickness of the solum ranges from 12 to 20 inches. The depth to bedrock ranges from 24 to 40 inches. The content of coarse fragments ranges from 5 to 10 percent in the A horizon, from 10 to 20 percent in the B horizon, and from 20 to 60 percent in the C horizon.

The A horizon has chroma of 2 or 3. It is loam or sandy loam. The B horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6. It is loam, sandy loam, or the channery or flaggy analogs of those textures. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6. It typically is sandy loam or the channery, very channery, flaggy, or very flaggy analogs of sandy loam. Some pedons have subhorizons of loamy sand.

Stendal Series

The Stendal series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slope ranges from 0 to 2 percent.

Stendal soils are similar to Newark and Orrville soils and are commonly adjacent to Chagrin, Cuba, Piopolis, and Pope soils. Newark and Orrville soils are less acid in the subsoil than the Stendal soils. Chagrin, Cuba, and Pope soils are well drained. They are in the higher areas on the flood plains. Piopolis soils are poorly drained and very poorly drained. They are in the lower areas on the flood plains.

Typical pedon of Stendal silt loam, occasionally flooded, about 1.2 miles southeast of Thurman, in Raccoon Township; about 840 feet south and 180 feet west of the northeast corner of sec. 30, T. 6 N., R. 16 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; weak fine and medium granular structure; friable; many fine and few medium roots; few fine dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; neutral; abrupt smooth boundary.

Cg1—10 to 17 inches; light gray (2.5Y 7/2) silt loam; common fine and medium prominent yellowish brown (10YR 5/4) mottles; weak fine and medium subangular blocky structure; friable; few fine roots; few distinct light brownish gray (2.5Y 6/2) silt coatings on faces of peds; few medium and coarse black (10YR 2/1) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Cg2—17 to 22 inches; light gray (2.5Y 7/2) silt loam; common fine and medium distinct light yellowish brown (2.5Y 6/4) and common fine and medium prominent yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few fine roots; few distinct light brownish gray (2.5Y 6/2) silt coatings on faces of peds; few fine and medium very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

C1—22 to 30 inches; light olive brown (2.5Y 5/4) silt loam; common medium distinct light brownish gray (2.5Y 6/2) and common medium and coarse prominent yellowish brown (10YR 5/6) mottles; massive; firm; few fine roots; few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; few fine dark brown (7.5YR 4/4) stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

C2—30 to 41 inches; light olive brown (2.5Y 5/4) silt loam; common medium and coarse distinct light brownish gray (2.5Y 6/2) and many medium and coarse prominent yellowish brown (10YR 5/6) mottles; massive; firm; few distinct light gray (10YR 7/2) streaks; few medium and coarse dark brown (7.5YR 4/4) stains and very dark grayish brown (10YR 3/2) concretions of iron and manganese oxide; very strongly acid; gradual wavy boundary.

C3—41 to 53 inches; light olive brown (2.5Y 5/4) silt loam; common medium and coarse prominent gray (10YR 6/1) and common medium prominent strong brown (7.5YR 5/6) mottles; massive; firm; few fine and medium dark brown (7.5YR 3/2) stains and concretions of iron and manganese oxide; strongly acid; gradual wavy boundary.

Cg′—53 to 62 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine and medium faint light gray (10YR 7/2) and common medium and coarse prominent dark yellowish brown (10YR 4/4) mottles; massive; firm; few fine dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; very strongly acid; clear wavy boundary.

C′—62 to 72 inches; light olive brown (2.5Y 5/4) silt loam; common medium prominent light gray (10YR 7/1) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few fine very dark grayish brown (10YR 3/2) concretions and stains of iron and manganese oxide; strongly acid.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It typically is silt loam, but the range includes silty clay loam. The Cg horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y and value of 5 or 6. The Cg and C horizons are silt loam or silty clay loam.

Taggart Series

The Taggart series consists of deep, somewhat poorly drained, slowly permeable soils on broad, silty lacustrine terraces along the major streams. These soils formed in acid alluvium. Slope ranges from 0 to 3 percent.

Taggart soils are commonly adjacent to Elkinsville, Gallipolis, Licking, and Peoga soils. Elkinsville soils are well drained. Gallipolis and Licking soils are moderately well drained. Elkinsville, Gallipolis, and Licking soils are in the higher areas on the terraces. Peoga soils are poorly drained. They are in the lower areas on the terraces.

Typical pedon of Taggart silt loam, 0 to 3 percent slopes, about 2.4 miles northeast of Gallipolis, in Gallipolis Township; about 2,450 feet north and 890 feet east of the southwest corner of sec. 18, T. 3 N., R. 14 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; moderate medium and coarse granular structure; friable; many fine and few coarse roots; few fine and medium dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; neutral; abrupt smooth boundary.

BE—9 to 14 inches; yellowish brown (10YR 5/4) silt loam; moderate coarse granular structure; friable; few fine roots; many distinct grayish brown (1YR 5/2) silt coatings on faces of peds; few fine and medium black (10YR 2/1) concretions and stains of iron and manganese oxide; slightly acid; abrupt smooth boundary.

Bt1—14 to 20 inches; yellowish brown (10YR 5/6) silt loam; common fine faint yellowish brown (10YR 5/4) and common medium prominent light brownish gray (2.5Y 6/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct brown (10YR 5/3) clay films and many prominent light gray (10YR 7/2) silt coatings on faces of peds; few fine dark reddish brown (5YR 3/2) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Bt2—20 to 28 inches; yellowish brown (10YR 5/4) silt loam; common fine and medium prominent light brownish gray (2.5Y 6/2) and common fine and medium faint yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common faint brown (10YR 5/3) clay films and many prominent light gray (5Y 7/2) silt coatings on faces of peds; few fine very dark brown (10YR 2/2) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Btg1—28 to 36 inches; light brownish gray (2.5Y 6/2) silt loam; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct brown (10YR 5/3) clay films on faces of peds; common medium dark brown (7.5YR 4/4) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Btg2—36 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam; many medium and coarse prominent brown (7.5YR 5/4) mottles; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common prominent brown (7.5YR 5/4) clay films and few distinct light gray (10YR 7/2) silt coatings on faces of peds; common medium dark brown (7.5YR 4/4) and black (7.5YR 2/1) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

Bt'—46 to 57 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; moderate coarse and very coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few fine roots; common distinct brown (7.5YR 5/4) clay films and few distinct light gray (10YR 7/2) silt coatings on faces of peds; common medium and coarse dark brown (7.5YR 3/2) concretions and stains of iron and manganese oxide; strongly acid; clear wavy boundary.

BC—57 to 65 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few distinct brown (7.5YR 5/2) clay films on faces of peds; common fine and medium black (10YR 2/1) concretions and stains of iron and manganese oxide; very strongly acid.

The thickness of the solum ranges from 40 to 72 inches. The solum generally does not contain coarse fragments.

The Ap horizon has chroma of 1 or 2. The Bt and Bt' horizons have hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 6. They are silt loam or silty clay loam.

Upshur Series

The Upshur series consists of deep, well drained, slowly permeable soils on hillsides, benches, and ridgetops in the uplands. These soils formed in colluvium and residuum weathered mainly from clay shale and siltstone bedrock. Slope ranges from 8 to 70 percent.

Upshur soils are similar to Vandalia soils and are commonly adjacent to Berks, Gilpin, Lily, and Steinsburg soils. Vandalia soils formed in colluvium. They have sandstone fragments in the subsoil. Berks and Steinsburg soils have less clay in the subsoil than the Upshur soils. They are on hillsides. Gilpin and Lily soils are moderately deep over bedrock. Gilpin soils are in landscape positions similar to those of the Upshur soils. Lily soils are on the higher part of ridgetops.

Typical pedon of Upshur silt loam, in an area of Lily-Upshur complex, 15 to 25 percent slopes, about 2.2 miles northwest of Sand Fork, in Walnut Township; 350

feet south and 450 feet east of the northwest corner of sec. 21, T. 4 N., R. 16 W.

Oi—0.5 inch to 0; very dark grayish brown (10YR 3/2), slightly decomposed leaf litter.

A—0 to 6 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; common fine and medium roots; about 2 percent shale fragments; strongly acid; clear wavy boundary.

BE—6 to 10 inches; brown (7.5YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine and medium roots; common faint brown (7.5YR 5/4) silt coatings and few distinct brown (10YR 4/3) organic coatings on faces of peds; about 2 percent siltstone fragments; strongly acid; clear wavy boundary.

Bt1—10 to 17 inches; reddish brown (5YR 4/4) clay; strong medium angular and subangular blocky structure; very firm; few fine and medium roots; common distinct reddish brown (5YR 4/3) clay films on faces of peds; about 5 percent soft siltstone fragments; strongly acid; clear wavy boundary.

Bt2—17 to 26 inches; reddish brown (2.5YR 4/4) clay; moderate coarse and very coarse prismatic structure parting to strong medium and coarse subangular blocky; very firm; few fine and medium roots; many distinct dark red (2.5YR 3/6) clay films on faces of peds; about 5 percent soft siltstone fragments; strongly acid; clear wavy boundary.

Bt3—26 to 35 inches; dark red (2.5YR 3/6) clay; moderate coarse and very coarse prismatic structure parting to moderate medium and coarse angular and subangular blocky; very firm; few fine and medium roots; common distinct dark reddish brown (2.5YR 3/4) clay films on faces of peds; about 5 percent soft siltstone fragments; medium acid; clear wavy boundary.

BC—35 to 40 inches; dark red (2.5YR 3/6) silty clay; weak medium and coarse subangular blocky structure; very firm; few fine and medium roots; common distinct dark reddish brown (2.5YR 3/4) pressure faces; about 5 percent soft siltstone fragments; medium acid; clear wavy boundary.

C—40 to 48 inches; dark reddish brown (2.5YR 3/4) channery clay; few fine and medium prominent strong brown (7.5YR 5/6) and few fine prominent light brownish gray (10YR 6/2) mottles; massive; firm; few fine roots; dusky red (2.5YR 3/2) pressure faces on rock fragments; about 20 percent siltstone and shale fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

Cr—48 to 50 inches; reddish brown (5YR 4/3), calcareous clay shale.

The thickness of the solum ranges from 27 to 50 inches. The depth to bedrock ranges from 40 to 71 inches. The content of coarse fragments ranges from 0 to 5 percent in the A horizon, from 0 to 10 percent in the Bt horizon, and from 0 to 30 percent in the C horizon.

The A horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It typically is silt loam, but the range includes silty clay loam. Some pedons have an Ap horizon, which has hue of 10YR to 5YR and chroma of 2 to 4. The Ap horizon is silt loam, silty clay loam, or silty clay. Some pedons have a BE horizon. The Bt horizon has hue of 5YR to 10R, value of 3 or 4, and chroma of 3 to 6. It is silty clay or clay. The C horizon has hue of 5YR to 10R, value of 3 or 4, and chroma of 4 to 6. It is silty clay loam, silty clay, clay, or the channery analogs of those textures.

Vandalia Series

The Vandalia series consists of deep, well drained, slowly permeable or moderately slowly permeable soils on foot slopes and benches. These soils formed in colluvium. Slope ranges from 6 to 25 percent.

Vandalia soils are similar to Upshur soils and are commonly adjacent to Berks, Gilpin, Guernsey, and Upshur soils. Upshur soils do not have so many coarse fragments of siltstone and sandstone in the subsoil as the Vandalia soils. Berks soils have a higher content of coarse fragments and less clay in the subsoil than the Vandalia soils. They are on very steep slopes on hillsides. Gilpin soils are moderately deep over bedrock. Guernsey soils are moderately well drained. Gilpin, Guernsey, and Upshur soils are on ridgetops and side slopes.

Typical pedon of Vandalia silty clay loam, 15 to 25 percent slopes, severely eroded, about 0.8 mile south of Kerr, in Springfield Township; about 800 feet south and 1,600 feet east of the northwest corner of sec. 7, T. 6 N., R. 15 W.

Ap1—0 to 3 inches; brown (7.5YR 4/4) silty clay loam, light brown (7.5YR 6/4) dry; weak fine and medium granular structure; firm; many fine and common medium roots; about 5 percent rock fragments; strongly acid; clear smooth boundary.

Ap2—3 to 8 inches; brown (7.5YR 4/4) silty clay loam; strong fine and medium subangular blocky structure; firm; common fine roots; 30 percent yellowish red (5YR 4/6) subsoil material; common prominent black (10YR 2/1) organic coatings on faces of peds and in root channels; common distinct brown (7.5YR 4/4) silt coatings on faces of peds; about 10 percent rock fragments; strongly acid; abrupt smooth boundary.

Bt1—8 to 14 inches; reddish brown (5YR 5/4) channery silty clay; strong fine and medium subangular blocky structure; very firm; common fine roots; many distinct reddish brown (5YR 4/4) clay films on faces of peds; about 20 percent sandstone fragments; very strongly acid; clear smooth boundary.

Bt2—14 to 21 inches; reddish brown (5YR 5/4) silty clay; moderate fine and medium prismatic structure parting to moderate medium subangular blocky; very firm; few fine roots; many distinct reddish brown (5YR 5/3) and many prominent dark red (2.5YR 3/6) clay films on faces of peds; about 5 percent sandstone fragments; very strongly acid; clear wavy boundary.

Bt3—21 to 31 inches; reddish brown (5YR 4/4) silty clay; strong coarse prismatic structure parting to strong medium and coarse subangular blocky; very firm; few fine roots; many distinct reddish brown (5YR 5/4 and 2.5YR 4/4) clay films on faces of peds; reddish brown (5YR 4/4) slickensides; about 5 percent coarse fragments; very strongly acid; clear wavy boundary.

Bt4—31 to 42 inches; dark reddish brown (2.5YR 3/4) clay; common medium prominent light yellowish brown (2.5Y 6/4) mottles; strong medium and coarse subangular blocky structure; firm; common distinct reddish brown (5YR 4/4) and dark reddish brown (2.5YR 3/4) clay films on faces of peds; many fine and medium black (10YR 2/1) stains of iron and manganese oxide; about 10 percent coarse fragments; slightly acid; clear wavy boundary.

BC1—42 to 51 inches; dark reddish brown (2.5YR 3/4) clay; weak fine and medium subangular blocky structure; firm; few distinct red (10R 4/6) clay films on faces of peds; few fine and medium black (10YR 2/1) stains of iron and manganese oxide; about 10 percent rock fragments; strong effervescence; moderately alkaline; clear wavy boundary.

BC2—51 to 58 inches; reddish brown (2.5YR 4/4) channery silty clay; weak medium and coarse subangular blocky structure; firm; few distinct reddish brown (5YR 5/4) clay films on faces of peds; about 15 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C—58 to 65 inches; dark red (2.5YR 3/6) very channery silty clay; massive; firm; many fine prominent greenish gray (5G 6/1) weathered coarse fragments; about 50 percent rock fragments; neutral.

The thickness of the solum ranges from 45 to 70 inches. The depth to bedrock and the thickness of the colluvium are more than 60 inches. The content of rock fragments ranges from 5 to 10 percent in the A horizon, from 5 to 30 percent in the Bt horizon, and from 10 to 50 percent in the C horizon.

The Ap horizon has hue of 10YR or 7.5YR and chroma of 2 to 4. It typically is silty clay loam, but the range includes silt loam. If the soils have never been plowed, a thin A horizon occurs. The upper part of the Bt horizon has hue of 7.5YR to 2.5YR and chroma of 3 to 6. It is silty clay loam, silty clay, or the channery analogs of those textures. The lower part of the Bt horizon has hue of 5YR to 10R and chroma of 3 to 6. It is silty clay, clay, or the channery analogs of those textures. The C horizon has hue of 5YR to 10R, value of 3 to 5, and chroma of 3 to 6. It is silty clay loam, silty clay, clay, or the channery or very channery analogs of those textures.

Wellston Series

The Wellston series consists of deep, well drained, moderately permeable soils on ridgetops in the uplands. These soils formed in loess and in the underlying material weathered from siltstone, sandstone, and shale. Slope ranges from 1 to 6 percent.

Wellston soils are commonly adjacent to Coolville, Rarden, Woodsfield, and Zanesville soils. Coolville, Rarden, and Woodsfield soils have a fragipan. Coolville, Rarden, and Zanesville soils are on the flatter part of gently sloping ridgetops.

Typical pedon of Wellston silt loam, 1 to 6 percent slopes, about 2.1 miles southwest of Bidwell, in Springfield Township; about 2,230 feet south and 1,080 feet east of the northwest corner of sec. 34, T. 6 N., R. 15 W.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; moderate fine and medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

BA—9 to 12 inches; yellowish brown (10YR 5/6) silt loam; weak fine and medium subangular blocky structure; friable; few fine roots; few distinct dark yellowish brown (10YR 4/4) organic coatings on faces of peds; strongly acid; clear wavy boundary.

Bt1—12 to 16 inches; yellowish brown (10YR 5/6) silt loam; moderate fine and medium subangular blocky structure; firm; few fine roots; few distinct dark yellowish brown (10YR 4/6) clay films and few distinct light yellowish brown (10YR 6/4) silt coatings on faces of peds; strongly acid; clear wavy boundary.

Bt2—16 to 25 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct strong brown (7.5YR 5/6) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt3—25 to 30 inches; yellowish brown (10YR 5/6) silty clay loam; few fine and medium distinct pale brown (10YR 6/3) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; about 14 percent rock fragments; very strongly acid; clear wavy boundary.

2Bt4—30 to 38 inches; yellowish brown (10YR 5/6) silty clay loam; common fine and medium prominent light gray (10YR 7/2) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; few distinct strong brown (7.5YR 5/6) clay films on faces of peds; about 20 percent rock fragments; strongly acid; clear wavy boundary.

2BC—38 to 45 inches; yellowish brown (10YR 5/6) channery silty clay loam; common fine and medium prominent light gray (10YR 7/2) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; few distinct strong brown (7.5YR 5/6) clay films on faces of peds; about 20 percent rock fragments; strongly acid; clear wavy boundary.

2C—45 to 50 inches; yellowish brown (10YR 5/6) channery silt loam; common fine and medium prominent light gray (10YR 7/2) mottles; massive; firm; few fine roots; few distinct dark yellowish brown (10YR 4/4) clay films on rock fragments; about 30 percent rock fragments; very strongly acid; abrupt smooth boundary.

2Cr—50 to 52 inches; light gray (10YR 7/2) and yellowish brown (10YR 5/6), soft sandstone and siltstone bedrock.

The thickness of the solum ranges from 34 to 50 inches. The depth to bedrock ranges from 40 to 72 inches. Coarse fragments generally are not in the upper part of the solum. The content of coarse fragments ranges from 0 to 20 percent in the lower part of the solum and from 10 to 30 percent in the C horizon.

The Ap horizon has chroma of 2 or 3. Some pedons have a BE horizon. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is dominantly silt loam or silty clay loam. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is dominantly silty clay loam, but the range includes silt loam. The 2C horizon has value of 4 or 5 and chroma of 3 to 6. It is silt loam, loam, clay loam, or the channery analogs of those textures.

Wheeling Series

The Wheeling series consists of deep, well drained soils on high terraces along the major streams. These soils formed in silty or loamy alluvium or in sand and gravel. Permeability is moderate in the solum and rapid in the substratum. Slope ranges from 0 to 40 percent.

Wheeling soils are similar to Kanawha soils and are commonly adjacent to Elkinsville, Gallipolis, Licking, and Taggart soils. Kanawha soils are less acid in the substratum than the Wheeling soils. Elkinsville soils have less sand in the subsoil than the Wheeling soils. They are in landscape positions similar to those of the Wheeling soils and on the lower terraces. Gallipolis and Licking soils are moderately well drained. Taggart soils are somewhat poorly drained. They are on the lower terraces.

Typical pedon of Wheeling silt loam, 0 to 3 percent slopes, about 1.4 miles northeast of Swan Creek, in Ohio Township; about 100 feet north and 100 feet east of the southwest corner of sec. 15, T. 1 N., R. 14 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; moderate fine and medium granular structure; friable; many fine and medium roots; about 5 percent gravel; slightly acid; abrupt smooth boundary.

BA—10 to 16 inches; dark yellowish brown (10YR 4/6) silt loam; weak medium subangular blocky structure; friable; few fine roots; few distinct brown (10YR 4/3) silt coatings on faces of peds and in root channels; dark brown (10YR 4/3) wormcasts; few fine black (10YR 2/1) stains and concretions of iron and manganese oxide; medium acid; clear wavy boundary.

Bt1—16 to 25 inches; dark yellowish brown (10YR 4/6) loam; moderate medium subangular blocky structure; friable; few fine roots; common distinct strong brown (7.5YR 4/6) clay films on faces of peds; few fine black (10YR 2/1) stains and concretions of iron and manganese oxide; medium acid; clear wavy boundary.

Bt2—25 to 32 inches; dark yellowish brown (10YR 4/6) loam; moderate medium and coarse subangular blocky structure; friable; few fine roots; common distinct strong brown (7.5YR 4/6) clay films and common distinct yellowish brown (10YR 5/6) silt coatings on faces of peds; common fine and medium black (10YR 2/1) stains and concretions of iron and manganese oxide; about 5 percent gravel; strongly acid; clear wavy boundary.

Bt3—32 to 40 inches; dark yellowish brown (10YR 4/6) gravelly loam; weak fine and medium subangular blocky structure; friable; few very fine roots; many prominent strong brown (7.5YR 4/6) clay films on faces of peds; about 25 percent gravel; strongly acid; clear wavy boundary.

2C1—40 to 71 inches; dark yellowish brown (10YR 4/4) very gravelly loamy sand; single grain; loose; about

60 percent gravel; medium acid; gradual wavy boundary.

2C2—71 to 80 inches; yellowish brown (10YR 5/4) extremely gravelly sand; single grain; loose; about 65 percent gravel; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments ranges from 0 to 5 percent in the Ap horizon, from 0 to 25 percent in the Bt horizon, and from 10 to 65 percent in the C horizon.

The Ap horizon typically is silt loam, but the range includes loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, loam, or the gravelly analogs of those textures. The C horizon has value and chroma of 4 to 6. It is loamy sand, loamy fine sand, sandy loam, sand, or the gravelly, very gravelly, or extremely gravelly analogs of those textures.

Woodsfield Series

The Woodsfield series consists of deep, well drained soils on wide ridgetops in the uplands. These soils formed in loess and in the underlying material weathered from shale. Permeability is moderate in the upper part of the subsoil and slow in the lower part. Slope ranges from 1 to 6 percent.

Woodsfield soils are similar to Coolville soils and are commonly adjacent to Gilpin, Guernsey, Rarden, and Upshur soils. Coolville, Guernsey, and Rarden soils are moderately well drained. Gilpin soils have more sand and less clay in the subsoil than the Woodsfield soils. Upshur soils have more clay in the upper part of the subsoil than the Woodsfield soils. Gilpin, Guernsey, Rarden, and Upshur soils are in the steeper areas on ridgetops and on side slopes.

Typical pedon of Woodsfield silt loam, 1 to 6 percent slopes, about 2.7 miles west of Eureka, in Clay Township; about 1,200 feet north and 720 feet west of the southeast corner of sec. 1, T. 4 N., R. 15 W.

Ap—0 to 10 inches; dark yellowish brown (10YR 4/4) silt loam, very pale brown (10YR 7/3) dry; weak fine and medium subangular blocky structure; firm; few fine roots; few specks of yellowish brown (10YR 5/6) subsoil material; few distinct brown (10YR 4/3) wormcasts; medium acid; clear smooth boundary.

Bt1—10 to 19 inches; strong brown (7.5YR 5/6) silty clay loam; moderate fine and medium subangular blocky structure; firm; few distinct brown (7.5YR 5/4) clay films, few prominent brown (10YR 5/3) silt coatings, and common prominent black (10YR 2/1) organic coatings on faces of peds; strongly acid; clear smooth boundary.

2Bt2—19 to 29 inches; red (2.5YR 4/6) silty clay; moderate medium subangular blocky structure; firm; few slickensides; many distinct red (2.5YR 4/6) and few distinct reddish brown (5YR 5/3) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt3—29 to 37 inches; reddish brown (5YR 5/4) silty clay; moderate medium and coarse subangular blocky structure; firm; few slickensides; many faint reddish brown (5YR 5/3 and 4/3) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt4—37 to 44 inches; reddish brown (5YR 4/4) silty clay; common coarse distinct light reddish brown (5YR 6/4) mottles; weak medium and coarse subangular blocky structure; firm; few slickensides; many distinct reddish brown (5YR 5/4) and few distinct pinkish gray (5YR 7/2) clay films on faces of peds; strongly acid; clear smooth boundary.

2C1—44 to 50 inches; reddish brown (2.5YR 4/4) silty clay loam; common coarse prominent brownish yellow (10YR 6/6) and few fine prominent light brownish gray (10YR 6/2) mottles; massive; firm; few slickensides; medium acid; clear smooth boundary.

2C2—50 to 58 inches; olive yellow (2.5Y 6/6) silty clay loam; few fine prominent gray (10YR 6/1) and common coarse prominent reddish brown (2.5YR 4/4) mottles; massive; firm; few slickensides; about 5 percent rock fragments; medium acid; clear wavy boundary.

2C3—58 to 63 inches; very dark grayish brown (10YR 3/2) silty clay loam; many fine and coarse prominent brownish yellow (10YR 6/6) mottles; massive; firm; about 5 percent coarse fragments; slightly acid; clear wavy boundary.

2C4—63 to 68 inches; olive yellow (2.5Y 6/6) silty clay loam; common coarse prominent dark reddish brown (2.5YR 3/4) mottles; massive; firm; few fine black (10YR 2/1) concretions and stains of iron and manganese oxide; about 10 percent rock fragments; neutral; abrupt smooth boundary.

2Cr—68 to 70 inches; light yellowish brown (2.5Y 6/4) shale bedrock.

The thickness of the solum ranges from 40 to 54 inches. The depth to soft bedrock ranges from 40 to 70 inches. The thickness of the silty mantle ranges from 14 to 26 inches. The content of rock fragments ranges from 0 to 5 percent in the 2Bt horizon and from 0 to 10 percent in the 2C horizon.

The Ap horizon has value of 4 or 5 and chroma of 3 or 4. Some pedons have a BE horizon. The Bt horizon has hue of 10YR or 7.5YR. It is silt loam or silty clay loam. The 2Bt horizon has chroma of 4 to 6. It is silty clay or clay. The 2C horizon has hue of 2.5YR to 2.5Y, value of 3 to 6, and chroma of 2 to 6. It is silty clay loam, silty clay, or clay.

Zanesville Series

The Zanesville series consists of deep, moderately well drained soils on ridgetops in the uplands. These soils formed in loess and in the underlying material weathered from acid, interbedded siltstone and shale bedrock. They have a fragipan. Permeability is moderate above the fragipan and slow or moderately slow in the fragipan. Slope ranges from 1 to 6 percent.

Zanesville soils are commonly adjacent to Coolville, Guernsey, Lily, Wellston, and Woodsfield soils. None of the adjacent soils have a fragipan. Coolville, Wellston, and Woodsfield soils are on ridgetops, in landscape positions similar to those of the Zanesville soils and in the slightly more convex areas. Guernsey and Lily soils are on the steeper ridgetops. Guernsey soils also are on side slopes.

Typical pedon of Zanesville silt loam, 1 to 6 percent slopes, about 1.3 miles southeast of Harrisburg, in Springfield Township; about 2,250 feet north and 2,600 feet east of the southwest corner of sec. 33, T. 6 N., R. 15 W.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

BE—9 to 13 inches; yellowish brown (10YR 5/4) silt loam; weak fine and medium subangular blocky structure; firm; few fine roots; common faint light yellowish brown (10YR 6/4) silt coatings on faces of peds; medium acid; clear wavy boundary.

Bt1—13 to 20 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; firm; few fine roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—20 to 23 inches; yellowish brown (10YR 5/6) silt loam; common fine and medium distinct brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; strongly acid; clear wavy boundary.

2Btx1—23 to 30 inches; yellowish brown (10YR 5/6) silt loam; common fine and medium prominent light brownish gray (2.5Y 6/2) mottles; moderate very coarse prismatic structure parting to moderate thin and medium platy; very firm and brittle; few fine roots on faces of prisms; common prominent grayish brown (10YR 5/2) clay films on faces of peds; common prominent pale red (2.5YR 6/2) silt coatings and few distinct strong brown (7.5YR 5/8) stains on faces of prisms; common coarse very dark brown (10YR 2/2) concretions of iron and manganese oxide; strongly acid; clear wavy boundary.

2Btx2—30 to 39 inches; yellowish brown (10YR 5/6) silt loam; common medium and coarse prominent light brownish gray (10YR 6/2) mottles; moderate very coarse prismatic structure parting to moderate thin and medium platy; very firm and brittle; few fine roots on faces of prisms; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common prominent gray (5Y 6/1) silt coatings and few distinct strong brown (7.5YR 5/8) stains on faces of prisms; common coarse very dark brown (10YR 2/2) concretions of iron and manganese oxide; about 2 percent weathered siltstone fragments; strongly acid; clear wavy boundary.

2BC1—39 to 48 inches; yellowish brown (10YR 5/4) silt loam; common fine and medium distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; few distinct yellowish brown (10YR 5/6) clay films on faces of peds; few medium dark brown (7.5YR 3/2) stains and common coarse very dark brown (10YR 2/2) concretions of iron and manganese oxide; about 5 percent weathered siltstone fragments; strongly acid; clear wavy boundary.

2BC2—48 to 57 inches; yellowish brown (10YR 5/4) silt loam; common medium and coarse distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; about 10 percent weathered siltstone fragments; strongly acid; clear smooth boundary.

2Cr—57 to 70 inches; light yellowish brown (2.5Y 6/4), weathered siltstone and shale bedrock.

2R—70 to 72 inches; light yellowish brown (2.5Y 6/4), interbedded siltstone and shale bedrock.

The thickness of the solum ranges from 40 to 60 inches. The depth to bedrock ranges from 40 to 70 inches. Depth to the fragipan ranges from 23 to 32 inches. The content of rock fragments ranges from 0 to 5 percent in the 2Btx horizon and from 0 to 10 percent in the 2BC horizon.

The Ap horizon has chroma of 2 or 3. The Bt, 2Btx, and 2BC horizons have chroma of 4 to 6. The 2Btx and 2BC horizons are silt loam or silty clay loam.

Formation of the Soils

This section describes how the major factors of soil formation have affected the soils in Gallia County and explains some of the processes of soil formation.

Factors of Soil Formation

Soils form through processes that act on deposited or accumulated geologic material. The major factors of soil formation are parent material, climate, relief, living organisms, and time.

The physical and chemical composition of the parent material affects the kind of soil that is formed. Climate and living organisms, particularly vegetation, are the active forces of soil formation. Their effect on the parent material is modified by relief and by the length of time that the parent material has been acted upon. Relief generally modifies the effects of climate and vegetation through its influence on runoff and temperature. Time is needed for a soil to form in the parent material. Generally, a long period of time is required for distinct soil horizons to develop. The relative importance of each factor differs from place to place. In some areas one factor determines most of the soil properties. Generally, however, the interaction of all five factors determines what kind of soil forms in any given place.

Parent Material

Parent material is the unconsolidated mass in which the soil forms. The soils in Gallia County formed in several kinds of parent material: residuum, colluvium, loess, lacustrine deposits, deposits of noncalcareous sand and gravel, old alluvium, and recent alluvium. Loess commonly overlies the other kinds of parent material, and in some areas colluvium overlies residuum.

Residuum from bedrock is the most extensive kind of parent material in the county. In the less sloping areas on uplands, the upper part of the soil formed in a layer of loess that overlies the residuum. Coolville, Wellston, Woodsfield, and Zanesville soils have a significantly thick loess cap.

Most of the soils in the county formed in residuum derived from different kinds of rock. The bedrock strata are nearly horizontal in most places. In some places the bedrock of a named geologic bedrock member may be a different type of rock at another location. Consequently, several different rock strata were exposed to weathering within short distances and most of the soils that formed on sloping landscapes have layers that formed in mixed material weathered from two or more kinds of rock.

Sandstone, siltstone, shale, and limestone are the dominant kinds of bedrock in the county. Gilpin and Berks soils formed in material weathered from interbedded shale, siltstone, and sandstone bedrock. Guernsey soils formed mainly in material weathered from shale, siltstone, and limestone. Upshur soils formed mainly in clay shale or siltstone residuum. Some soils formed mainly in material weathered from only one kind of bedrock. Clymer, Lily, and Steinsburg soils formed in material weathered from sandstone. Rarden soils formed in material weathered from clay shale.

The colluvial deposits from soils that weathered from bedrock at the higher elevations have been transported by water and gravity to foot slopes. They vary in thickness and generally are at the foot of steep or very steep slopes. They are a mixture of the material on slopes above them. Vandalia soils formed in these deposits.

Some of the soils in the county formed in lacustrine deposits that have a loess mantle. In places the mantle of loess has eroded away. The lacustrine deposits are mostly on terraces along the Ohio River and other major streams in the county. Fine textured lacustrine sediments were deposited when the outlet of the Ohio River system was blocked. Licking and McGary soils formed in fine textured lacustrine material. Silty lacustrine sediments were deposited by water that moved very slowly because of the slow outlet for the Ohio River basin. Peoga and Taggart soils formed in silty lacustrine sediments.

Some of the soils in the county formed in loess, colluvium, or old alluvium and in the underlying stratified lacustrine deposits. Omulga and Doles soils formed in this parent material. They are in valleys of the abandoned preglacial Marietta River drainage system.

Both the old alluvium and the colluvium are derived from acid, weathered shale, siltstone, and sandstone. The colluvium is from soils and bedrock formations that are in the higher positions on the landscape. The old alluvium is from the surface layer of soils and from bedrock outcrops in unglaciated areas. The soils that formed in colluvium or old alluvium have a fragipan in the colluvium or, if the colluvial portion does not occur, in the old alluvium. The fragipan commonly is not so well expressed where the colluvium is thinner or has a higher content of clay than is typical.

Allegheny and Monongahela soils formed in old loamy alluvium derived mainly from sandstone and shale. Gallia soils formed mostly in stratified old alluvium along the Marietta River. This alluvium is commonly called Gallia sand. It is the oldest of the old alluvium in the county and is preglacial in origin. Allegheny soils are on stream terraces in dissected preglacial valleys. Gallia soils are on terrace remnants in dissected preglacial valleys. Monongahela soils have a fragipan.

Elkinsville, Kanawha, and Wheeling soils also formed in old alluvium. They are younger than the soils in the abandoned preglacial Marietta River system. Elkinsville soils are on terraces along the Ohio River and its tributaries. Kanawha soils formed in alluvium derived from interbedded shale, siltstone, and sandstone. They are on stream terraces. Wheeling soils formed in silty or loamy material underlain by noncalcareous sand or sand and gravel deposits at a depth of more than 40 inches.

Recent alluvium, which is material that was recently deposited by floodwater, is the youngest parent material in the county. It accumulates as fresh sediment that is deposited by the overflow of streams. The sediment is derived from soils that are in the higher positions on the landscape. Chagrin, Cuba, Lindside, Newark, Nolin, Orrville, Piopolis, Pope, and Stendal soils formed in recent alluvium.

Climate

The climate in the county is uniform enough that it has not greatly contributed to differences among the soils. During formation of the soils, the climate has favored the physical and chemical weathering of parent material and biological activity. Rainfall has been adequate for percolation of water. As a result, carbonates have been leached, clay minerals have been translocated, and soil structure has developed. These processes have occurred in the Rarden, Upshur, and Wellston soils. Freezing and thawing have also aided in the formation of soil structure. The warm summer temperatures have favored chemical reactions in the weathering of primary minerals. Both the rainfall and the temperature have favored plant growth and the subsequent accumulation of organic matter in all soils.

Relief

Relief is a factor affecting how soils that form in the same kind of parent material differ from one another. For example, Taggart and Peoga soils formed in silty lacustrine material. The somewhat poorly drained Taggart soils are in nearly level areas on lacustrine terraces, and the poorly drained Peoga soils are in depressions on lacustrine terraces. These two soils differ from each other and from the moderately well drained soils in the more sloping areas and in the higher positions on lacustrine terraces.

Living Organisms

Plants, animals, bacteria, fungi, and other living organisms affect soil formation. When Gallia County was settled, the vegetation was predominantly hardwood forest. The species included white oak, black oak, chestnut, beech, sugar maple, red oak, yellow-poplar, white ash, and elm. The soils that formed in these forested areas are generally acid and are moderate or low in natural fertility.

Small animals, insects, earthworms, and burrowing animals make channels in the soil, making it more permeable to water. Animals also mix the soil material and add organic matter to the soil. Worm channels and wormcasts are most common in the surface layer of soils that have been limed or in soils on flood plains. Examples of these soils are the Nolin, Chagrin, Lindside, Cuba, and Pope soils. Crawfish channels are evident in the poorly drained and very poorly drained Piopolis soils and the somewhat poorly drained Newark, Orrville, and Stendal soils.

Human activities also affect soil formation. Examples of these activities are cultivation, plowing, seeding, installation of drainage systems, irrigation, cutting and filling, and surface mining. Another example is the application of lime and fertilizer, which affect soil chemistry.

Time

Time is needed for the other factors of soil formation to produce their effects. The age of a soil is indicated, to some extent, by the degree of profile development. In many places parent material that weathers slowly and relief that is steep have affected the formation of soils more than time.

The oldest parent material in the county is residuum derived from sedimentary bedrock. The soils that formed in this material show various degrees of development because of the parent material, topography, and other soil-forming factors. In some soils on steep and very steep slopes, the soil material is removed by geologic erosion before it has time to form into deep soils that have well defined horizons. Examples of these soils are the Berks, Gilpin, and Steinsburg soils. In contrast are older soils that have developed with little or no interruption of soil formation. Some of these soils are on wide ridgetops in the uplands. They include the Coolville, Wellston, Woodsfield, and Zanesville soils.

The youngest parent material in the county is recent alluvium, which is on flood plains that are periodically flooded. Chagrin, Cuba, Nolin, Lindside, Pope, and other alluvial soils are so young that they show little or no differentiation of horizons.

Processes of Soil Formation

Most of the soils in the county have strongly expressed profiles. The processes of soil formation have resulted in distinct changes in the parent material. The strongest development is evident in the upland soils on ridgetops and in the less sloping areas on side slopes, the colluvial soils on foot slopes below the steep side slopes, the old alluvial soils, the lacustrine soils, and the soils on valley terraces. In contrast, the soils on flood plains and in surface mined areas have been only slightly modified from the parent material.

All of the factors of soil formation act in unison to control the processes that form different layers in the soil *(12)*. These processes are additions, losses, transfers, and transformations. Some processes promote horizon differentiations, while other processes retard or obliterate differences that are already present. The processes are caused by basic chemical and physical interaction, such as oxidation, reduction, hydration, hydrolysis, solution, eluviation (leaching), illuviation (accumulation), and other highly complex phenomena.

The most important addition to the soils in Gallia County is the addition of organic matter to the surface layer. A thin layer of organic matter accumulates under forest vegetation. If the soil is cleared and cultivated, this organic matter is mixed with the underlying mineral material. In some severely eroded areas, all evidence of this addition has been removed. Other additions include the deposition of sediment and the accumulation of nutrients and colloidal matter from such sources as organic matter, ground water, lime, and fertilizers. Some nutrients move in a cycle from the soil to the plant and then back to the soil as by-products of organic matter decomposition. This process occurs on all soils in the county, except where the cycle is modified by cropping. Alluvial soils, such as Chagrin, Cuba, Lindside, Newark, Nolin, Orrville, Piopolis, Pope, and Stendal soils, periodically receive sediment from floodwater. Not all of the sediment is beneficial. Some soils, such as the Kyger soils, have received overwash sediment from strip mines upstream. This sediment contains virtually no organic matter and is highly acid.

Leaching of carbonates from calcareous parent material is one of the most significant losses preceding many other chemical changes in the soils. The lacustrine soils in the county are good examples of soils that have been partly leached of carbonates. McGary soils, for example, have carbonates at a depth of 20 to 40 inches. Most of the other soils on uplands and terraces in the county no longer have carbonates within a depth of 5 feet and are medium acid to very strongly acid in the subsoil. Some of the soils in the preglacial valleys are deeply leached and have very low base saturation in the lower part of the profile. Examples of these soils are the Allegheny and Monongahela soils, which are Ultisols. In some areas in these valleys, the Doles and Omulga soils have clayey lacustrine material in the substratum, and in other areas, they do not have this material. The clayey lacustrine material has been affected by the extent of leaching.

Following the removal of carbonates, the alteration of such minerals as biotite and feldspar results in color changes within the subsoil. The free iron oxide that is produced may be segregated by a fluctuating high water table. As a result, the soils are gray and mottled. Examples are the Piopolis, Kyger, Peoga, McGary, Newark, Orrville, Stendal, and Taggart soils. Unless the water table is seasonally high because of a restrictive layer or fragipan, brownish or reddish colors from the iron oxide are typical in most of the soils in the county. Examples are the Doles, Monongahela, Omulga, and Zanesville soils.

The transfer of clay from the A horizon to the faces of peds in the B horizon takes place because of seasonal wetting and drying of the soil profile. The fine clay is suspended in water percolating through the surface layer and then is deposited in the subsoil. This transfer accounts for the patchy to nearly continuous clay films on faces of peds in the subsoil of most of the soils on uplands and terraces and in preglacial valleys in the county.

The transformation of mineral compounds occurs in most soils. The results of this process are most apparent if the formation of layers is not affected by rapid erosion or by the accumulation of material at the surface. The primary silicate minerals are weathered chemically to produce secondary minerals, mainly layer lattice silicate clays. Most of the layer lattice clays remain in the subsoil.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (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 moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

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

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

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

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

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; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. The depth to bedrock. Deep soils are more than 40 inches deep to bedrock, moderately deep soils are 20 to 40 inches deep to bedrock, and shallow soils are 10 to 20 inches deep to bedrock.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, 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 classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine earth. That part of a soil that can be passed through a No. 10 (2.0 millimeter) sieve.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded 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 of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

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

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Perimeter drain. An artificial drain placed around the perimeter of a septic tank absorption field to lower the water table. Also called a curtain drain.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

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

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

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

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

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

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bar. A shallow trench and a mound of earth constructed at an angle across a road or trail to intercept and divert surface runoff and to help control erosion.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.