SOIL SURVEY OF

Somerset County, New Jersey

United States Department of Agriculture
Soil Conservation Service
In cooperation with
New Jersey Agricultural Experiment Station
Cook College, Rutgers, The State University
and the
New Jersey Department of Agriculture
State Soil Conservation Committee

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

Major fieldwork for this soil survey was completed in the period 1957-68. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1971. This survey was made cooperatively by the Soil Conservation Service and the New Jersey Agricultural Experiment Station, Cook College, Rutgers, the State University. It is part of the technical assistance furnished to the Somerset-Union Soil Conservation District.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the woodland group and landscape planting group in which the soil has been placed.

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

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the section "Management of Soils for Crops and Pasture."

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

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

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

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

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

Newcomers in Somerset County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication.

Cover: **Intersection of Interstate Highways 78 and 287 in the Norton-Penn-Lansdowne association near Pluckemin, New Jersey.**

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SOIL SURVEY OF SOMERSET COUNTY, NEW JERSEY

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION, COOK COLLEGE, RUTGERS, THE STATE UNIVERSITY; AND THE NEW JERSEY DEPARTMENT OF AGRICULTURE, STATE SOIL CONSERVATION COMMITTEE

SOMERSET COUNTY is in the north-central part of New Jersey (fig. 1). It borders Morris, Union, Middlesex, Mercer, and Hunterdon Counties. Somerset County has a total of 196,288 acres. The northeastern fourth of the county is mostly steep and wooded. The other three-fourths consists of gently undulating and moderately sloping plains.

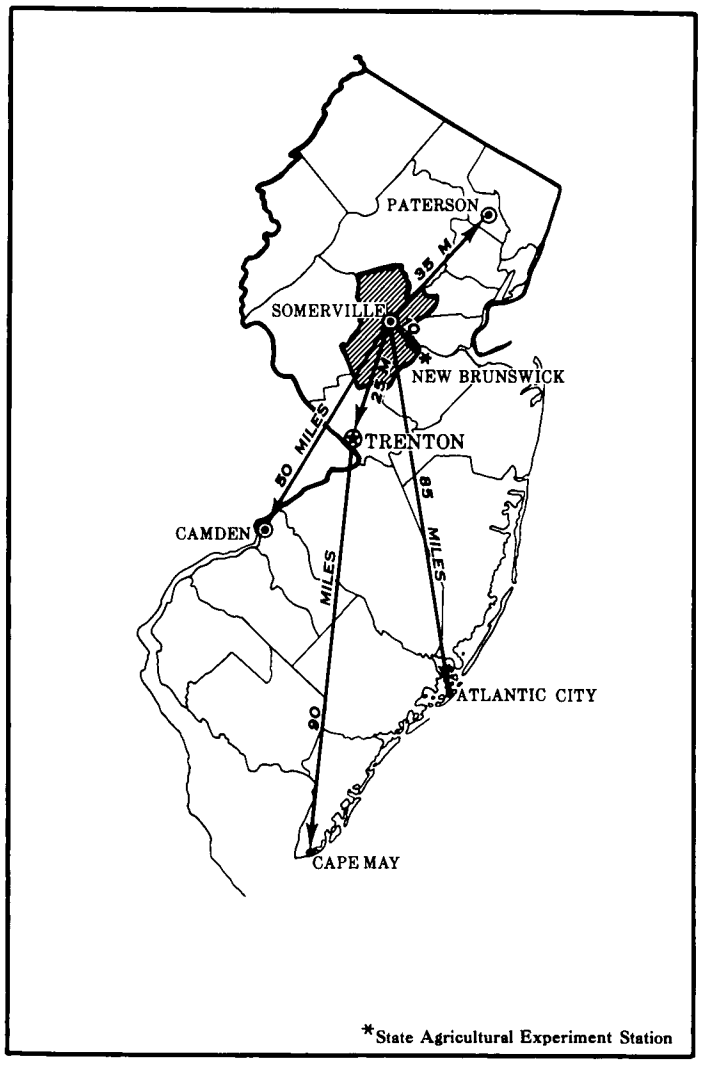

Figure 1.—Location of Somerset County in New Jersey.

About 25 percent of the county is in farms, and about 65 percent of the farmland is cultivated. In 1970 the population was 198,372 for the county and 14,165 for Somerville, the county seat. Nearly all the streams drain into the Raritan River, which flows east to the ocean. The Dead and Passaic Rivers in the northeastern part of the county flow eastward and empty into the Hudson River.

Dairying is the dominant type of farming in Somerset County. In 1969 about 371 farms were in the county. About 40 percent of this total was dairy farms, 25 percent horse farms, 25 percent poultry farms, 5 percent general farms, and 5 percent miscellaneous and unclassified farms.

How This Survey Was Made

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

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

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Royce and Raritan,

for example, are the names of two soil series named after towns in Somerset County. All the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Penn silt loam, 2 to 6 percent slopes, is one of several phases within the Penn series.

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

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

Some mapping units are made up of soils of different series or of different phases within one series. One such kind of mapping unit, a soil complex, is shown on the soil map of Somerset County.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Neshaminy-Mount Lucas very stony silt loams, 2 to 12 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the detailed soil map and are described in the survey, but they are classified at the subgroup level of the classification system. Urban land is an example.

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

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

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

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

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

The soil associations shown on the general soil map of Somerset County may not join exactly with the areas delineated on the general soil maps of Morris, Hunterdon, and Mercer Counties, and the names of some of the adjoining associations are different. The reason for these differences is that the soils of major extent in an association in one county may not occur as major soils in the adjacent association of the adjoining county. Also, some of the soils that occur in Somerset County do not occur in the adjacent counties. Likewise, some of the soils that are common in adjacent counties do not occur in or are not extensive in Somerset County.

The soil associations in Somerset County are described in the paragraphs that follow.

Soils Formed Mainly in Glacial Till or Material Weathered from Granitic Gneiss, Diabase, or Basalt

The nearly level to very steep soils that make up these associations are dominantly gravelly, very stony, or rocky and are underlain by granitic gneiss, diabase, or basalt bedrock. The depth to bedrock is mainly 4 or more feet. In some areas of the steep and very steep soils, outcrops of bedrock are common. The soils of these associations are on ridges and hills and are mostly wooded.

1. Edneyville-Parker-Meckesville association

Gently sloping to very steep, deep, moderately well drained to somewhat excessively drained, gravelly, very stony, and rocky soils that have bedrock mainly below a depth of 4 feet; on uplands

The soils of this association are in the rolling and hilly uplands of the granitic gneiss Highlands. They are dominantly steep, gravelly, and very stony.

This association makes up about 6 percent of the county. It is 40 percent Edneyville soils, 20 percent Parker soils, 15 percent Meckesville soils, and 25 percent minor soils. The minor soils are Califon, Fluvaquents, and Udifluvents and Ochrepts.

Edneyville soils are deep, well-drained gravelly loams that have a moderately high content of gravel. They are gently sloping to steep and are subject to erosion if cultivated.

Parker soils are gently sloping to very steep, deep, somewhat excessively drained sandy loams. They are very gravelly, rocky, or very stony.

Meckesville soils are gently sloping to strongly sloping, moderately well drained gravelly loams. They have a slowly permeable fragipan.

The moderately well drained to somewhat poorly drained Califon soils are on uplands. The poorly drained Fluvaquents and the somewhat poorly drained to moderately well drained Udifluvents and Ochrepts are along streams.

The soils in this association are used mainly as woodland. Some areas of Edneyville and Parker soils have been cleared of stones and are cultivated. The major crops are corn, small grains, and hay and pasture plants. The abundant stones and gravel on the surface are a severe limitation for farming. Erosion is a potential hazard where a protective cover of vegetation is not maintained. Steep slopes, stoniness, and slow permeability are limitations for community development.

2. Neshaminy-Mount Lucas-Amwell association

Gently sloping to very steep, deep, well drained to somewhat poorly drained, loamy, gravelly, and very stony soils that have bedrock mainly below a depth of 4 feet; on uplands

The soils of this association are in several large areas in the northern part of the county in the Watchung Mountains, in an area primarily in the Sourland Mountains, and in an area near Rocky Hill and east of the Millstone River. The landscape is mainly one of rolling or hilly uplands. Relief is determined by the underlying basalt and diabase bedrock.

This association makes up about 18 percent of the county. It is 45 percent Neshaminy soils, 30 percent Mount Lucas soils, 10 percent Amwell soils, and 15 percent minor soils. The minor soils are Riverhead, Norton, Lawrenceville, and Watchung.

Neshaminy soils are well drained or moderately well drained silt loams or very stony silt loams that are deep over bedrock. They are gently sloping to very steep. The very steep Neshaminy soils are very stony.

Mount Lucas soils are deep, moderately well drained to somewhat poorly drained silt loams, gravelly silt loams, or very stony silt loams. They are gently sloping to strongly sloping.

Amwell soils are deep, moderately well drained to somewhat poorly drained loams and gravelly silt loams. They are gently sloping to strongly sloping.

The Riverhead and Norton soils are well drained, the Lawrenceville soils are moderately well drained, and the Watchung soils are poorly drained.

The soils in this association are used mainly for farming and woodland. The stony steep soils are used as woodland and are better suited to this use than to others. The nonstony nearly level to strongly sloping soils are used for corn, soybeans, small grains, and hay and pasture plants. Artificial drainage is needed to remove excess water from the Mount Lucas and Amwell soils. Erosion is a potential hazard where the soils are strongly sloping or steep. Steep slopes, stoniness, and a seasonal high water table are limitations for community development.

Soils Formed in Material Weathered Mainly From Shale, Siltstone, or Sandstone but Partly From Conglomerate and Argillite

The nearly level to very steep soils that make up these associations formed mainly in material weathered from red shale. In places they formed in material weathered from sandstone, siltstone, argillite, or conglomerate. The soils are mainly nearly level to strongly sloping. They have a surface layer of silt loam. The main farming areas of the county are in these associations.

3. Arendtsville-Penn-Pattenburg association

Nearly level to moderately steep, deep to moderately deep, well-drained loamy, gravelly, and shaly soils underlain mainly by quartzite conglomerate and red shale; on uplands

This association is on uplands mainly where the landscape is undulating and rolling. It makes up about 2 percent of the county. It is 50 percent Arendtsville soils, 25 percent Penn soils, 20 percent Pattenburg soils, and 5 percent minor soils. The minor soils are Meckesville, Klinesville, Rowland, Fluvaquents, and Udifluvents and Ochrepts.

Arendtsville soils are deep, well-drained gravelly loams. They are gently sloping to strongly sloping.

Penn soils are moderately deep, well-drained silt loams or shaly silt loams. They are nearly level to strongly sloping.

Pattenburg soils are deep, well-drained gravelly loams. They are strongly sloping to moderately steep.

The well-drained, deep Meckesville soils and the well-drained, shallow Klinesville soils are on uplands. The moderately well drained and somewhat poorly drained, deep Rowland soils are on flood plains and are subject to frequent flooding. Other soils on flood plains in this association are Udifluvents and Ochrepts and Fluvaquents, which are also subject to annual flooding.

Much of this association is used for farming or as woodland. The moderately steep soils in this association are presently used as woodland and are better suited to this use than to others. The less sloping soils are used for row crops, hay, and pasture. Because the soils are gravelly and shaly, they tend to be somewhat droughty, are moderate in natural fertility, and are strongly acid. The more sloping soils that are in cultivation are subject to erosion unless conservation measures are used. Slopes and depth to bedrock are limitations for community developments.

4. Norton-Penn-Lansdowne association

Nearly level to strongly sloping, deep and moderately deep, well drained to somewhat poorly drained loamy and shaly soils underlain mainly by red shale; on uplands

This association is on uplands where the landscape is undulating and rolling. It makes up about 7 percent of the

county. It is 45 percent Norton soils, 20 percent Penn soils, 15 percent Lansdowne soils, and 20 percent minor soils. The minor soils are Reaville, Croton, Meckesville, Birdsboro, and Raritan.

Norton soils are deep, well-drained loams that formed in glacial till. They are nearly level to strongly sloping.

Penn soils are moderately deep, well-drained silt loams or shaly silt loams that formed in material weathered mainly from shale. They are nearly level to strongly sloping.

Lansdowne soils are deep, moderately well drained to somewhat poorly drained silt loams that formed in glacial till. These soils are in slight depressions. They are nearly level to gently sloping, are slowly permeable, and have a subsoil that is high in content of clay.

The minor soils are dominantly nearly level to gently sloping. Reaville soils are moderately well drained or somewhat poorly drained soils on uplands. They are moderately deep over shale bedrock. Croton soils are deep, poorly drained soils on uplands. Meckesville soils are deep, moderately well drained soils on uplands. Birdsboro and Raritan soils are on stream terraces and are underlain by strata of sand and gravel. Some low-lying Raritan soils are subject to stream flooding.

Most areas of this association are used for farming. Horse farms and dairying are the major farm enterprises. The main crops are corn, small grains, hay, and pasture. Artificial drainage is commonly needed for removing excess water from the Lansdowne, Raritan, Croton, and Reaville soils. The more sloping soils that are farmed intensively are subject to erosion unless conservation measures are used. Slow permeability, depth to bedrock, and a seasonal high water table are the main limitations for community development.

5. *Penn-Klinesville-Reaville association*

Nearly level to very steep, moderately deep and shallow, well drained to somewhat poorly drained loamy and shaly soils underlain mainly by red shale; on uplands

This association is on uplands where the landscape is undulating and rolling. Areas are dissected by many streams and drainageways.

This association (fig. 2) is the most extensive of any in the county. It makes up about 31 percent of the county. It is 50 percent Penn soils, 20 percent Klinesville soils, 5 percent Reaville soils, and 25 percent minor soils. The minor soils are Abbottstown, Croton, Norton, and Lansdowne soils.

Penn soils are moderately deep, well-drained silt loams and shaly silt loams. They are nearly level to strongly sloping.

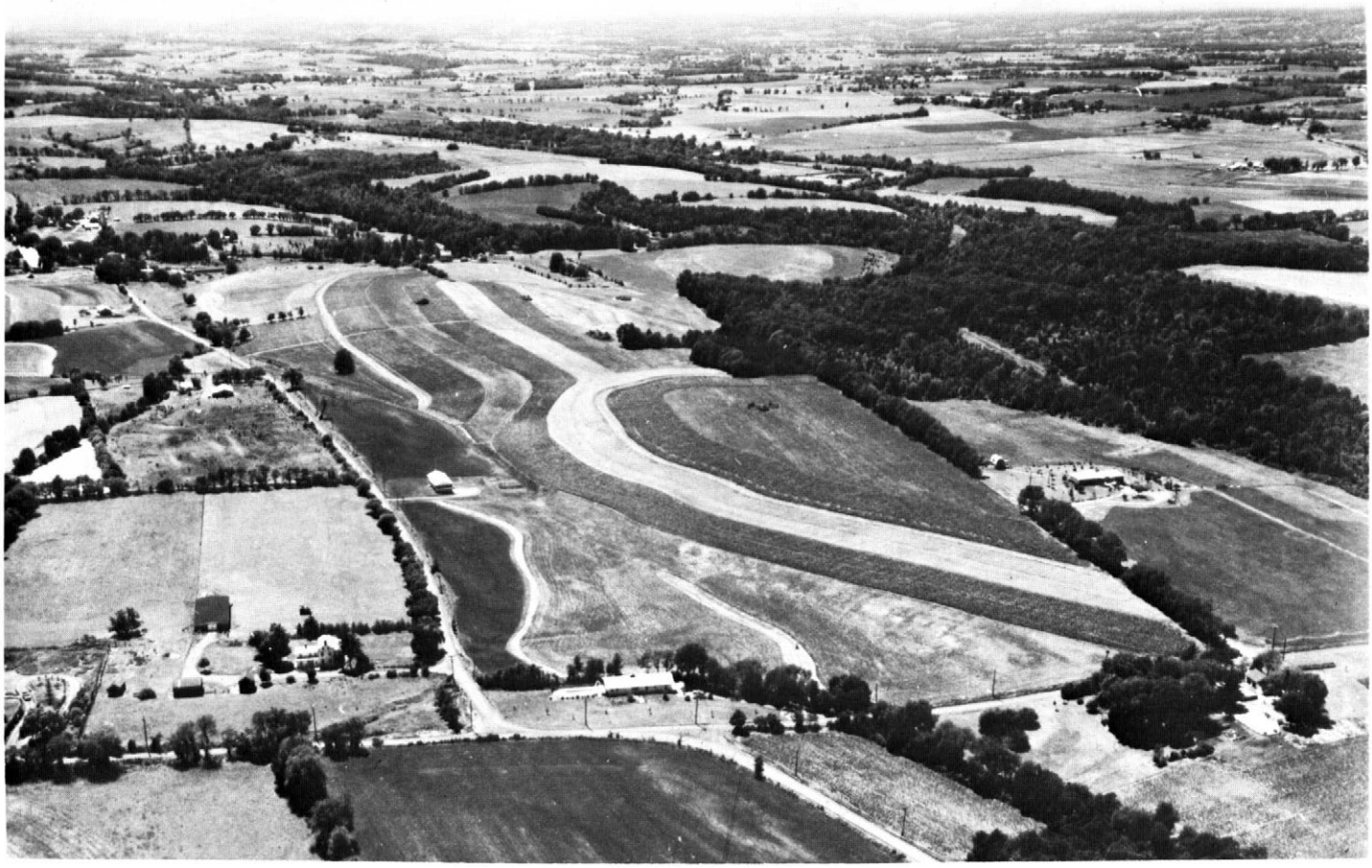

Figure 2.—Typical area of association 5.

Figure 3.—Dairy farm on association 6.

Klinesville soils are shallow, well-drained shaly loams. They are gently sloping to very steep.

Reaville soils are moderately deep, moderately well drained to somewhat poorly drained silt loams. They are nearly level or gently sloping.

The Abbottstown soils are somewhat poorly drained, the Croton soils are poorly drained, the Norton soils are well drained, and the Lansdowne soils are moderately well drained and somewhat poorly drained. The Abbottstown, Croton, and Lansdowne soils have a seasonal perched water table. The Norton soils are well drained and have a slowly permeable subsoil.

The soils in this association are used mostly for general farming and dairying. The less sloping soils are used for corn, soybeans, small grains, hay, and pasture. Klinesville soils are droughty, shallow, and shaly and are not well suited to crops. Artificial drainage is generally needed to remove excess water from the Reaville, Abbottstown, Croton, and Lansdowne soils. Erosion is a potential hazard where the soils are farmed intensively unless conservation measures are used. Depth to bedrock, steepness of slope, and a seasonal water table are limitations for community development.

6. *Bucks-Abbottstown-Readington association*

Nearly level to strongly sloping, deep, well drained to somewhat poorly drained loamy soils underlain mainly by red shale; on uplands

The soils of this association are on uplands along the Hunterdon County line (fig. 3). The landscape is undulating and rolling.

This association makes up about 3 percent of the county. It is 60 percent Bucks soils, 25 percent Abbottstown soils, 5 percent Readington soils, and 10 percent minor soils. The minor soils are Penn, Reaville, and Croton soils.

Bucks soils are deep, well-drained silt loams. They are nearly level to strongly sloping.

Abbottstown soils are deep, somewhat poorly drained silt loams that have a fragipan. They are nearly level to gently sloping.

Readington soils are deep, moderately well drained silt loams that have a fragipan. They are gently sloping.

Penn soils are moderately deep over shale bedrock. Reaville soils are moderately deep over shale, and they have a seasonal high water table. Croton soils are poorly drained, and they are deep over shale bedrock.

Most of the soils in this association are used mainly for general farming and dairying. Bucks and Readington soils are well suited to cultivated crops. The hazard of erosion is the main limitation to the use of the Bucks soil for farming, but wetness commonly delays tillage in spring on the Abbottstown and Readington soils. Artificial drainage is needed for good growth of crops, particularly on Abbottstown soils. Slow permeability and a perched seasonal high water table are limitations for community development.

7. *Royce-Penn-Klinesville association*

Gently sloping to very steep, deep to shallow, well-drained loamy and shaly soils underlain mainly by red shale; on uplands

This association is on uplands where the landscape is undulating and rolling. It makes up about 9 percent of the county. It is 30 percent Royce soils, 30 percent Penn soils, 20 percent Klinesville soils, and 20 percent minor soils. The minor soils are Norton, Lansdowne, and Birdsboro.

Royce soils are deep, well-drained silt loams. They are gently sloping.

Penn soils are moderately deep, well-drained silt loams or shaly silt loams. They are nearly level to strongly sloping.

Klinesville soils are shallow, well-drained shaly loams. They are gently sloping to very steep.

Norton and Birdsboro soils are well drained, and Lansdowne soils are moderately well drained to somewhat poorly drained. Birdsboro soils are on stream terraces.

Most of the soils in this association are used for general farming and dairying. Royce and Penn soils are well suited to cultivated crops. The hazard of erosion is the main limitation to use of the Royce and Penn soils for farming. The Klinesville soils are generally wooded or are used for pasture. Steep slopes and depth to bedrock are limitations for community development.

8. Chalfont-Lehigh-Croton association

Nearly level to steep, deep, poorly drained to moderately well drained loamy and stony soils underlain mainly by argillite or metamorphosed shale; on uplands

This association is on uplands where the landscape is rolling and hilly. It makes up about 4 percent of the county. It is 50 percent Chalfont soils, 20 percent Lehigh soils, 20 percent Croton soils, and 10 percent minor soils. The minor soils are Quakertown, Reaville, and Lawrenceville soils.

Chalfont soils are deep, somewhat poorly drained silt loams or stony silt loams that have a slowly permeable subsoil. They are gently sloping to steep.

Lehigh soils are deep, moderately well drained to somewhat poorly drained silt loams that have a slowly permeable subsoil. They are gently sloping to strongly sloping.

Croton soils are deep, poorly drained silt loams that have a slowly permeable subsoil. They are nearly level to gently sloping.

The Quakertown soils are well drained, the Reaville soils are moderately well drained and somewhat poorly drained, and the Lawrenceville soils are moderately well drained.

Most areas of this association are wooded. Areas of the less sloping and less stony soils are cultivated. A large part of this association is in the Sourland Mountains. Stoniness and wetness are the main limitations to use for farming. Areas that are cultivated have been drained. Slopes and a perched seasonal water level are the main limitations for community development.

Soils Formed Mainly in Glacial Lake Sediment and Marine Sediment

The mostly nearly level to gently sloping soils that make up these associations are mainly in the Passaic Basin, although some of the soils are on uplands. They formed mainly in water-deposited material, and they have a surface layer that is dominantly silt loam. The soils of these associations are mostly in basins, on low plains, and in depressions. Most areas are wooded.

9. Parsippany-Lansdowne-Watchung association

Nearly level to gently sloping, deep, very poorly drained to moderately well drained loamy soils underlain mainly by shale, granitic gneiss, diabase, and basalt; on lake plains

The soils of this association are mainly poorly drained, but somewhat poorly drained and moderately well drained soils are also present. This association is in the northern part of the county in the old Lake Passaic basin. It occupies the lowest positions in the landscape along the Dead and Passaic Rivers.

This association makes up about 5 percent of the county. It is 40 percent Parsippany soils, 30 percent Lansdowne soils, 10 percent Watchung soils, and 20 percent minor soils. The minor soils are Riverhead, Penn, Norton, Reaville, and Whippany.

Parsippany soils are poorly drained silt loams. They are excessively wet during winter, spring, and other wet periods, and they are subject to flooding.

Lansdowne soils are deep, slowly permeable silt loams on knolls. They are nearly level to gently sloping.

Watchung soils are deep, poorly drained silt loams. They are nearly level and are on flats and in depressions and drainageways. Watchung soils have a greater number of coarse fragments in the profile than the other associated soils.

The Riverhead, Penn, and Norton soils are well drained; the Reaville soils are somewhat poorly drained; and the Whippany soils are poorly drained.

Most of the soils in this association have been farmed, but they are now idle and are reverting to shrubs and trees. The association is used to a limited extent for pasture. Excessive wetness, flooding, and the lack of adequate drainage outlets are severe limitations for farming and community development.

10. Keyport-Neshaminy-Elkton association

Dominantly nearly level to gently sloping, deep, well drained to poorly drained loamy and stony soils underlain mainly by diabase; on uplands

The soils of this association are in two areas of undulating and rolling uplands near the Millstone River and along the Middlesex County line.

This association makes up about 1 percent of the county. It is 55 percent Keyport soils, 20 percent Neshaminy soils, 15 percent Elkton soils, and 10 percent minor soils. The minor soils are Birdsboro, Mount Lucas, and Watchung.

Keyport soils are deep, moderately well drained silt loams. They are nearly level to gently sloping.

Neshaminy soils are deep, well-drained silt loams or very stony silt loams. They are gently sloping to very steep.

Elkton soils are deep, poorly drained silt loams. They are nearly level and occupy slight depressions. A seasonal high water table is near the surface several months each year.

The Birdsboro soils are well drained, the Mount Lucas soils are moderately well drained or somewhat poorly drained, and the Watchung soils are poorly drained.

The soils in this association are used mainly for farming and as woodland. The nearly level and gently sloping soils are used for corn, soybeans, small grains, hay, and pasture. Artificial drainage is needed to remove excess water from the Keyport and Elkton soils. The very stony and more sloping Neshaminy soils are used mainly as woodland. A seasonal high water table and slow permeability are limitations for community development.

Soils Formed in Recent Alluvium and Old Alluvium

The nearly level to strongly sloping soils that make up these associations are on the flood plains and terraces along the major streams. They formed dominantly in stream sediment and glacial outwash material. The soils of these associations are mainly farmed or are in pasture.

11. Dunellen-Rowland-Birdsboro association

Nearly level to strongly sloping, deep, well drained to somewhat poorly drained loamy soils formed in glacial outwash or alluvial deposits; on flood plains and terraces

The soils of this association are in one large area in the east-central part of the county in the foothills of the Watchung Mountains (fig. 4). They are mainly nearly level to gently sloping.

This association makes up about 4 percent of the county. It is 45 percent Dunellen soils, 30 percent Rowland soils, 15 percent Birdsboro soils, and 10 percent minor soils. The minor soils are the Raritan, Bowmansville, Lamington, and Dunellen, moderately well drained variant.

Dunellen soils are deep, well-drained sandy loams. These soils formed in glacial outwash material and are on high terraces. They are nearly level to gently sloping.

Rowland soils are deep, moderately well drained and somewhat poorly drained silt loams that formed in recent alluvium along the major streams. They are subject to flooding several times a year.

Birdsboro soils are deep, well-drained silt loams that formed in old alluvium deposits on stream terraces. They are nearly level to strongly sloping and are subject to flooding in only the lowest areas.

The Dunellen moderately well drained variant and the Raritan soils are on terraces above the normal flood plains. Bowmansville soils are on flood plains and are subject to frequent flooding. The Lamington soils are on terraces.

Most of the soils in this association are used for farming and for urban uses. The main crops are corn, small grains, hay, and pasture. Vegetable crops are also well suited to most of the soils in this association. Where water is available for irrigation, vegetables, nursery crops, and other high-value crops can be grown on these soils. The Rowland soils, which are subject to annual flooding, are used mainly for pasture and sod farming. Frequent flooding is a limitation for community development.

12. Rowland-Birdsboro-Raritan association

Nearly level to strongly sloping, deep, well drained to somewhat poorly drained loamy soils formed in alluvial sediment; on flood plains and terraces

The soils of this association are along the major streams. Soils that are subject to flooding are dominant in the association. These soils occupy the flood plains and terraces that are adjacent to the north and south branches of the Raritan River and adjacent to the Lamington, Millstone, Neshanic, and Green Brook Rivers.

This association makes up about 10 percent of the

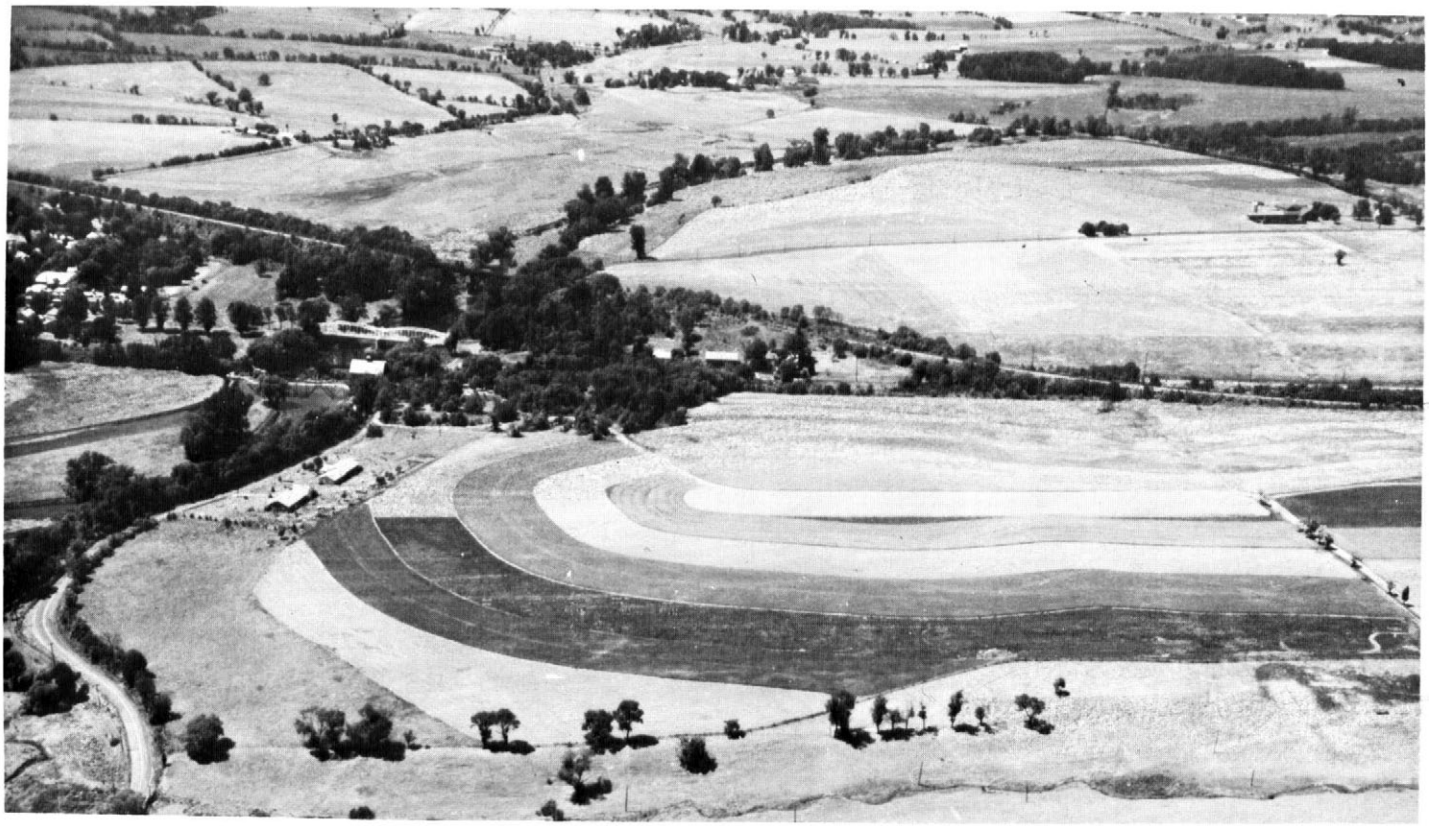

Figure 4.—**Birdsboro and Raritan soils, association 11.**

county. It is 60 percent Rowland soils, 15 percent Birdsboro soils, 15 percent Raritan soils, and 10 percent minor soils. The minor soils are Bowmansville and Lamington soils, Fluvaquents, and Udifluvents and Ochrepts.

Rowland soils are moderately well drained to somewhat poorly drained soils on flood plains. They have a seasonal high water table and are subject to frequent flooding. These soils are deep silt loams that formed in recent alluvium washed from uplands.

Birdsboro and Raritan soils formed in old alluvium. Birdsboro soils are deep, well-drained silt loams. They are on the higher positions on the terraces, and only the lowest areas are subject to infrequent stream flooding. Raritan soils are deep, moderately well drained to somewhat poorly drained silt loams. They have a seasonal high water table and are slowly permeable. They are on stream terraces, and only the lowest areas are subject to flooding. Flooding as a result of stream overflow, however, is an infrequent occurrence.

The poorly drained Bowmansville soils are on the lower flood plains. Although both the Rowland and Bowmansville soils are subject to flooding, the Bowmansville soils tend to become flooded more frequently. Lamington soils are on terraces. Fluvaquents and Udifluvents and Ochrepts occupy the flood plains in the Highlands. They are subject to frequent flooding in most places.

Most of the soils in this association have been cleared of trees and are used mainly for general farming. The main crops are corn, small grains, soybeans, hay, and pasture. Because flooding is a hazard, the Rowland soils are used mainly for pasture, but some areas are used for sod farming. Birdsboro soils are well suited to cultivated crops. Vegetables or nursery crops are well suited, particularly where water for irrigation is available. Frequent flooding and a perched seasonal high water table are limitations for community development.

Descriptions of the Soils

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

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the soil series is representative of mapping units in that series. If a given mapping unit has a profile in some ways different from the one described in the series, these differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit. The description of each mapping unit contains suggestions on how the soil can be managed. Color terms are for moist soil unless otherwise stated.

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

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

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*11*).[1]

Abbottstown Series

The Abbottstown series consists of deep, somewhat poorly drained soils on uplands. These soils are nearly level to gently sloping. They are on flats, in depressions, and on the concave lower parts of the heads of drainageways. The soils formed in a thin mantle of silt that is underlain by material weathered from red sandstone, siltstone, or shale. The lower part of the subsoil is an extremely firm and compact fragipan.

In a representative profile in a wooded area, the surface layer is dark grayish-brown silt loam about 4 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The upper 6 inches of the subsoil is brown heavy silt loam, the middle 4 inches is mottled, brown light silty clay loam, and the lower 16 inches is an extremely firm, compact and brittle fragipan of mottled, reddish-brown heavy silt loam. The substratum, between depths of 35 and 48 inches, is mottled, reddish-brown shaly silt loam. Shale bedrock is at a depth of 48 inches.

In unlimed areas these soils are very strongly acid in the upper part and strongly acid or medium acid in the substratum. Natural fertility is medium. The effective rooting depth is restricted by the fragipan. Permeability is slow in the subsoil, and the available water capacity is moderate. These soils have a perched seasonal high water table at a depth of 6 to 18 inches in fall, in winter, and early in spring. During this period, water moves laterally over the fragipan.

Most areas of Abbottstown soils are wooded. The native vegetation consists of forests of such mixed hardwoods as upland oaks, pin oak, sweetgum, beech, maple, and hickory. Because they are wet, Abbottstown soils are not well suited to intensive cultivation and are better suited to hay and pasture consisting of grasses and legumes that tolerate wetness. Crops respond fairly well to drainage on these soils.

Representative profile of Abbottstown silt loam, 0 to 2 percent slopes, in Branchburg Township; at the west edge

[1] Italic numbers in parentheses refer to Literature Cited, p. 112.

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Abbottstown silt loam, 0 to 2 percent slopes	240	0.1	Mount Lucas gravelly silt loam, 6 to 12 percent slopes	420	.2
Abbottstown silt loam, 2 to 6 percent slopes	1,380	.7	Mount Lucas-Watchung very stony silt loams, 2 to 12 percent slopes	7,130	3.6
Amwell gravelly loam, 2 to 6 percent slopes	1,670	.9	Neshaminy silt loam, 2 to 6 percent slopes	3,500	1.8
Amwell gravelly loam, 6 to 12 percent slopes	410	.2	Neshaminy silt loam, 6 to 12 percent slopes	1,210	.6
Amwell gravelly silt loam, rock substratum, 2 to 6 percent slopes	1,960	1.0	Neshaminy very stony silt loam, 18 to 35 percent slopes	2,360	1.2
Amwell gravelly silt loam, rock substratum, 6 to 12 percent slopes	570	.3	Neshaminy-Mount Lucas very stony silt loams, 2 to 12 percent slopes	10,050	5.1
Arendtsville gravelly loam, 2 to 6 percent slopes	1,000	.5	Neshaminy-Mount Lucas very stony silt loams, 12 to 18 percent slopes	4,620	2.4
Arendtsville gravelly loam, 6 to 12 percent slopes	1,020	.5	Neshaminy silt loam, fragipan variant, 2 to 6 percent slopes	420	.2
Bartley loam, 3 to 15 percent slopes	420	.2	Neshaminy silt loam, fragipan variant, 6 to 12 percent slopes	820	.4
Birdsboro silt loam, 0 to 2 percent slopes	430	.2	Norton loam, 0 to 2 percent slopes	560	.3
Birdsboro silt loam, 2 to 6 percent slopes	5,500	2.8	Norton loam, 2 to 6 percent slopes	5,400	2.8
Birdsboro silt loam, 6 to 12 percent slopes	560	.3	Norton loam, 6 to 12 percent slopes	580	.3
Bowmansville silt loam	2,350	1.2	Norton loam, 6 to 12 percent slopes, eroded	630	.3
Bucks silt loam, 2 to 6 percent slopes	3,000	1.5	Parker very gravelly sandy loam, 3 to 15 percent slopes	1,150	.6
Bucks silt loam, 6 to 12 percent slopes, eroded	700	.4	Parker rocky sandy loam, 25 to 35 percent slopes	530	.3
Califon gravelly loam, 3 to 8 percent slopes	260	.1	Parker-Edneyville very stony soils, 15 to 25 percent slopes	1,600	.8
Califon very stony loam, 3 to 8 percent slopes	320	.2	Parsippany silt loam	4,450	2.3
Chalfont silt loam, 2 to 6 percent slopes	1,430	.7	Parsippany silt loam, very poorly drained variant	520	.3
Chalfont silt loam, 6 to 12 percent slopes	520	.3	Pattenburg gravelly loam, 6 to 12 percent slopes	390	.2
Chalfont stony silt loam, 2 to 6 percent slopes	680	.3	Pattenburg gravelly loam, 12 to 18 percent slopes	560	.3
Chalfont stony silt loam, 6 to 12 percent slopes	880	.4	Penn silt loam, 0 to 2 percent slopes	570	.3
Chalfont stony silt loam, 12 to 25 percent slopes	710	.4	Penn silt loam, 2 to 6 percent slopes	16,700	8.6
Cokesbury very stony loam, 0 to 8 percent slopes	220	.1	Penn silt loam, 6 to 12 percent slopes	2,960	1.5
Croton silt loam, 0 to 2 percent slopes	1,740	.9	Penn shaly silt loam, 2 to 6 percent slopes	11,500	5.8
Croton silt loam, 2 to 6 percent slopes	310	.2	Penn shaly silt loam, 6 to 12 percent slopes	8,470	4.3
Dunellen sandy loam, 0 to 2 percent slopes	330	.2	Quakertown silt loam, 2 to 12 percent slopes	330	.2
Dunellen sandy loam, 2 to 6 percent slopes	3,050	1.6	Quakertown silt loam, 12 to 18 percent slopes	230	.1
Dunellen sandy loam, 6 to 12 percent slopes	200	.1	Raritan silt loam, 0 to 4 percent slopes	5,210	2.7
Dunellen sandy loam, moderately well drained variant	1,620	.8	Readington silt loam, 2 to 6 percent slopes	560	.3
Edneyville gravelly loam, 3 to 8 percent slopes	1,460	.7	Reaville silt loam, 0 to 2 percent slopes	1,330	.7
Edneyville gravelly loam, 8 to 15 percent slopes	2,200	1.1	Reaville silt loam, 2 to 6 percent slopes	3,560	1.8
Edneyville gravelly loam, 15 to 25 percent slopes	850	.4	Riverhead sandy loam, 3 to 15 percent slopes	390	.2
Elkton silt loam	330	.2	Rowland silt loam	15,600	8.0
Fluvaquents	740	.4	Royce silt loam, 2 to 6 percent slopes	5,460	2.8
Keyport silt loam, 0 to 2 percent slopes	610	.3	Udifluvents and Ochrepts	1,500	.8
Keyport silt loam, 2 to 6 percent slopes	480	.2	Urban land	970	.5
Klinesville shaly loam, 2 to 12 percent slopes	13,000	6.6	Watchung silt loam	1,830	.9
Klinesville shaly loam, 12 to 18 percent slopes	3,150	1.6	Whippany silt loam, 0 to 4 percent slopes	470	.2
Klinesville shaly loam, 18 to 35 percent slopes	330	.2	Made land, sanitary landfill	210	.1
Lamington silt loam	480	.2	Pits, sand and gravel	150	.1
Lansdowne silt loam, 0 to 2 percent slopes	3,030	1.5	Quarries	778	.4
Lansdowne silt loam, 2 to 6 percent slopes	3,340	1.7	Water, less than 40 acres	300	.1
Lawrenceville silt loam, 2 to 6 percent slopes	640	.3			
Lawrenceville silt loam, 6 to 12 percent slopes	290	.1	Total	196,288	100.0
Lehigh silt loam, 2 to 6 percent slopes	1,100	.6			
Lehigh silt loam, 6 to 15 percent slopes	790	.4			
Meckesville gravelly loam, 2 to 6 percent slopes	1,530	.8			
Meckesville gravelly loam, 6 to 12 percent slopes	660	.3			
Mount Lucas silt loam, 2 to 6 percent slopes	1,820	.9			

of a woodlot, 300 feet north of Baird Road and north of a school that is one-third mile west of County Line Road:

AO—½ inch to 0, partly decomposed leaves, twigs, and grasses.

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; many fine roots; 1 percent coarse fragments of shale and siltstone; medium acid; clear, wavy boundary.

A2—4 to 9 inches, brown (7.5YR 5/2) silt loam; moderate, medium, granular structure; friable; many fine roots; 1 percent shale fragments; very strongly acid; clear, wavy boundary.

B21t—9 to 15 inches, brown (7.5YR 5/2) heavy silt loam; common, medium, distinct mottles of brown (7.5YR 5/4) and pinkish gray (7.5YR 6/2); moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; fine roots; common thin clay films on ped faces and in root channels; 2 percent shale fragments; very strongly acid; clear, wavy boundary.

B22t—15 to 19 inches, brown (7.5YR 5/2) light silty clay loam; many, medium, distinct mottles of brown (7.5YR 5/4) and pinkish gray (7.5YR 6/2); moderate, medium, subangular blocky structure; firm; few fine roots; many moderately thick clay films on ped faces and in root channels; 5 percent shale fragments; very strongly acid; clear, wavy boundary.

Bx—19 to 35 inches, reddish-brown (5YR 5/4) heavy silt loam; many distinct mottles of gray (5YR 6/1) and pinkish gray (5YR 6/2); weak, very coarse, prismatic structure parting to moderate, medium, angular blocky; extremely firm, compact and brittle; common thin clay films on ped faces; 10 percent shale fragments; strongly acid; clear, wavy boundary.

C—35 to 48 inches, reddish-brown (2.5YR 5/4) shaly silt loam; few, fine, distinct mottles of light gray (5YR 6/1) and pinkish gray (5YR 7/2); weak, thick, platy structure; friable; 25 percent shale fragments; strongly acid; clear, wavy boundary.

R—48 inches, reddish-brown (2.5YR 4/4) partly weathered shale.

The solum ranges from 30 to 43 inches in thickness. Depth to the fragipan is 15 to 25 inches, and depth to bedrock is 3½ to 4½ feet. Coarse fragments make up as much as 10 percent of the solum and 10 to 30 percent of the C horizon. Low-chroma mottles are at a depth of 9 to 18 inches.

The A horizon has a hue of 10YR to 5YR, a value of 3 to 5, and a chroma of 2 to 4.

The B2t horizon ranges from silt loam to clay loam. It has a hue of 7.5YR or 5YR, a value of 4 to 6, and a chroma of 1 to 6.

The Bx horizon has a hue of 5YR or 2.5YR, a value of 4 to 6, and a chroma of 1 to 4. It has weak, very coarse, prismatic structure parting to moderate, medium, angular blocky and weak, medium, platy.

The C horizon ranges from shaly loam to shaly clay loam. It has a hue of 5YR or 2.5YR, a value of 4 or 5, and a chroma of 1 to 6.

Abbottstown soils are associated with the moderately well drained Readington soils at the higher elevations. They are associated with the moderately deep, moderately well drained and somewhat poorly drained Reaville soils and the poorly drained Croton soils on the lower parts of slopes, in depressions, and along drainageways. Well-drained Bucks and Penn soils are near the Abbottstown soils but are higher and steeper.

Abbottstown soils are less gray in the B horizon than Croton soils and more gray than Reaville soils. Mottling in the B horizon distinguishes Abbottstown soils from Penn and Bucks soils.

Abbottstown silt loam, 0 to 2 percent slopes (AbA).—This soil occupies intermediate positions of the landscape. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Readington and Bucks soils. Also included are areas where the subsoil is brown and very silty.

The content of organic matter is moderate. The surface layer is generally easy to till, but wetness early in spring and after heavy rain delays plowing and cultivation. Runoff is slow, and ponding is common in low-lying areas after heavy rain. The hazard of erosion is slight.

This soil is used for the crops commonly grown in the county and for hay and pasture. In undrained areas it is only fairly suited to corn, soybeans, and spring-sown small grains. Alfalfa and winter grains are likely to be seriously affected by ponded water and frost heaving. The natural wetness caused by seeps, springs, and ponding can be reduced by diversion terraces and surface drains. Drainage ditches remove excess water effectively. Drainage via drain tiles, however, is generally too slow to be practical. Capability unit IIIw-71; woodland suitability group 3w1.

Abbottstown silt loam, 2 to 6 percent slopes (AbB).—This soil is on broad undulating uplands. It has a profile similar to the one described as representative of the series, but the surface layer contains more shale fragments.

Included with this soil in mapping are areas of Readington soils, Croton soils, soils that have slopes of more than 6 percent, and eroded soils. The eroded soils have poorer germination and poorer crop production than the soils that are not eroded.

The content of organic matter is medium in the surface layer. Tilth is generally good. This soil is hard, cloddy, and difficult to till if it is plowed when it is wet or eroded. Wetness early in spring and after heavy rain delays plowing and cultivation and is the main limitation to the use of this soil. Runoff is slow, and the hazard of erosion is slight.

This soil is used for the crops commonly grown in the county and for hay and pasture. In undrained areas it is only fairly suited to corn, soybeans, and spring-sown small grains. Alfalfa and winter grains are likely to be seriously damaged by frost heaving. The natural wetness caused by seeps and springs can be reduced by diversion terraces and surface drains. Many areas need diversion terraces to intercept runoff from higher soils, improve drainage, and control erosion. Drain tiles generally do not remove excess water effectively. On long slopes contour cultivation and contour stripcropping help reduce runoff and the amount of soil lost through erosion. Capability unit IIIw-71; woodland suitability group 3w1.

Amwell Series

The Amwell series consists of deep, moderately well drained and somewhat poorly drained soils that have a firm fragipan in the lower part of the subsoil. These soils are gently sloping and strongly sloping. They are on hillsides and lower slopes and at the base of the Watchung Mountains. They occupy intermediate positions of the landscape. The surface layer and upper part of the subsoil formed in gravelly trap colluvium, and the lower part of the subsoil formed in residuum of basalt or diabase.

In a representative profile the surface layer is dark grayish-brown gravelly loam 3 inches thick. The upper part of the subsoil is dark-brown gravelly loam 11 inches thick. The next 7 inches of the subsoil is mottled, yellowish-brown clay loam. The lower 15 inches of it is a firm fragipan of brown loam and dark yellowish-brown fine sandy loam. The substratum, between depths of 36 and 60 inches, is yellowish-brown and dark yellowish-brown fine sandy loam.

In unlimed areas these soils are strongly acid to medium acid in the upper part of the profile and strongly acid to slightly acid in the lower part. Natural fertility is high. The effective rooting depth is limited by the fragipan. Permeability is slow in the lower part of the subsoil, and the available water capacity is moderate. These soils have a perched seasonal high water table at a depth of 1 foot to 4 feet. Water moves laterally over the fragipan late in winter and early in spring.

Much of the acreage of Amwell soils is wooded. The native vegetation consists of hardwood forest of mixed oaks, beech, ash, and maple. The soils are fairly well suited to crops and are well suited to hay and pasture.

Representative profile of Amwell gravelly loam, 2 to 6 percent slopes, in Bernards Township; on the east side of the Mine Brook Road, 200 yards north of Interstate 287:

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) gravelly loam; strong, fine, granular structure; friable; many fine and large roots; 15 percent pebbles and cobbles, mostly basalt; medium acid; gradual, wavy boundary.

B1—3 to 14 inches, dark-brown (10YR 4/3) gravelly loam; weak, coarse, subangular blocky structure; friable; many fine and large roots; 15 percent pebbles, mostly basalt; medium acid; clear, wavy boundary.

B2t—14 to 21 inches, yellowish-brown (10YR 5/4) clay loam; many, coarse, distinct, light brownish-gray (2.5Y 6/2) mottles and few, fine, distinct, brownish-yellow (10YR 6/8) mottles; weak, medium and coarse, subangular blocky structure; friable; slightly sticky and slightly plastic; many fine roots; 5 percent pebbles, mostly basalt; thin patchy clay films on ped surfaces; medium acid; abrupt, wavy boundary.

Bx1—21 to 26 inches, brown (7.4YR 5/4) loam; many, coarse, prominent, light brownish-gray (2.5Y 6/2) mottles; weak, thick, platy structure and weak, very coarse, prismatic; brittle, firm; few roots concentrated in widely spread, vertical, light brownish-gray (10YR 6/2) streaks; 5 percent

pebbles; thin patchy clay films on horizontal surfaces of peds; medium acid; gradual, wavy boundary.

Bx2—26 to 36 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; common, coarse, distinct, light brownish-gray (10YR 6/2) mottles; weak, thick, platy structure; brittle, very firm; 5 percent pebbles; thin patchy clay films on horizontal surfaces of peds; medium acid; gradual, wavy boundary.

C1—36 to 46 inches, yellowish-brown (10YR 5/6) fine sandy loam; few, coarse, distinct, light brownish-gray (2.5Y 6/2) mottles and few, fine, olive-yellow (2.5Y 6/6) mottles; massive; friable; 10 percent pebbles; medium acid; gradual, wavy boundary.

C2—46 to 60 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; massive; friable; 10 percent pebbles; medium acid.

The solum ranges from 30 to 50 inches in thickness. Depth to red shale or basalt bedrock ranges from 3½ to 8 feet or more. Coarse fragments make up 15 to 25 percent of the upper part of the solum and 20 to 35 percent of the lower part.

The A horizon has a hue of 10YR or 7.5YR, a value of 3 to 6, and a chroma of 2 to 6. In wooded areas hue, value, and chroma are commonly 10YR 4/2, and in cultivated areas they are 10YR 5/6. This horizon is typically gravelly loam or gravelly silt loam.

The matrix of the B2t horizon has a hue of 7.5YR or 10YR, a value of 4 to 6, and a chroma of 4 to 6. Few to many low-chroma mottles start at a depth of 10 to 20 inches. The Bt horizon is loam, silt loam, clay loam, silty clay loam, and gravelly silt loam. The Bx horizon has a hue of 7.5YR to 10YR, a value of 4 to 6, and a chroma of 1 to 6. The fragipan is commonly loam but ranges to fine sandy loam, gravelly silty clay loam, and cobbly light silty clay loam.

The C horizon has a hue of 7.5YR or 10YR, a value of 4 to 6, and a chroma of 2 to 6. This horizon is commonly fine sandy loam but ranges to gravelly silt loam and very gravelly sandy loam.

Amwell soils are next to the moderately well drained Neshaminy fragipan variant soils on hillsides and ridges, the moderately well drained and somewhat poorly drained Mount Lucas soils on lower slopes, and the gray poorly drained Watchung soils in slight depressions and pockets along drainageways.

Amwell soils differ from the Neshaminy fragipan variant in containing more gravel in the surface layer and in having a mottled subsoil. Unlike Mount Lucas soils, Amwell soils have a fragipan. They are better drained and not so gray as Watchung soils.

Amwell gravelly loam, 2 to 6 percent slopes (AmB).—This gently sloping soil is on lower slopes and along drainageways at the base of the Watchung Mountains. It has the profile described as representative of the series. Bedrock is rippable red shale.

Included with this soil in mapping are small areas of nongravelly or cobbly soils and poorly drained Watchung soils in depressions and drainageways.

The organic-matter content is moderate, and the surface layer is generally easy to till. Wetness and the slow permeability of the subsoil delay working of this soil in spring. Runoff is slow, and the hazard of erosion is slight. Wetness is the main limitation of this soil for crops. Interceptor drains and diversion terraces are effective in reducing wetness on lower slopes and helping to distribute water from springs and seeps.

This soil is fairly well suited to corn, soybeans, spring-sown small grains, hay, and pasture. Alfalfa and winter-sown grains are subject to winterkill. In cultivated areas, a suitable cropping system and conservation practices are needed to control runoff and erosion. Capability unit IIIw-70; woodland suitability group 2w1.

Amwell gravelly loam, 6 to 12 percent slopes (AmC).—This strongly sloping soil is on hillsides and lower slopes in the Watchung Mountains. It has a profile similar to the one described as representative of the series, but it contains more coarse fragments. Bedrock is red shale.

Included with this soil in mapping are some small areas where the brown subsoil has been mixed with the surface layer in plowing. Also included are some small areas of the Neshaminy fragipan variant and Mount Lucas and Neshaminy soils.

The organic-matter content is moderate, and the surface layer is generally easy to till. This soil should be cultivated only during optimum moisture conditions because of wetness caused by slow permeability and seeps. Drainage is necessary for the best growth of most crops. Runoff is medium, and the erosion hazard is moderate where this soil is plowed and left bare or where it is used for row crops.

This soil is fairly well suited to corn, soybeans, spring-sown small grains, hay, and pasture. Alfalfa is subject to winterkill. Diversion terraces can be used for drainage, and tile can be used to remove water from seep spots. In cultivated fields a suitable cropping system, contour farming, and stripcropping are needed to control runoff and erosion. Capability unit IIIe-70; woodland suitability group 2w1.

Amwell gravelly silt loam, rock substratum, 2 to 6 percent slopes (AnB).—This soil has a profile similar to the one described as representative of the series, but it has more coarse fragments in the surface layer. Bedrock is hard basalt.

Included with this soil in mapping are small areas of poorly drained soils and some areas of soils that have less coarse fragments in the surface layer than this Amwell soil. Also included are areas of Neshaminy and Mount Lucas soils.

Runoff and the hazard of erosion are slight. Wetness is the major concern of management in cultivated areas, and the seasonal high water table limits the use of this soil for crops. Drainage is needed for the best growth of most crops and for many other uses. Wetness also affects alfalfa. Grasses and legumes that tolerate wetness should be planted for hay and pasture.

Most of the acreage is wooded, but a small acreage is used for pasture or orchards. Drainage by diversion terraces or by other methods can be used to remove excess water. Underdrains can be used to carry water away from seep spots. The depth to bedrock may interfere with installation of underdrains. Where gravel and cobbles make up more than 25 percent of the surface layer, they interfere with cultivation. Management is needed to control runoff and erosion and to reduce wetness. Capability unit IIIw-70; woodland suitability group 2w1.

Amwell gravelly silt loam, rock substratum, 6 to 12 percent slopes (AnC).—This sloping soil is on hillsides near the foot of the Watchung Mountains in the northern part of the county. It has a profile similar to the one described as representative of the series, but it has more coarse fragments in the surface layer and depth to the fragipan is about 15 inches. Bedrock is hard basalt.

Included with this soil in mapping are areas of soils that have less coarse fragments in the surface layer. Also included are areas of Neshaminy, Mount Lucas, and Watchung soils.

Runoff is medium, and the hazard of erosion is moderate. This soil should be cultivated only during optimum moisture conditions because of wetness caused by slow permeability and seeps. Drainage is necessary for the best growth of most crops.

This soil is fairly well suited to corn, soybeans, spring-sown small grains, hay, and pasture. Management is

needed to control runoff and erosion and reduce wetness. Capability unit IIIe-70; woodland suitability group 2w1.

Arendtsville Series

The Arendtsville series consists of deep, well-drained soils. These soils are gently sloping to strongly sloping. They are in undulating and rolling uplands and occupy high positions in the landscape. They formed in material weathered from quartzite conglomerate or fanglomerate.

In a representative profile in a cultivated area, the surface layer is reddish-brown gravelly loam 10 inches thick. The upper part of the subsoil, between depths of 10 and 30 inches, is reddish-brown gravelly loam and dark reddish-brown heavy gravelly loam. The next 13 inches of the subsoil is dark reddish-brown gravelly sandy clay loam. Between depths of 43 and 55 inches is dark reddish-brown gravelly sandy loam. The substratum, between depths of 55 and 62 inches, is very friable, dark reddish-brown gravelly sandy loam.

In unlimed areas these soils are extremely acid or very strongly acid in the upper part and very strongly acid or strongly acid in the lower part. Natural fertility is medium. The rooting zone is deep. Permeability is moderately rapid, and the available water capacity is moderate.

Arendtsville soils are suited to the crops commonly grown in the county, including corn, soybeans, small grains, fruit, hay, and pasture. The native vegetation consists of forests of such mixed deciduous trees as yellow-poplar, upland oaks, hickory, and maple.

Representative profile of Arendtsville gravelly loam, 2 to 6 percent slopes; in Bedminster Township, one-half mile west of intersection of Highway 202 and County Route 7 and 400 feet south of County Route 7:

Ap—0 to 10 inches, reddish-brown (5YR 4/3) gravelly loam; weak, fine, granular structure; friable; common fine roots; 20 percent rounded and broken quartzite pebbles and cobbles; medium acid; abrupt, smooth boundary.

B1—10 to 15 inches, reddish-brown (5YR 4/4) gravelly loam; weak, fine, subangular blocky structure; friable; common fine roots; 20 percent rounded and broken quartzite pebbles and cobbles; few thin clay films on some ped faces; medium acid; clear, wavy boundary.

B21t—15 to 30 inches, dark reddish-brown (5YR 3/4) heavy gravelly loam; moderate, medium, subangular blocky structure; friable; few fine roots; slightly sticky and slightly plastic; common moderately thick clay films on ped faces and in root channels; 20 percent rounded and broken quartzite pebbles and cobbles; strongly acid; gradual, wavy boundary.

B22t—30 to 43 inches, dark reddish-brown (2.5YR 3/4) gravelly sandy clay loam; moderate, medium, angular and subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; moderately thick clay films on most ped faces; 20 percent rounded and broken quartzite pebbles and cobbles; strongly acid; gradual, wavy boundary.

B3—43 to 55 inches, dark reddish-brown (2.5YR 3/4) gravelly sandy loam; weak, fine, subangular blocky structure; very friable; 20 percent rounded and broken quartzite pebbles and cobbles; strongly acid; diffuse, irregular boundary.

C—55 to 62 inches, dark reddish-brown (2.5YR 3/4) gravelly sandy loam; massive; very friable; 35 percent rounded quartzite pebbles and cobbles; strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 6 to 10 feet. Coarse fragments of rounded quartzite make up 15 to 35 percent of the solum and 20 to 60 percent of the C horizon.

The A horizon has a hue of 7.5YR or 5YR, a value of 4 or 5, and a chroma of 2 to 4.

The B horizon has a hue of 5YR or 2.5YR, a value of 3 or 4, and a chroma of 3 or 4. This horizon is loam, sandy clay loam, clay loam, and their gravelly equivalents.

The C horizon has a hue of 5YR, 2.5YR, or 10R; a value of 3 or 4; and a chroma of 3 or 4. It is gravelly and very gravelly sandy loam.

Arendtsville soils are next to the shallow, well-drained Klinesville soils on steep hillsides; the moderately deep, well-drained Penn soils on rolling uplands; the deep, well-drained gravelly Pattenburg soils on side slopes; the deep, moderately well drained Meckesville soils on hilltops and ridges; and the deep, moderately well drained to somewhat poorly drained Rowland soils along drainageways and stream flood plains.

Arendtsville soils contain less gravel and more clay in the B horizon than Pattenburg soils. They are deeper over bedrock and less shaly than Klinesville and Penn soils. They are redder than Meckesville soils, and they do not have the firm, brittle fragipan that is common in those soils. They have a more developed B horizon than Rowland soils.

Arendtsville gravelly loam, 2 to 6 percent slopes (ArB).—This gently sloping soil is on broad undulating uplands. It has the profile described as representative of the series. Rounded gravel and cobbles 1 inch to 6 inches in diameter are scattered over the surface and throughout the profile.

Included with this soil in mapping are areas where the surface layer is loam and small areas of soils that are capped with a thin layer of gneissic glacial till. Also included are small areas of moderately deep Penn soils and shallow Klinesville soils.

The organic-matter content is medium. The surface layer is generally easy to till, but gravel and cobbles interfere somewhat with tillage operations. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for corn, small grains, and hay. Long slopes may need stripcropping or contour cultivation to control erosion. Capability unit IIe-55; woodland suitability group 2o1.

Arendtsville gravelly loam, 6 to 12 percent slopes (ArC).—This sloping soil is on hillsides along drainageways.

Included with this soil in mapping are small areas where slopes are more than 12 percent and small areas of soils that are capped with a thin layer of gneissic glacial till. Also included are areas of moderately deep Penn soils and shallow Klinesville soils.

In cultivated and unprotected areas, runoff is medium and the hazard of erosion is moderate. Gravel and cobbles interfere with tillage operations, especially where they make up more than 25 percent of the surface layer.

This soil is used mainly for hay and corn. Other crops are alfalfa, Ladino clover, timothy, and bromegrass. Long slopes may need diversion terraces to intercept surface water. Stripcropping and contour cultivation are needed on long slopes to control erosion and reduce runoff. Capability unit IIIe-53; woodland suitability group 2o1.

Bartley Series

The Bartley series consists of deep, moderately well drained soils that have a firm fragipan in the lower part of the subsoil. These soils are gently sloping to strongly sloping. They are in intermediate positions in the landscape. They formed in material weathered mostly from glacial till composed of granitic gneiss and limestone over limestone bedrock.

In a representative profile in a cultivated area, the surface layer is dark-brown loam about 10 inches thick. The subsurface layer is dark-brown loam about 5 inches thick.

The subsoil is strong-brown loam and dark-brown heavy loam in the upper 10 inches. Between depths of 25 and 43 inches it is a firm, compact fragipan of dark-brown light clay loam that is mottled with brown and yellowish brown. The substratum, between depths of 43 and 50 inches, is friable, brown heavy loam. Dark-gray hard limestone bedrock is at a depth of 50 inches.

In unlimed areas these soils are slightly acid in the upper part and neutral in the lower part. Natural fertility is high. Permeability is moderately slow, and available water capacity is moderate. A seasonal high water table, at a depth of 2 to 4 feet, is perched on the fragipan of these soils. Water flows laterally over the fragipan late in winter and in spring.

Bartley soils are well suited to the crops commonly grown in the county, including corn, soybeans, small grains, fruit, vegetables, hay, and pasture. The native vegetation consists of forests of such mixed deciduous trees as upland oaks, yellow-poplar, ash, maple, and hickory.

Representative profile of Bartley loam, 3 to 15 percent slopes; one-fourth mile south of Morris-Somerset County line along the Chester-Gladstone Road:

Ap—0 to 10 inches, dark-brown (10YR 3/3) loam; moderate, fine, granular structure; friable; 5 percent angular pebbles of black chert, quartzite, and gneiss; many fine roots; neutral; abrupt, smooth boundary.

A2—10 to 15 inches, dark-brown (7.5YR 4/4) loam; moderate, medium, granular structure; friable; 5 percent angular pebbles of black chert, quartzite, and gneiss; common fine roots; neutral; clear, wavy boundary.

B1—15 to 19 inches, strong-brown (7.5YR 5/6) loam; weak, fine, subangular blocky structure; friable; 5 percent angular pebbles of black chert, quartzite, and gneiss; common fine roots; neutral; clear, wavy boundary.

B2t—19 to 25 inches, dark-brown (7.5YR 4/4) heavy loam; moderate, medium, subangular blocky structure; friable; 10 percent angular pebbles of black chert, quartzite, and gneiss; few fine roots; common moderately thick clay films on ped faces and in root channels; neutral; gradual, wavy boundary.

Bx—25 to 43 inches, dark-brown (7.5YR 4/4) light clay loam; few, fine, faint, brown (10YR 5/3) and yellowish-brown (10YR 5/6) mottles; moderate, very coarse, prismatic structure; firm; 10 percent angular pebbles of black chert, quartzite, and granite gneiss; few fine roots; common moderately thick clay films on ped faces and in root channels; neutral; clear, wavy boundary.

C—43 to 50 inches, brown (7.5YR 5/4) heavy loam; weak, moderate, subangular blocky structure; friable; 10 percent angular pebbles of chert and limestone; neutral; clear, irregular boundary.

R—50 inches, dark-gray (N 4/0) limestone interbedded with thin strata of shale.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 4 to 8 feet. Coarse fragments make up 5 to 15 percent of the soil.

The Ap horizon has a hue of 10YR to 7.5YR, a value of 3 or 4, and a chroma of 3 or 4.

The Bt horizon commonly has a hue of 7.5YR to 10YR, a value of 4 or 5, and a chroma of 4 to 6. This horizon ranges from heavy loam to clay loam.

The C horizon typically has a hue of 7.5YR but ranges to 5YR and 10YR. Value and chroma are 3 or 4. This horizon is commonly loam, but in places it is sandy loam and their gravelly equivalents.

Bartley soils are associated with the well-drained Pattenburg and Edneyville soils on strongly sloping uplands. Mottling and the fragipan distinguish Bartley soils from Pattenburg and Edneyville soils.

Bartley loam, 3 to 15 percent slopes (BaC).—This gently sloping to strongly sloping soil is on undulating and rolling uplands in the northern part of the county. Chert, gneiss, and limestone pebbles and cobbles are scattered over the surface and throughout the profile.

Included with this soil in mapping are some areas of nearly level soils and small areas of soils that are steep or moderately eroded. Also included are areas of soils that have a surface layer of silt loam and some small areas of Bartley soils that do not have a fragipan. Somewhat poorly drained and well-drained soils along drainageways are also included.

The organic-matter content is medium. The surface layer is generally easy to till, and it can be plowed and cultivated early in spring and soon after light showers. In cultivated and unprotected areas, runoff is medium and the hazard of erosion is moderate.

This soil is used mainly for corn, vegetables, and hay. Hay plants include alfalfa, Ladino clover, orchardgrass, timothy, and bromegrass. On long areas of strongly sloping soils, stripcropping is needed to control erosion. Capability unit IIIe-71; woodland suitability group 2w1.

Birdsboro Series

The Birdsboro series consists of deep, well-drained soils on stream terraces of the Lamington, Neshanic, and Raritan Rivers. These soils are nearly level to strongly sloping. They are on benches scattered along the major streams. They formed in old stream sediment of mixed composition, mainly red sandstone, siltstone, and shale.

In a representative profile in a cultivated area, the surface layer is dark reddish-gray silt loam about 8 inches thick. The subsurface layer is 4 inches of reddish-brown silt loam. The upper 7 inches of the subsoil is reddish-brown heavy silt loam, and the lower 19 inches is dark reddish-brown light silty clay loam that contains some rounded pebbles. Between depths of 38 and 56 inches the substratum is dark reddish-brown sandy loam, and between depths of 56 and 70 inches it is dark reddish-brown stratified sand and gravel.

In unlimed areas these soils are very strongly acid or strongly acid. Natural fertility is medium. The effective rooting zone is deep. Permeability is moderate, and the available water capacity is high.

Most areas of Birdsboro soils are above normal stream overflow. The lowest areas and areas near the confluence of streams are subject to stream overflow once every 50 to 100 years. Such areas make up less than 10 percent of the total acreage of these soils.

Nearly all areas of Birdsboro soils have been cleared for crops. The native vegetation consists of forests of such deciduous hardwood trees as white, red, and black oaks; yellow-poplar; birch; maple; and hickory. The soils are suited to a wide variety of crops, including vegetables and fruit, nursery, and other specialized crops; and they are excellent for corn, soybeans, and small grains.

Representative profile of Birdsboro silt loam, 2 to 6 percent slopes, in Branchburg Township; in a road cut along U.S. Highway 202, one-half mile west of the north branch of the Raritan River:

Ap—0 to 8 inches, dark reddish-gray (5YR 4/2) silt loam; moderate thin, platy structure parting to moderate, fine, granular; friable; common fine and very fine roots; 2 percent rounded pebbles of mixed composition; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, reddish-brown (5YR 5/4) silt loam; moderate, medium, platy structure; friable; common fine roots; 1

percent rounded pebbles of mixed composition; strongly acid; clear, wavy boundary.

B21t—12 to 19 inches, reddish-brown (5YR 4/4) heavy silt loam; moderate, medium, subangular blocky structure; friable; few fine roots; 1 percent rounded pebbles; few thin clay films on ped faces and in pores; many silt coatings on ped faces; very strongly acid; clear, wavy boundary.

B22t—19 to 38 inches, dark reddish-brown (2.5YR 3/4) light silty clay loam; moderate, medium, angular blocky structure; slightly firm; 1 percent rounded pebbles; common thin clay films on ped faces; very strongly acid; clear, wavy boundary.

IIC1—38 to 56 inches, dark reddish-brown (5YR 3/4) sandy loam; massive; very friable; strongly acid; abrupt, smooth boundary.

IIC2—56 to 70 inches, dark reddish-brown (5YR 3/4) stratified sand and gravel of mixed composition; strongly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to shale bedrock is generally 6 to 10 feet or more. Coarse fragments of mixed composition make up 0 to 15 percent of the solum.

The Ap horizon has a hue of 10YR, 7.5YR, 5YR, and 2.5YR; a value of 3 or 4; and a chroma of 2 or 3. In wooded areas color in the A1 horizon commonly is 7.5YR 3/2 or 5YR 3/2.

The Bt horizon has a hue of 2.5YR, 5YR, and 7.5YR; a value of 3 or 4; and a chroma of 3 to 5. The Bt horizon is typically light silty clay loam, but in places it ranges to heavy loam, sandy clay loam, clay loam, and heavy silt loam.

In the C horizon hue, value, and chroma are commonly 5YR 3/4, but hue ranges to 2.5YR and 7.5YR. This horizon ranges from sandy loam to clay loam and contains varying amounts of gravel, cobbles, and shale. The content of gravel ranges from 0 to 30 percent in the IIC1 horizon and from 10 to 50 percent in the IIC2 horizon.

Birdsboro soils are on the higher parts of stream terraces adjacent to the moderately well drained to somewhat poorly drained Raritan soils on nearly level flats and the poorly drained, gray Lamington soils in slight depressions. They are adjacent to Rowland and Bowmansville soils on flood plains. They are near areas of the moderately deep Penn soils, the shallow Klinesville soils, and the moderately deep Reaville soils on uplands.

Birdsboro soils are deeper, less shaly, and more gravelly than Penn, Klinesville, and Reaville soils. They do not have the gray mottles and the firm, slowly permeable fragipan that are typical of Raritan soils. They do not have the mottles that are characteristic of Rowland and Bowmansville soils.

Birdsboro silt loam, 0 to 2 percent slopes (BdA).—This nearly level, well-drained soil is on stream terraces in the valleys of the major streams. In a few places bedrock is as close to the surface as 4 feet.

Included with this soil in mapping are some areas of more sloping, moderately eroded soils and areas of soils that have a surface layer of loam. Also included are some small areas where the surface layer is as much as 25 percent gravel. Small areas of Raritan and Penn soils are also included.

The organic-matter content is medium. The surface layer is generally in good tilth, and it can be plowed and worked early in spring. Runoff is slow, and the hazard of erosion is slight. The soil can be cultivated continuously under a high level of management. Smoothing the surface improves runoff in some areas.

This soil is used for the commonly grown field crops and for hay and pasture. Cover crops and minimum tillage are needed to maintain the organic-matter content and good tilth. Capability unit I-55; woodland suitability group 2o1.

Birdsboro silt loam, 2 to 6 percent slopes (BdB).—This gently sloping soil is on undulating terraces in the valleys of the major streams. It has the profile described as representative of the series. In a few places bedrock is as close to the surface as 4 feet.

Included with this soil in mapping are some areas of moderately eroded soils and areas of soils that have a surface layer of loam or sandy loam. Also included are some small areas where the surface layer is as much as 25 percent gravel and areas of Penn and Raritan soils.

The organic-matter content is medium. The surface layer is generally easy to till, and it can be plowed and worked early in spring. In cultivated areas runoff is medium and the hazard of erosion is moderate.

This soil is used mainly for general crops. Less than 5 percent of the total acreage is wooded. Contour stripcropping and minimum tillage are needed on long slopes to maintain the organic-matter content and good tilth and to control runoff and erosion. Capability unit IIe-55; woodland suitability group 2o1.

Birdsboro silt loam, 6 to 12 percent slopes (BdC).—This strongly sloping soil is on sharp breaks between flood plains and terraces in the valleys of the major streams. It has a profile similar to the one described as representative of the series, but it has more gravel scattered throughout the surface layer. Also, depth to stratified sand and gravel in this soil is about 3 feet.

Included with this soil in mapping are some areas of eroded soils where patches of subsoil are exposed if the soil is plowed. Also included are areas where the surface layer is loam or gravelly sandy loam.

The organic-matter content is medium. The surface layer is generally easy to till, and the soil can be plowed and cultivated early in spring and soon after heavy rain. Runoff is rapid in cultivated areas, and the hazard of erosion is moderate.

This soil is used for general field crops common to the county. It is suited to corn, soybeans, small grains, grasses, and legumes. Most of the acreage is used for hay or permanent pasture. Contour cultivation, stripcropping, and minimum tillage are needed to control runoff and erosion and to maintain the organic-matter content and good tilth in cultivated areas. Capability unit IIIe-55; woodland suitability group 2o1.

Bowmansville Series

The Bowmansville series consists of deep, poorly drained soils on the flood plains of the major rivers and smaller streams in the county. Along the Raritan, Lamington, and Millstone Rivers these soils formed in mixed sediment, mainly glacial till and granite gneiss that washed from the upper part of the Raritan River basin. Along the small streams they formed in sediment that washed mostly from red shale, siltstone, or fine-grained sandstone on uplands.

In a representative profile in a cultivated area, the surface layer is mottled, reddish-brown silt loam 9 inches thick. The subsurface layer is 8 inches of mottled, weak-red silt loam. The upper part of the subsoil is 9 inches of mottled, gray light clay loam. The lower part, between depths of 26 and 38 inches, is mottled, gray sandy clay loam. The upper 9 inches of the substratum is mottled, reddish-gray fine sandy loam. The lower part of the substratum, between depths of 47 and 60 inches, is reddish-brown, stratified sand and gravel.

These soils are strongly acid or very strongly acid in the upper part and strongly acid or medium acid in the lower part. Natural fertility is medium. Permeability is moderately slow, and the available water capacity is high. The water table is at the surface late in fall, in winter, and early in spring.

These soils are subject to frequent flooding, mostly in spring but occasionally in summer and fall. At times planted crops cannot be harvested because of floodwater, and sometimes flooding destroys the crops.

More than half the acreage of Bowmansville soils has been cleared for farming. The native vegetation consists of forests of such deciduous trees as pin oak, white oak, ash, sycamore, hickory, and river birch. Because of their wetness, some areas have been left wooded. Most areas are used for pasture or hay. Plants that tolerate wetness are more suitable than others. Some areas have been developed as parks.

Representative profile of Bowmansville silt loam in Franklin Township, 1 mile north of Rocky Hill along Canal Road and 300 feet west of road:

Ap—0 to 9 inches, reddish-brown (2.5YR 4/4) silt loam; few, fine, faint mottles of weak red (2.5YR 4/2); weak, medium, granular structure; friable; many fine roots; strongly acid; abrupt, wavy boundary.

A2g—9 to 17 inches, weak-red (2.5YR 4/4) silt loam; common, medium, distinct mottles of gray (5YR 5/1) and reddish yellow (5YR 6/8); weak, medium, granular structure; friable; common fine roots; strongly acid; clear, wavy boundary.

B1g—17 to 26 inches, gray (5YR 5/1) light clay loam; common, medium, distinct mottles of reddish yellow (5YR 6/8); weak, fine, subangular blocky structure; friable; few fine roots; strongly acid; clear, wavy boundary.

B2g—26 to 38 inches, gray (5YR 5/1) sandy clay loam; common, medium, distinct mottles of reddish yellow (5YR 6/8); weak, medium, subangular blocky structure; friable; 2 percent rounded coarse fragments of mixed composition; iron concretions throughout the horizon; medium acid; clear, wavy boundary.

C1g—38 to 47 inches, reddish-gray (5YR 5/2) fine sandy loam; common, medium, distinct mottles of yellowish red; massive; friable; medium acid; clear, wavy boundary.

IIC2—47 to 60 inches, reddish-brown (5YR 4/4) stratified sand and gravel; medium acid.

The solum ranges from 24 to 40 inches in thickness. Depth to bedrock ranges from 3½ to more than 7 feet. Coarse fragments make up 0 to 15 percent of the solum, 0 to 30 percent of the C horizon, and 10 to 50 percent of the IIC horizon.

The A horizon has a hue of 2.5YR, 5YR, or 10R; a value of 4 or 5; and a chroma of 0 to 2.

The Bg horizon has a hue of 2.5YR, 5YR, or 10R; a value of 4 to 6; and a chroma of 0 to 2. High-chroma mottles are 5 to 8. This horizon is commonly clay loam but in places ranges to sandy clay loam and silty clay loam. It is friable to slightly firm.

The C horizon ranges from silt loam to sandy loam above a depth of 40 inches and includes stratified sand and gravel below a depth of 40 inches.

Bowmansville soils, which formed on flood plains, are associated with the moderately well drained to somewhat poorly drained Rowland soils, which formed in slight depressions in slight rises and natural levees.

Bowmansville soils have a grayer B horizon than Rowland soils.

Bowmansville silt loam (Bt).—This nearly level soil is in depressions and in old stream meanders on flood plains at the base of slopes that rise to terraces or uplands.

Included with this soil in mapping are some small areas where the surface layer is silty clay loam and some areas of very poorly drained, dark-gray soils. Also included are areas of Rowland soils and soils along Green Brook that have a yellowish-brown, mottled subsoil. Other inclusions are some large flat areas, near the Green Brook High School, of soils that are not subject to frequent flooding and areas where the depth to stratified sand and gravel is less than 40 inches.

The organic-matter content is high. The surface layer is generally in fair tilth, but because the soil is wet most of the time it is likely to clod or crust if plowed or cultivated during unfavorable moisture conditions. Drainage improvement is needed if the soil is to be farmed or used for recreation. Runoff is very slow, and the hazard of erosion is slight.

This soil is better suited to plants that tolerate wetness. Wetness and flooding delay plowing and cultivation. In places the water table can be lowered by deep ditches or drain tiles. Surface drainage is generally needed to reduce surface ponding. Capability unit VIw-86; woodland suitability group 1w1.

Bucks Series

The Bucks series consists of deep, well-drained soils on divides and rolling uplands. These soils are gently sloping or strongly sloping. They are in high positions of the landscape. They formed mainly in a silty mantle and in the underlying material, which was weathered from red shale, siltstone, or fine-grained sandstone.

In a representative profile in a cultivated area, the surface layer is dark yellowish-brown silt loam 8 inches thick. The subsoil is dark-brown and reddish-brown heavy silt loam and dark reddish-brown silt loam that extends to a depth of 35 inches. The substratum, between depths of 35 and 44 inches, is dark reddish-brown shaly silt loam. Fractured dusky-red shale bedrock is at a depth of 44 inches.

These soils are strongly acid or very strongly acid. Natural fertility is medium. The effective rooting zone is deep. Permeability is moderate or moderately slow, and the available water capacity is high.

Nearly all the acreage of Bucks soils has been cleared for farming. The native vegetation consists of forests of such hardwood trees as white, red, and black oaks; yellow-poplar; ash; birch; maple; and hickory. Eastern redcedar is prolific in abandoned farmland. The soils are well suited to all the general crops, including corn, soybeans, small grains, and vegetables. They are also well suited to fruits, nursery plants, and other specialized crops.

Representative profile of Bucks silt loam, 2 to 6 percent slopes, in Branchburg Township in a field along Whiton Road; one-half mile south of U.S. Highway 202, south of woodlot on west side of road:

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

B1—8 to 15 inches, dark-brown (7.5YR 4/4) heavy silt loam; weak, coarse, subangular blocky structure parting to moderate, medium, subangular blocky; friable, slightly firm in place; very strongly acid; clear, smooth boundary.

B21t—15 to 25 inches, reddish-brown (5YR 4/4) heavy silt loam; moderate, coarse, subangular blocky structure parting to weak, fine, subangular blocky; friable, slightly firm in place; discontinuous clay films on faces of peds; very strongly acid; gradual, wavy boundary.

B22t—25 to 35 inches, dark reddish-brown (2.5YR 3/4) silt loam; moderate, medium and fine, subangular blocky structure; friable, firm in place; discontinuous clay films on faces of peds are same color as interiors of peds; very strongly acid; clear, wavy boundary.

IIC—35 to 44 inches, dark reddish-brown (2.5YR 3/4) shaly silt loam; massive; firm; 35 percent shale fragments, ½ inch to 2 inches across the maximum width; very strongly acid; abrupt, wavy boundary.

IIR—44 inches, dusky-red (2.5YR 3/2) fractured shale.

The solum ranges from 30 to 40 inches in thickness. The silty mantle ranges from 18 to 36 inches in thickness. Depth to bedrock is 3½ to 5 feet or more. Fine, soft shale fragments make up less than 5

percent of the volume of the A horizon and the upper part of the B horizon. Coarse fragments of shale, siltstone, or fine-grained sandstone generally increase in number, size, and hardness in the lower part of the B horizon and in the C horizon. Coarse fragments make up 0 to 30 percent of the lower part of the B horizon and 0 to 50 percent of the C horizon.

The A horizon has a hue of 10YR or 7.5YR, a value of 4 or 5, and a chroma of 2 to 4. The A2 horizon is thin and plowing generally destroys it.

The B horizon ranges from reddish brown (2.5YR 4/4) to yellowish red (5YR 5/6). In the B2 horizon texture includes silt loam, shaly silt loam, shaly silty clay loam, and silty clay loam. This horizon has weak to strong, subangular blocky structure for the most part, but in places it has weak, platy structure. Consistence is friable in most peds when they are removed, but it is firm when they are in place.

The C horizon generally contains a high percentage of shattered shale.

Bucks soils generally are in higher positions on the landscape than the nearby moderately well drained Readington soils on lower slopes and broad flats, the somewhat poorly drained Abbottstown soils on broad flats and in slight depressions, and the poorly drained Croton soils in depressions. They occupy positions in the landscape similar to those of the Penn soils.

Bucks soils are deeper than Penn soils and redder than Readington soils. They do not have the mottles that are common to those soils, and they do not have the gray, mottled horizon that is typical of Abbottstown and Croton soils.

Bucks silt loam, 2 to 6 percent slopes (BuB).—This gently sloping soil is on slight rises and ridgetops in undulating uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas where the surface layer and subsoil are redder than in this soil. Also included are areas of Penn, Readington, and Klinesville soils.

The organic-matter content of the plow layer is medium, and this layer is generally easy to till. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for general field crops, vegetables, apples, and nursery crops. Contour stripcropping and minimum tillage are needed to maintain the organic-matter content and good tilth and to control runoff and erosion in cultivated areas. Capability unit IIe-55; woodland suitability group 2o1.

Bucks silt loam, 6 to 12 percent slopes, eroded (BuC2).—This sloping soil is on side slopes between ridges on the undulating uplands. It has a profile similar to the one described as representative of the series, but it is slightly shallower over bedrock. In cultivated areas the plow layer is a mixture of material from the original dark-brown surface layer and the reddish-brown subsoil. Shale fragments are numerous on the surface, and rill erosion is a hazard.

Included with this soil in mapping are small areas of noneroded soils and small areas of Penn and Readington soils.

The surface layer is low in organic-matter content because it is eroded, but it is generally easy to till. Runoff is rapid, and the hazard of erosion is moderate.

This soil is used mainly for corn, soybeans, wheat, oats, and alfalfa. Diversion terraces, contour stripcropping, and minimum tillage are needed to control runoff and erosion and to maintain good tilth and the organic-matter content in cultivated areas. Capability unit IIIe-55; woodland suitability group 2o1.

Califon Series

The Califon series consists of deep, moderately well drained and somewhat poorly drained soils that have a very firm fragipan in the lower part of the subsoil. These soils are gently sloping. They are on undulating uplands in intermediate positions of the landscape. They formed in a thick mantle of weathered granite gneiss till over granite gneiss bedrock.

In a representative profile in a wooded area, the surface layer is dark grayish-brown gravelly loam about 4 inches thick. The subsurface layer is 7 inches of yellowish-brown gravelly loam. The upper 11 inches of the subsoil is mottled, brown heavy loam. The lower part of the subsoil, between depths of 22 and 52 inches, is a very firm, compact and brittle fragipan of brown heavy loam. The substratum, between depths of 52 and 65 inches, is mottled, strong-brown gravelly sandy loam.

In unlimed areas these soils are strongly acid or very strongly acid. Natural fertility is medium. The effective rooting depth is restricted by the fragipan. Permeability is moderate above the fragipan and slow in the fragipan. The available water capacity is moderate. A perched water table is at a depth of ½ foot to 2½ feet late in winter and early in spring. During this period, water moves laterally over the fragipan.

About half the acreage of Califon soils has been cleared for farming. The native vegetation consists of forests of such mixed hardwood trees as oaks, ash, beech, and hickory. Califon nonstony soils are not generally suitable for intense cultivation because of wetness. If drained, these soils are suited to corn, soybeans, small grains, hay, and pasture. They are better suited to grasses and legumes that tolerate wetness, such as birdsfoot trefoil, Ladino clover, reed canarygrass, timothy, and bluegrass, than to other plants.

Representative profile of Califon gravelly loam, 3 to 8 percent slopes, in a woodlot in Bernards Township; 200 feet south of old Army Road and one-fourth mile north of old Fort Road:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) gravelly loam; moderate, medium, granular structure; friable; many fine roots; 20 percent pebbles and cobbles of mixed composition; strongly acid; clear, wavy boundary.

A2—4 to 11 inches, yellowish-brown (10YR 5/4) gravelly loam; moderate, medium, granular structure; friable; many fine roots; 20 percent pebbles and cobbles of mixed composition; strongly acid; clear, wavy boundary.

B2t—11 to 22 inches, brown (7.5YR 4/4) heavy loam; common, medium, distinct, very pale brown (10YR 7/3) mottles; moderate, medium, subangular blocky structure; friable; common fine roots; 10 percent pebbles and cobbles of mixed composition; common thin clay films on ped faces; very strongly acid; clear, wavy boundary.

Bx1t—22 to 35 inches, brown (7.5YR 5/4) heavy loam; common, medium, distinct, pinkish-gray (7.5YR 6/2) and very pale brown (10YR 7/3) mottles; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; very firm, compact and brittle; few fine roots along ped faces; 10 percent pebbles and cobbles of mixed composition; common thin clay films on ped faces; very strongly acid; gradual, wavy boundary.

Bx2t—35 to 52 inches, brown (7.5YR 5/4) heavy loam; common, medium, distinct, pinkish-gray (7.5YR 6/2) mottles along structure faces; moderate, coarse, prismatic structure parting to moderate, coarse, subangular blocky; very firm, compact and brittle; few fine roots along ped faces; 10 percent pebbles and cobbles of granite gneiss; common thin clay films on ped faces; very strongly acid; clear, wavy boundary.

C—52 to 65 inches, strong-brown (7.5YR 5/8) gravelly sandy loam; few, fine, distinct, pinkish-gray (7.5YR 6/2) mottles; massive; very friable; 30 percent pebbles and cobbles of granitic gneiss; strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is 6 feet or more. Depth to the fragipan ranges from 20 to 30 inches. Coarse fragments, mainly granite gneiss, make up 10 to 25 percent of the soil. Quartz, quartzite, sandstone, and shale are also present in small amounts.

In wooded areas the A1 horizon has a hue of 10YR or 7.5YR, a value of 3 or 4, and a chroma of 2.

The B2t and Bx horizons range from brown (7.5YR 4/4) to yellowish brown (10YR 5/6) and have common, distinct, low-chroma mottles. These horizons are typically heavy loam but range to clay loam, gravelly loam, and gravelly clay loam. The Bx horizon has weak or moderate, coarse or very coarse, prismatic structure parting to moderate, medium or coarse, subangular blocky or moderate, thick, platy.

The thick C horizon, present in most profiles, has a matrix color of strong brown (7.5YR 5/6) to yellowish brown (10YR 5/8). It is sandy loam, loam, gravelly sandy loam, or gravelly loam.

Califon soils are associated with the poorly drained Cokesbury soils along drainageways and in slight depressions. Nearby soils are the well-drained Edneyville soils.

Califon soils have mottles in the B horizon, which are absent in Edneyville soils. They do not have the low-chroma matrix color that is common in the B horizon of Cokesbury soils.

Califon gravelly loam, 3 to 8 percent slopes (CaB).—This gently sloping soil is on undulating uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas where the content of coarse fragments in the surface layer is less than in this soil and some areas where a few stones are on the surface. Also included are small areas of Cokesbury, Meckesville, and Edneyville soils.

The organic-matter content is medium. The surface layer is generally in good tilth, but tillage operations are hindered where coarse fragments make up more than 25 percent of the surface layer. Wetness early in spring and after heavy rain delays plowing and cultivation. Water moves laterally over the fragipan. Runoff and the hazard of erosion are slight. Wetness is the major concern of management in cultivated areas.

If drained, this soil is suited to corn, soybeans, hay, and pasture. Deep-rooted legumes and fall-seeded small grains are subject to frost heaving and winterkill. Where this soil is adequately drained, it is well suited to grasses and legumes. Drainage by diversion terraces and shallow surface drains can be used to remove excess water. In cultivated areas contour cultivation and minimum tillage are needed to control runoff and erosion. Capability unit IIe-71; woodland suitability group 2w1.

Califon very stony loam, 3 to 8 percent slopes (CcB).—This gently sloping soil is on low positions in the undulating uplands. It has a profile similar to the one described as representative of the series, but stones and boulders are on the surface and throughout the profile. Stones generally are spaced 3 to 30 feet apart.

Included with this soil in mapping are small areas of nonstony Califon soils and a few areas where the surface layer is loam. Also included are small areas of Cokesbury, Meckesville, and Edneyville soils.

The organic-matter content is medium. This soil is generally not cultivated. It is used mainly for pasture or as woodland. Removal of stones and boulders is generally not practical. Runoff and the hazard of erosion are slight.

This soil is better suited to grasses and trees that tolerate wetness than to other uses. Pasture generally can be renovated by disking, fertilizing, and seeding instead of by plowing and preparing a seedbed. Wetness can be reduced by shallow surface drains. Capability unit VIs-75; woodland suitability group 2w1.

Chalfont Series

The Chalfont series consists of deep, somewhat poorly drained soils that have a firm fragipan in the lower part of the subsoil. These soils are gently sloping to steep. They are on uplands in the Sourland Mountains. They formed in a silty mantle over material weathered from argillite bedrock.

In a representative profile in a wooded area, the surface layer is 4 inches of very dark grayish-brown silt loam. The subsurface layer is brown silt loam about 6 inches thick. The upper 5 inches of the subsoil is friable, yellowish-brown, mottled silt loam. The lower part of the subsoil, between depths of 15 and 40 inches, is a firm, compact fragipan of mottled, brown heavy silt loam and silt loam. The substratum, between depths of 40 and 46 inches, is mottled, brown silt loam. Black argillite bedrock is at a depth of 46 inches.

In unlimed areas these soils are very strongly acid or strongly acid. Natural fertility is medium. Growth of roots is restricted in the fragipan. Permeability is slow, and the available water capacity is moderate. The seasonal high water is perched on the fragipan at a depth of ½ foot to 1½ feet. Water flows laterally over the fragipan. The surface layer is friable and easy to till, but excessive wetness delays plowing and cultivation.

Most areas of Chalfont soils are wooded. The native vegetation consists of forests of such deciduous hardwood trees as pin oak, white oak, sugar maple, ash, and beech. The soils are suited to limited cultivation and are used mainly for hay and pasture. They are well suited to grasses and legumes that tolerate wetness, such as birdsfoot trefoil, Ladino clover, reed canarygrass, timothy, and bluegrass.

Representative profile of Chalfont silt loam, 2 to 6 percent slopes, in Montgomery Township; on the north side of Dutchtown-Zion Road, 770 yards west of Pin Oak Road:

O—1 inch to 0, thin layer of leaves, twigs, and grasses.

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; many fine roots; 10 percent angular pebbles and cobbles of argillite; medium acid; clear, wavy boundary.

A2—4 to 10 inches, brown (10YR 4/3) silt loam; moderate, fine, granular structure; friable; many fine and coarse roots; 5 percent pebbles and cobbles of argillite; strongly acid; clear, wavy boundary.

B2t—10 to 15 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; common thin clay films on most ped faces; few fine roots; 5 percent pebbles and cobbles of argillite; strongly acid; clear, wavy boundary.

Bx1—15 to 22 inches, brown (10YR 4/3) heavy silt loam; many, medium, distinct, grayish-brown (10YR 5/2) and dark grayish-brown (10YR 4/2) mottles; moderate, very coarse, prismatic structure parting to thin, platy; firm, compact and brittle; common thin clay films on ped faces and in pores; 5 percent pebbles and cobbles of argillite; strongly acid; clear, wavy boundary.

Bx2—22 to 40 inches, brown (10YR 4/3) silt loam; many, medium, distinct, grayish-brown (10YR 5/2) and light brownish-gray (10YR 6/2) mottles; moderate, very coarse, prismatic structure; firm, compact and brittle; common, thin, dark-brown (10YR 4/3) clay films on ped faces and in pores; few black (10YR 2/1) stains on peds; 5 percent pebbles and cobbles of argillite; strongly acid; clear, wavy boundary.

IIC—40 to 46 inches, brown (10YR 5/3) silt loam; many, medium, distinct, light-gray (10YR 6/1) and brownish-yellow (10YR 6/6) mottles; weak, coarse, prismatic structure; friable; 15 percent pebbles and cobbles of argillite; strongly acid; abrupt, wavy boundary.

IIR—46 inches, black (10YR 2/1) argillite bedrock.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock ranges from 3½ to 5½ feet, and depth to the fragipan is 15 to 22 inches. Coarse fragments make up 0 to 10 percent of the A and B horizons and 0 to 50 percent of the C horizon.

The A1 horizon has a hue of 10YR, a value of 3 or 4, and a chroma of 2 or 3.

The B horizon is mainly yellowish brown (10YR 5/4) or brown (10YR 5/3) but ranges from brown (7.5YR 5/4) to olive brown (2.5Y 4/4). Low-chroma mottles are common to many in the B horizon but are not dominant. This horizon ranges from silt loam to light silty clay loam. The Bx horizon ranges from 12 to 30 inches in thickness and from silty clay loam to loam in texture.

In places the C horizon is channery silt loam that is 20 to 50 percent, by volume, coarse fragments. This horizon ranges from loam to silt loam.

Chalfont soils are associated with Lawrenceville, Croton, Lansdowne, Abbottstown, and Reaville soils.

Chalfont soils have low-chroma mottles nearer to the surface than Lawrenceville soils. They do not have the gray matrix colors that are common in Croton soils. They are deeper over bedrock than Reaville soils and have a fragipan, which is not present in those soils. They have less clay in the B horizon than Lansdowne soils and a thicker, more strongly developed fragipan than Abbottstown soils.

Chalfont silt loam, 2 to 6 percent slopes (CdB).—This gently sloping soil is on broad gently undulating uplands on the north and south sides of the Sourland Mountains. It has the profile described as representative of the series.

Included with this soil in mapping are some areas of nearly level soils and areas of moderately eroded soils that have a surface layer that is a mixture of material from the original brown surface layer and the mottled, yellowish-brown and gray subsoil. Also included are some small areas of Lawrenceville and Croton soils.

The organic-matter content is medium. The surface layer is generally easy to till. Runoff is medium, and the hazard of erosion is slight. Wetness is the main limitation of this soil for crops. Drainage ditches are effective in removing surface water, but tile drains generally are too slow to be practical.

This soil is used for most general field crops, hay, and pasture. Where this soil is adequately drained, it is well suited to hay and pasture consisting of grasses and legumes that tolerate wetness. Contour cultivation and minimum tillage are needed to control runoff and erosion and to maintain the organic-matter content and good tilth. Capability unit IIIw-70; woodland suitability group 3w1.

Chalfont silt loam, 6 to 12 percent slopes (CdC).—This strongly sloping soil is on hillsides on the gently rolling uplands.

Included with this soil in mapping are areas of eroded soils that have material from the mottled, yellowish-brown subsoil mixed into the surface layer by plowing. Also included are some areas of Lawrenceville and Croton soils.

The organic-matter content is medium. The surface layer is generally easy to till. Runoff is medium in cultivated areas, and the hazard of erosion is moderate.

This soil is used mainly for the commonly grown row crops, small grains, hay, and pasture. Where this soil is adequately drained, it is well suited to hay and pasture consisting of grasses and legumes that tolerate wetness. Diversion terraces, contour stripcropping, and minimum tillage are needed to control runoff and erosion and to maintain the organic-matter content and good tilth. Capability unit IIIe-70; woodland suitability group 3w1.

Chalfont stony silt loam, 2 to 6 percent slopes (CeB).—This gently sloping soil is on broad undulating uplands on the north and south sides of the Sourland Mountains. It has a profile similar to the one described as representative of the series, but it has stones scattered 30 to 100 feet apart on the surface.

Included with this soil in mapping are small areas of nonstony soils that have slopes of less than 2 percent. Also included are some small areas of Lawrenceville and Croton soils.

The organic-matter content is medium. The stones interfere with tillage. Runoff is slow, and the hazard of erosion is slight. Wetness and stones are the main limitations of this soil for crops. Open ditches and diversion terraces can be used to remove surface water, but tile drains are generally too slow to be practical.

This soil is generally used for hay or pasture or as woodland. Because of the numerous stones on the surface, cultivation is generally impractical. Grasses and legumes that tolerate wetness grow better on this soil than other plants. Capability unit IIIw-70; woodland suitability group 3w1.

Chalfont stony silt loam, 6 to 12 percent slopes (CeC).—This sloping soil is on hillsides on the gently rolling uplands. It has a profile similar to the one described as representative of the series, but it has stones scattered throughout the soil and on the surface. The stones on the surface are 30 to 100 feet apart.

Included with this soil in mapping are small areas of nonstony soils and Lawrenceville and Lehigh soils.

The organic-matter content is medium. The surface layer is generally in good tilth. Runoff is medium, and the hazard of erosion is moderate.

This soil is generally used for hay or pasture or as woodland. In cultivated areas erosion can be controlled by stripcropping and diversion terraces. Cultivation is impeded by the numerous stones on the surface. Grasses, legumes, and trees that tolerate wetness grow better on this soil than other plants. Capability unit IIIe-70; woodland suitability group 3w1.

Chalfont stony silt loam, 12 to 25 percent slopes (CeE).—This moderately steep to steep soil is on hillsides on the strongly sloping uplands on the north and south sides of the Sourland Mountains. It has a profile similar to the one described as representative of the series, but it contains more stones on the surface and has a thinner profile. The stones are spaced 30 to 100 feet apart. Depth to bedrock is about 3½ to 4½ feet.

Included with this soil in mapping are some small areas of nonstony soils and Lawrenceville and Lehigh soils.

The organic-matter content is medium.

This soil is generally used for pasture or as woodland. Stones and the moderately steep slopes make growing cultivated crops impractical. Water-tolerant trees and grasses and legumes that tolerate wetness grow better in this soil than other plants. Capability unit VIe-70; woodland suitability group 3w1.

Cokesbury Series

The Cokesbury series consists of deep, poorly drained, very stony soils that have a firm fragipan in the lower part of the subsoil. These soils are nearly level and gently sloping. They are in uplands on low positions in the landscape. They formed in a mantle of weathered granite gneiss glacial till.

In a representative profile in a wooded area, the surface layer is 3 inches of friable, very dark gray gravelly loam that contains stones. The subsurface layer is 7 inches of mottled, light brownish-gray gravelly loam. The upper 11 inches of the subsoil is friable, mottled gray clay loam. The lower part of the subsoil, between depths of 21 and 32 inches, is a firm, compact and brittle fragipan of mottled, grayish-brown heavy loam. The substratum, between depths of 32 and 62 inches, is mottled, pale-brown gravelly sandy loam.

In unlimed areas these soils are very strongly acid or

strongly acid throughout the profile. Natural fertility is medium. The effective rooting depth is restricted by the fragipan. Permeability is moderate in the surface layer and upper part of the subsoil and slow in the fragipan, and the available water capacity is moderate. These soils have a seasonal high water table at a depth of 0 to 1 foot during winter and early in spring. On the more sloping areas water moves laterally over the fragipan.

Less than half the acreage of Cokesbury soils has been cleared for farming. The native vegetation consists of a forest of such deciduous hardwood trees as pin oak, white oak, ash, maple, and hickory. Cokesbury soils are poorly suited to cultivated crops because of stones and wetness. They are better suited to pasture of grasses and legumes that tolerate wetness than to other uses. If the stones are removed, the soils are suitable for hay.

Representative profile of Cokesbury gravelly loam in an area of Cokesbury very stony loam, 0 to 8 percent slopes, in Bernards Township; 50 feet west of Hardscrabble Road and 200 feet north of Lloyd Road:

A1—0 to 3 inches, very dark gray (10YR 3/1) gravelly loam; moderate, medium, granular structure; friable; many fine roots; 20 percent pebbles and cobbles and a few stones, mostly granite gneiss and some quartzite; strongly acid; clear, wavy boundary.

A2g—3 to 10 inches, light brownish-gray (10YR 6/2) gravelly loam; common, medium, distinct, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/4) mottles; moderate, medium, granular structure; friable; many fine roots; 20 percent pebbles, cobbles, and stones, mostly granite gneiss, and some quartzite cobbles; strongly acid; clear, wavy boundary.

B2tg—10 to 21 inches, gray (10YR 6/1) clay loam; few, medium, distinct, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/6) mottles in ped interiors; moderate, medium, subangular blocky structure; friable; common fine roots; 10 percent pebbles, cobbles, and stones, mostly granite gneiss, and a few quartzite cobbles; common thin clay films on all ped faces; strongly acid; clear, wavy boundary.

Bxtg—21 to 32 inches, grayish-brown (10YR 5/2) heavy loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; firm, compact and brittle; few fine roots along structure faces; common thin clay films on ped faces; 10 percent gravel, cobbles, and stones, mostly granite gneiss; strongly acid; clear, wavy boundary.

C—32 to 62 inches, pale-brown (10YR 6/3) gravelly sandy loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; massive; 35 percent pebbles, cobbles, and stones of granite gneiss; strongly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is more than 6 feet, and depth to the fragipan ranges from 20 to 25 inches. Coarse fragments make up 5 to 25 percent of the solum and 30 to 50 percent of the C horizon.

The A1 horizon has a hue of 10YR to 2.5Y, a value of 3 or 4, and a chroma of 1 or 2.

The Bt horizon commonly has a hue of 10YR to 2.5Y, a value of 4 to 7, and a chroma of 1 or 2. This horizon is loam, clay loam, sandy clay loam, and their gravelly equivalents. The matrix of the Bx horizon has a hue of 7.5YR or 10YR, a value of 4 to 6, and a chroma of 2 to 4. This horizon is loam, clay loam, sandy clay loam, and their gravelly equivalents.

The C horizon has a hue of 7.5YR or 10YR, a value of 4 to 6, and a chroma of 3 to 6. It ranges from sandy loam to loam and their gravelly equivalents.

Cokesbury soils are associated with Califon soils. They are more gray in the subsoil than those soils.

Cokesbury very stony loam, 0 to 8 percent slopes (CpB).—This nearly level to gently sloping soil is on low positions in the landscape along drainageways, in depressions, and on low-lying flats at the heads of drainageways. Stones generally are 5 to 30 feet apart.

Included with this soil in mapping are small areas of Califon soils and some areas of very poorly drained soils. Also included are areas of nonstony soils.

The organic-matter content is high. Excessive wetness and the content of stones restrict tillage operations. Runoff is slow, and the hazard of erosion is slight. Wetness and stoniness are the main limitations for farming.

This soil is generally used as woodland or for pasture. It is poorly suited to small grains, alfalfa, and other deep-rooted legumes. Open ditches, and in some areas tile drains, are needed to reduce wetness. Capability unit VIIs-77; woodland suitability group 3w1.

Croton Series

The Croton series consists of deep, poorly drained soils that have a very firm fragipan in the lower part of the subsoil. These soils are nearly level to gently sloping. They are on upland flats in slight depressions and along drainageways in low positions of the landscape. They formed in material weathered from argillite, red shale, siltstone, or fine-grained sandstone.

In a representative profile in a cultivated area, the surface layer is dark grayish-brown silt loam 9 inches thick. The upper 5 inches of the subsoil is friable, mottled, light brownish-gray heavy silt loam; the middle 5 inches is mottled, reddish-gray silty clay loam; and the lower 14 inches is a very firm, compact and brittle fragipan of mottled, gray silty clay loam. The substratum, between depths of 33 and 42 inches, is mottled, dark reddish-brown shaly clay loam. Dark reddish-brown shale bedrock is at a depth of 42 inches.

In unlimed areas these soils are medium acid to very strongly acid. Natural fertility is high. Permeability is moderate or moderately slow above the fragipan and slow in the pan. The available water capacity is moderate. The seasonal high water table is perched on the fragipan at a depth of 0 to 1 foot in winter and spring. The fragipan restricts the growth of plant roots and the downward movement of water, and water moves laterally over the pan. Excessive wetness delays plowing and cultivation in spring and after heavy rain.

Much of the acreage of Croton soils is wooded or is reverting to woods. The natural vegetation consists of forests of such hardwood trees as pin oak, beech, maple, and hickory. The soils are suited to plants that tolerate wetness. They are used mainly for hay and pasture. In undrained areas they are poorly suited to field crops. They are better suited to birdsfoot trefoil, Ladino clover, reed canarygrass, timothy, and bluegrass than to other plants.

Representative profile of Croton silt loam, 0 to 2 percent slopes, northeast of Flagtown; about 300 feet east of Beekman Road and 100 feet south of the tracks of Lehigh Railroad:

Ap—0 to 9 inches, dark grayish-brown (2.5Y 4/2) silt loam; weak, fine, granular structure; friable; many fine roots; 5 percent coarse fragments of medium-size rounded quartz gravel; medium acid; abrupt, smooth boundary.

B1g—9 to 14 inches, light brownish-gray (2.5Y 6/2) heavy silt loam; common, medium, faint, light-gray (2.5Y 7/2) mottles and common, medium, distinct, dark reddish-brown (5YR 3/3) mottles; moderate, thin, platy structure; friable, slightly sticky and slightly plastic; few thin clay films on ped faces and in pores; few fine roots; 3 percent coarse fragments; strongly acid; gradual, wavy boundary.

B2g—14 to 19 inches, reddish-gray (5YR 5/2) silty clay loam; many, medium, distinct, reddish-brown (5YR 4/4) and yellowish-red (5YR 4/8) mottles; weak, medium, prismatic structure; slightly firm, slightly sticky and slightly plastic; thin com-

mon clay films on ped faces; strongly acid; gradual, wavy boundary.

Bxg—19 to 33 inches, gray (5YR 6/1) silty clay loam; many, medium, distinct, reddish-brown (2.5YR 4/4) mottles; weak, coarse, prismatic structure; very firm, slightly sticky and slightly plastic; thin common clay films on ped faces and in pores; 10 percent coarse fragments; strongly acid; clear, wavy boundary.

C—33 to 42 inches, dark reddish-brown (2.5YR 3/4) shaly clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) and gray (N 6/0) mottles; massive; friable; 30 percent shale fragments; few thin clay films on shale fragments; strongly acid; gradual, wavy boundary.

R—42 inches, dark reddish-brown (2.5YR 3/4) shale bedrock.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock ranges from 3½ to 5 feet, and depth to the fragipan ranges from 15 to 20 inches. Coarse fragments make up 0 to 10 percent of the A and B horizons and 20 to 35 percent of the C horizon. Mottles are in the A horizon or the upper part of the B horizon. They are generally reddish brown (5YR 4/4) and yellowish red (5YR 4/8).

The A horizon ranges from dark grayish brown (2.5Y 4/2) to reddish gray (5YR 5/2).

The B horizon is commonly gray (5YR 6/1) to reddish gray (5YR 5/2) but includes gray (N 5/0 and 10YR 5/1). This horizon ranges from silty clay loam to heavy silt loam.

The thin C horizon is generally between the solum and bedrock. This horizon ranges from dark reddish brown (2.5YR 3/4) to brown (7.5YR 4/4). It is typically shaly clay loam but ranges to silt loam and loam.

Croton soils are near or adjacent to the well-drained Penn and Bucks soils. Nearby, on slight rises and broad flats, are the deep, mottled, somewhat poorly drained Abbottstown soils and the moderately deep, somewhat poorly drained Reaville soils.

Croton soils are more gray than Penn, Bucks, Abbottstown, and Reaville soils. They are deeper over bedrock than Reaville soils.

Croton silt loam, 0 to 2 percent slopes (CrA).—This nearly level soil is in low-lying areas, on broad upland flats in depressions, and in drainageways in the red shale uplands and the Sourland Mountains. It has the profile described as representative of the series.

Included with this soil in mapping are some areas of moderately eroded soils that have a surface layer of silty clay loam. Also included are some areas of Reaville and Abbottstown soils.

The organic-matter content of the surface layer is medium. The surface layer is easy to till. Runoff is slow, and in places water is ponded. The hazard of erosion is slight. Wetness is the most severe limitation for production of crops, but it can be reduced by surface drainage. Open drainage ditches are effective in removing most of the surface water.

If drained, this soil is used for corn, soybeans, spring-sown grains, and water-tolerant grasses and legumes. The slow permeability severely limits the effectiveness of drain tile in most places. Capability unit IVw-80; woodland suitability group 3w1.

Croton silt loam, 2 to 6 percent slopes (CrB).—This gently sloping soil is on slight rises and broad flats in the undulating uplands.

Included with this soil in mapping are some areas of moderately eroded soils that have a finer textured surface layer than this Croton soil. Also included are some areas of Reaville soils and some small areas where slopes are less than 2 percent.

The organic-matter content is medium. The surface layer is generally easy to till. Runoff is medium, and the hazard of erosion is slight. Water flows laterally over the fragipan, causing numerous seeps. Wetness is the major limitation for farming.

If the soil is drained and erosion is controlled, it can be used for corn, soybeans, and moisture-tolerant grasses and legumes. Tile drains generally are not effective. Open ditches, bedding, and diversion terraces are needed to improve the drainage condition. Capability unit IVw-80; woodland suitability group 3w1.

Dunellen Series

The Dunellen series consists of deep, well-drained soils. These soils are nearly level to sloping. They are on stream terraces in intermediate positions in the landscape. They formed in old stream sediment of mixed composition, mostly red sandstone, siltstone, gneiss, basalt, chert, and quartzite. This sediment is believed to be glacial outwash.

In a representative profile in a cultivated area, the surface layer is dark-brown sandy loam 8 inches thick. The subsurface layer is 6 inches of brown sandy loam. The subsoil is reddish-brown and dark reddish-brown sandy loam 18 inches thick. The substratum, between depths of 32 and 70 inches, is stratified, dark reddish-brown sandy loam and loamy sand.

In unlimed areas these soils are strongly acid to a depth of about 42 inches and medium acid below. Natural fertility and the organic-matter content are medium. Permeability is moderate, and the available water capacity is moderate. The effective rooting zone is deep, and the tilth is good. The soils warm up early in spring and can be plowed early.

Most areas of Dunellen soils have been cleared for farming. The native vegetation consists of forests of such hardwood trees as white, red, and black oaks; yellow-poplar; beech; maple; and hickory. The soils are well suited to intensive cultivation of vegetables, fruit, corn, small grains, nursery crops, and alfalfa.

Representative profile of Dunellen sandy loam, 2 to 6 percent slopes, in Franklin Township; 250 yards north of East Millstone Reform Church and 100 yards east of Delaware and Raritan Canal:

Ap—0 to 8 inches, dark-brown (7.5YR 4/2) sandy loam; moderate, medium, granular structure; friable; common fine roots; 3 percent rounded pebbles; medium acid; abrupt, smooth boundary.

A2—8 to 14 inches, brown (7.5YR 4/4) sandy loam; weak, fine, subangular blocky structure; friable; common fine roots; 2 percent rounded pebbles; medium acid; clear, wavy boundary.

B1—14 to 20 inches, reddish-brown (5YR 4/3) sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; 3 percent rounded pebbles; medium acid; clear, wavy boundary.

B2t—20 to 32 inches, dark reddish-brown (5YR 3/4) sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; few, thin, patchy clay films on faces of peds; 5 percent rounded pebbles; strongly acid; gradual, wavy boundary.

C1—32 to 42 inches, dark reddish-brown (5YR 3/4) sandy loam; massive; friable; 10 percent rounded pebbles; strongly acid; gradual, wavy boundary.

IIC2—42 to 70 inches, dark reddish-brown (5YR 3/4) loamy sand; single grained; loose; 10 percent rounded pebbles; medium acid.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is more than 8 feet. In most places the bedrock is red shale. Coarse fragments of gravel size make up less than 15 percent of the solum and 5 to 50 percent of the C horizon.

The Ap horizon ranges from dark reddish gray (5YR 4/2) to dark brown (7.5YR 3/2). In wooded areas the A1 horizon is commonly dark grayish brown (10YR 4/2).

The B horizon has a hue of 5YR to 7.5YR, a value of 3 or 4, and a chroma of 3 or 4. This horizon is loam, sandy loam, and their gravelly equivalents. In places it contains thin strata of silt loam and clay.

The C horizon has a hue of 2.5YR to 7.5YR, a value of 3 or 4, and

a chroma of 3 or 4. The stratified subhorizons are sandy loam or loamy sand and contain thin strata of material that ranges from silt to clay. In places beds of gravel and cobbles are in the lower part of the substratum.

Dunellen soils occupy high positions on the stream terraces and are adjacent to Birdsboro soils and the moderately well drained, Dunellen variant soils in slight depressions. Where Dunellen soils are adjacent to flood plains, they are next to Rowland and Bowmansville soils.

Dunellen soils are not so fine textured in the B horizon as Birdsboro soils. They do not have the mottles that are common in Dunellen variants. They occupy higher positions than Rowland and Bowmansville soils, which are on flood plains, and they do not have the mottles that are common in those soils.

Dunellen sandy loam, 0 to 2 percent slopes (DnA).—This soil has a profile similar to the one described as representative of the series, but depth to the substratum is about 42 inches.

Included with this soil in mapping are areas where the surface layer is silt loam or loam and small areas of soils that are more than 15 percent gravel. Also included are small areas of somewhat poorly drained soils that need drainage in places.

This soil is used for the commonly grown field crops, vegetables, and hay and pasture plants. Runoff is slow, and the hazard of erosion is slight. Intensive cultivation is possible under a high level of management. Irrigation can be used to advantage, especially for high-value crops. Capability unit I-56; woodland suitability group 2o1.

Dunellen sandy loam, 2 to 6 percent slopes (DnB).—This gently sloping soil is on stream terraces. It has the profile described as representative of the series.

Included with this soil in mapping are areas of eroded Dunellen soils. Also included are areas where the surface layer is silt loam or loam and areas of moderately well drained Dunellen soils. In places these areas need drainage improvement.

Runoff is slow, and the hazard of erosion is slight.

This soil is suited to vegetables and to a variety of crops. Contour stripcropping and diversion terraces can be used to reduce runoff and erosion. Capability unit IIe-56; woodland suitability group 2o1.

Dunellen sandy loam, 6 to 12 percent slopes (DnC).—This sloping soil is in narrow bands on the edge of terraces that are adjacent to flood plains or uplands.

Included with this soil in mapping are small areas where slopes are more than 12 percent. Also included are areas of moderately eroded soils and small areas of gravelly soils.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for pasture and as woodland. Control of erosion is needed in cultivated areas. Stripcropping, diversion terraces, and cropping systems can be used to help reduce runoff and erosion. Capability unit IIIe-56; woodland suitability group 2o1.

Dunellen Variant

The Dunellen variant consists of deep soils. These gently sloping soils are in small areas on stream terraces of the Millstone River, Green Brook, and the lower reaches of the Raritan River. They formed in old stream sediment of mixed composition, mainly gneiss, red sandstone, basalt, chert, and quartzite.

In a representative profile in a cultivated field, the surface layer is very dark grayish-brown sandy loam about 9 inches thick. The subsoil is friable, distinctly mottled, brown sandy loam about 27 inches thick. The substratum, between depths of 36 and 60 inches, is mottled, very friable, strong-brown sandy loam.

In unlimed areas these soils are strongly acid or medium acid. Natural fertility is medium. The effective rooting zone is deep. Permeability is moderate throughout the profile, and the available water capacity is moderate. These soils have a seasonal high water table at a depth of ½ foot to 4 feet late in winter and early in spring.

More than half the acreage of the Dunellen moderately well drained variant has been cleared for farming. The native vegetation consists of forests of such deciduous hardwood trees as pin oak, red oak, sweetgum, ash, beech, and hickory. The soils are suited to all general crops, such as corn, soybeans, small grains, hay, and pasture. If high-value crops are to be grown, drainage needs to be improved.

Representative profile of Dunellen sandy loam, moderately well drained variant, in Franklin Township; 30 feet east of Canal Road and 200 feet south of Bunker Hill Road:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; common fine roots; 2 percent pebbles; medium acid; abrupt, smooth boundary.

B1—9 to 14 inches, brown (7.5YR 5/4) sandy loam; few, fine, faint, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; friable; common fine roots; 2 percent pebbles; medium acid; clear, wavy boundary.

B21t—14 to 22 inches, brown (7.5YR 5/4) sandy loam; common, medium, distinct, brown (7.5YR 5/2) and strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure; friable; few fine roots; common, thin, patchy clay films on ped faces, in root channels, and in pores; 2 percent pebbles; strongly acid; gradual, wavy boundary.

B22t—22 to 36 inches, brown (7.5YR 5/4) sandy loam; common, medium, distinct, brown (7.5YR 5/2) and strong-brown (7.5YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; common patchy clay films on ped faces and in pores; 2 percent pebbles; strongly acid; clear, wavy boundary.

C—36 to 60 inches, strong-brown (7.5YR 5/6) sandy loam; common, medium, distinct, brown (7.5YR 5/2) mottles; massive; very friable; strongly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is more than 8 feet. Coarse fragments make up less than 3 percent of the solum. Depth to low-chroma mottles is 10 to 25 inches.

The Ap horizon has a hue of 10YR, 7.5YR, or 5YR; a value of 3 to 5; and a chroma of 2 to 4.

The B horizon has a hue of 7.5YR or 5YR, a value of 4 to 6, and a chroma of 2 to 8. This horizon ranges from heavy fine sandy loam to sandy loam.

The C horizon is commonly sandy loam but ranges to fine sandy loam and loam. In places beds of sand or gravel are in the lower part of the substratum.

The Dunellen moderately well drained variant occurs with the well-drained Dunellen and Birdsboro soils and the somewhat poorly drained Raritan soils. Nearby on flood plains are the nearly level Bowmansville and Rowland soils.

Mottling distinguishes the Dunellen moderately well drained variant from the well-drained Dunellen and Birdsboro soils. The variant does not have the fragipan that is common in Raritan soils. It is coarser textured than Rowland and Bowmansville soils and is not subject to frequent flooding.

Dunellen sandy loam, moderately well drained variant (Dw).—This gently sloping variant is at slightly lower elevation than the well-drained Dunellen soils. It is on broad terraces along the Raritan and Millstone Rivers and along Green Brook Creek.

Included with this soil in mapping are some areas of very poorly drained soils in slight depressions and along drainageways and some small areas of the well-drained Dunellen soils.

The organic-matter content of the surface layer is medium. The surface layer is generally easy to till. Wetness early in spring and after heavy rain slightly delays plowing and cultivation. A moderately high water table occurs in this soil in fall and winter and early in spring. Runoff is slow, and ponding occurs in some low-lying areas after heavy rain. The hazard of erosion is slight. Wetness is the main limitation to use of this soil for crops.

This soil is used mainly for corn, soybeans, and hay. Because this soil is moderately permeable, tile drains are effective in lowering the water table. Open ditches are also effective in lowering the water table. Capability unit IIw-73; woodland suitability group 2o1.

Edneyville Series

The Edneyville series consists of deep, well-drained, nonstony and very stony soils. These gently sloping to steep soils are on hills and ridges of the Highlands (fig. 5). They formed in material weathered from granite gneiss.

In a representative profile in a cultivated area, the surface layer is dark-brown gravelly loam 11 inches thick. Between depths of 11 and 15 inches, the subsoil is friable, brown loam; between depths of 15 and 39 inches, it is dark-brown and strong-brown gravelly loam. The substratum, between depths of 39 and 65 inches, is strong-brown gravelly sandy loam. Fractured bedrock is at a depth of 65 inches.

In unlimed areas these soils are strongly acid or very strongly acid in the upper part and strongly acid or medium acid in the lower part. Natural fertility is medium. The effective rooting zone is deep. Permeability is moderate in the subsoil, and the available water capacity is moderate.

About half the acreage of Edneyville soils has been cleared for farming. The native vegetation is forests of such hardwood trees as mixed oaks, yellow-poplar, ash, maple, and hickory. The less sloping Edneyville soils are suited to a wide variety of crops, including vegetables, fruit and nursery crops, corn, soybeans, small grains, hay, and pasture.

Representative profile of Edneyville gravelly loam, 8 to 15 percent slopes, in the northeast corner of intersection of Anderson Hill Road and Stone Fence Road, in Bernardsville:

Ap—0 to 11 inches, dark-brown (10YR 4/3) gravelly loam; moderate, medium, granular structure; friable; many fine roots; 20 percent angular granite gneiss pebbles and cobbles; medium acid; abrupt, smooth boundary.

B1—11 to 15 inches, brown (7.5YR 5/4) loam; weak, medium, subangular blocky structure; friable; many fine roots; 10 percent angular granite gneiss pebbles and cobbles; medium acid; clear, wavy boundary.

B21t—15 to 22 inches, dark-brown (7.5YR 4/4) gravelly loam; weak, medium, subangular blocky structure; friable; few fine roots; 25 percent angular granite gneiss pebbles and cobbles; strongly acid; clear, wavy boundary.

B22t—22 to 39 inches, strong-brown (7.5YR 5/6) gravelly loam; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; friable; few roots; thin discontinuous clay films on ped faces and in root channels; 30 percent angular granite gneiss pebbles and cobbles; strongly acid; clear, wavy boundary.

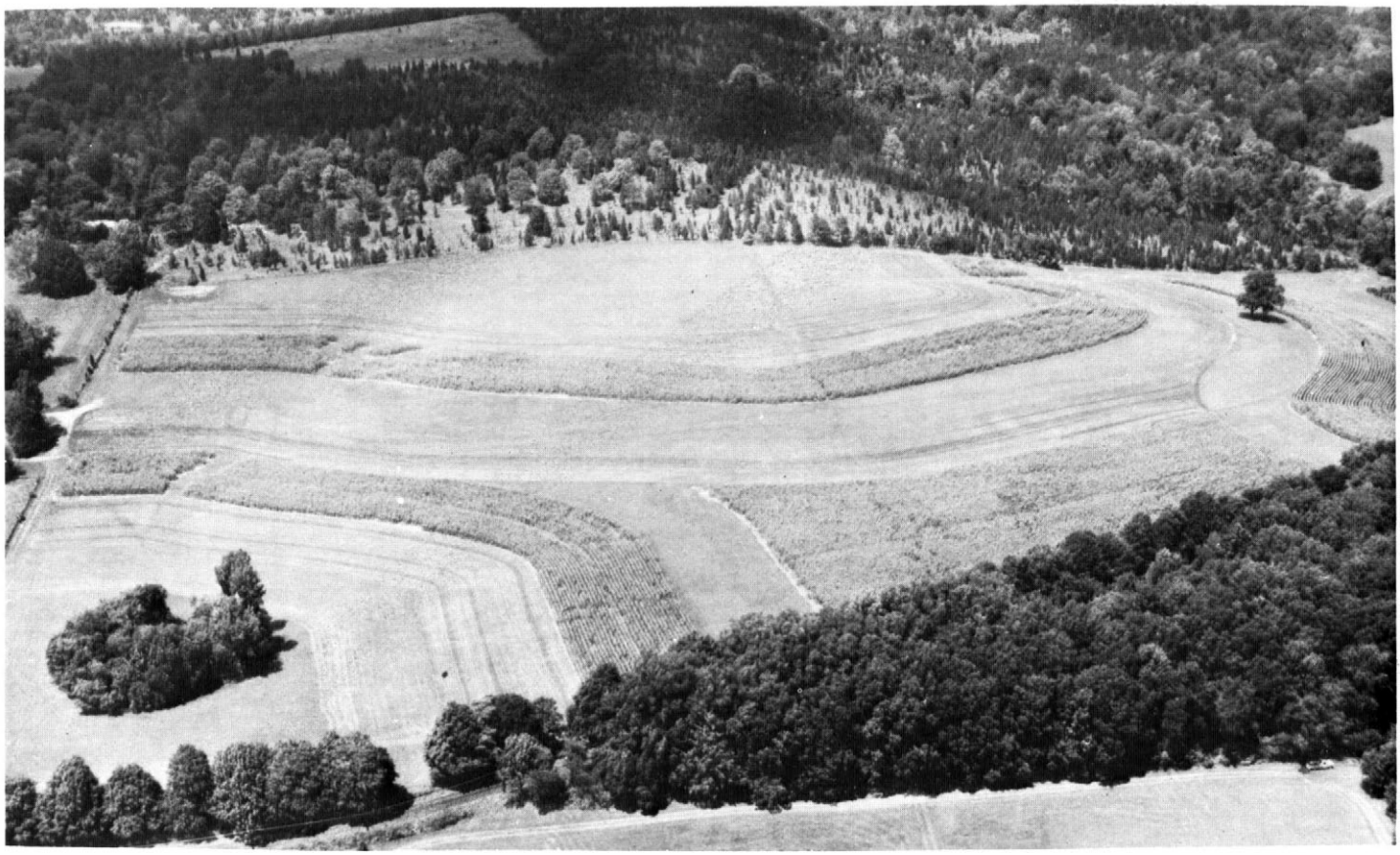

Figure 5.—**Stripcropping on gently sloping Edneyville gravelly loam.**

C—39 to 65 inches, strong-brown (7.5YR 5/8) gravelly sandy loam; massive; very friable; very few roots; 40 percent angular granite gneiss pebbles and cobbles; strongly acid; gradual, irregular boundary.

R—65 inches, very pale brown (10YR 7/3) and black (10YR 2/1) highly fractured granite gneiss bedrock.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is 3½ to more than 6 feet. Coarse fragments make up 15 to 30 percent of the upper part of the solum and 25 and 35 percent of the lower part of the solum and the C horizon.

Hue, value, and chroma in the A horizon range from 10YR 4/3 in cultivated areas to 10YR 3/1 in wooded areas.

The B horizon has a hue of 7.5YR, a value of 4 or 5, and a chroma of 4 to 6. This horizon ranges from loam to sandy clay loam and their gravelly equivalents.

The C horizon ranges from strong-brown (7.5YR 5/8) to yellowish-red (5YR 5/8) gravelly sandy loam or sandy loam.

Edneyville soils border Parker, Califon, and Cokesbury soils. They do not have the high content of cobbles and pebbles that is common in Parker soils, and they do not have the mottles and fragipan that are common in Califon and Cokesbury soils.

Edneyville gravelly loam, 3 to 8 percent slopes (EdB).—This soil has a profile similar to the one described as representative of the series, but it is deeper over bedrock and generally many of the cobbles and stones have been removed from the fields and placed along the edges as a stone fence.

Included with this soil in mapping are some areas of soils that are capped with a thin layer of glacial till and some areas of soils that have lost most of the surface layer through erosion. Also included are areas of Parker and Califon soils.

The organic-matter content is medium. The surface layer is generally easy to till. Where gravel, cobbles, and stones make up more than 25 percent of the surface layer, however, they interfere with tillage. Runoff is slow, and the hazard of erosion is moderate.

This soil is well suited to general farm crops, such as corn, soybeans, fruit, hay, and pasture. Contour stripcropping, minimum tillage, and cover crops are needed in cultivated areas to control runoff and erosion and maintain organic-matter content and good tilth. Capability unit IIe-58; woodland suitability group 2o1.

Edneyville gravelly loam, 8 to 15 percent slopes (EdC).—This strongly sloping soil is on the rolling hills in the Highland section of the county. It has the profile described as representative of the series.

Included with this soil in mapping are areas where most of the original surface layer has been lost through erosion. In plowing, material from the upper part of the subsoil is mixed with the present surface layer. Also included are small areas of soils that are capped with a thin layer of glacial till and some areas of Parker and Califon soils.

The organic-matter content is low. The surface layer is generally easy to till. Where gravel and cobbles make up more than 25 percent of the surface layer, they interfere with tillage. Runoff is medium, and the hazard of erosion is moderate.

This soil is well suited to such general farm crops as corn, soybeans, fruit, hay, and pasture if conservation practices are used that reduce the erosion hazard. Contour stripcropping, minimum tillage, and cover crops are needed in cultivated areas to control runoff and erosion and maintain the organic-matter content and good tilth. Capability unit IIIe-58; woodland suitability group 2o1.

Edneyville gravelly loam, 15 to 25 percent slopes (EdD).—This steep soil is on hillsides in the Highlands section of the county. It has a profile similar to the one described as representative of the series, but bedrock is at a depth of about 4 feet and generally more gravel and cobbles are on the surface.

Included with this soil in mapping are areas where most of the original surface layer has been lost through erosion. Also included are areas of Parker soils.

The organic-matter content is low. The surface layer is generally easy to till, but gravel and cobbles interfere with tillage where they make up more than 25 percent of the surface layer. Runoff is very rapid, and the hazard of erosion is severe in cultivated areas.

Because erosion is a severe hazard, this soil is poorly suited to such row crops as corn and soybeans. Row crops can be grown occasionally without the risk of severe erosion, if they are alternated with small grains and hay. Capability unit IVe-58; woodland suitability group 2o1.

Elkton Series

The Elkton series consists of deep, poorly drained soils. These nearly level soils are on broad upland flats and in slight depressions in low positions in the landscape. They formed in marine deposits.

In a representative profile in a formerly cultivated area, the surface layer is dark-gray silt loam 9 inches thick. The subsoil, in sequence from the top, is 5 inches of mottled, light-gray heavy silt loam; 11 inches of mottled, light-gray heavy silty clay loam; and 13 inches of mottled, light-gray silty clay. The substratum, between depths of 38 and 63 inches, is mottled, light-gray heavy silty clay loam.

In unlimed areas these soils are strongly acid to extremely acid. Natural fertility is medium. Permeability is slow in the subsoil, and the available water capacity is high. Rooting is somewhat restricted by the denseness of the soil particles. Water is perched above the fine-textured subsoil.

Most areas of Elkton soils are in pasture or woods, but some are cultivated. The native vegetation is willow oak, white oak, pin oak, sweetgum, and red maple. Grasses and legumes that tolerate wetness are better suited to these soils than other plants.

Representative profile of Elkton silt loam in Franklin Township; in an idle field 30 feet north of transcontinental gas line, one-fourth mile west of State Route 27, and one-fourth mile north of Little Rocky Hill:

Ap—0 to 9 inches, dark-gray (10YR 4/1) silt loam; moderate, medium, granular structure; friable; many fine roots; strongly acid; abrupt, smooth boundary.

B1g—9 to 14 inches, light-gray (10YR 6/1) heavy silt loam; common, medium, distinct, light yellowish-brown (10YR 6/4) and brownish-yellow (10YR 6/6) mottles; weak, medium, subangular blocky structure; friable; common fine roots; strongly acid; clear, wavy boundary.

B21gt—14 to 25 inches, light-gray (10YR 6/1) heavy silty clay loam; many, medium, distinct, light yellowish-brown (10YR 6/4) and brownish-yellow (10YR 6/6) mottles in interior of peds; moderate, medium, angular blocky structure; firm, sticky and plastic; common, moderately thick, dark-gray (10YR 4/1) clay films on ped faces and in root channels; strongly acid; gradual, wavy boundary.

B22gt—25 to 38 inches, light-gray (10YR 6/1) silty clay; many, medium, distinct, light brownish-gray (10YR 6/2), light yellowish-brown (10YR 6/4), and brownish-yellow (10YR 6/6) mottles in interior of peds; moderate, medium, angular blocky structure; firm, sticky and plastic; common, moderately thick, dark-gray (10YR 4/1) clay films on ped faces; strongly acid; gradual, wavy boundary.

Cg—38 to 63 inches, light-gray (10YR 6/1) heavy silty clay loam; common, medium, distinct, light yellowish-brown (10YR

6/4) and brownish-yellow (10YR 6/6) mottles; massive; strongly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is more than 7 feet. Coarse fragments make up less than 1 percent of the soil.

The Ap horizon has a hue of 10YR or 2.5YR, a value of 4 to 6, and a chroma of 1.

The B horizon has a value of 5 or 6 and a chroma of 1 or 2. This horizon is clay loam, silty clay loam, and silty clay.

The C horizon is commonly silty clay loam but ranges to silty clay and clay loam.

Elkton soils occur with the moderately well drained Keyport soils on slightly higher elevations and the moderately well drained to somewhat poorly drained Lehigh and Mount Lucas soils that are gently sloping or are on slight rises. Nearby, on slight rises, are the deep, well-drained Neshaminy soils.

Elkton soils have a grayer B horizon than Keyport soils. They are deeper over bedrock than Lehigh and Mount Lucas soils, and they have a grayer B horizon than Neshaminy soils.

Elkton silt loam (Ek).—This nearly level soil is on low positions in the landscape.

Included with this soil in mapping are some areas of very poorly drained soils in slight depressions, some areas where the surface layer is slightly browner than that of this soil, and some small areas of Keyport soils.

The organic-matter content is moderately high. The soil is generally easy to till, but excessive wetness reduces the time during which it can be plowed and cultivated. A perched high water table occurs in this soil in fall, winter, and spring. Most of the time the soil is too wet to permit plowing or planting. Runoff is slow, and the hazard of erosion is slight. Rooting is limited by the density of the soil material. Wetness is the main concern of management. Drainage is needed for best growth of most crops and for many other uses of this soil.

This soil is mainly wooded or used for hay and pasture. It is fairly well suited to such late-planted crops as corn, soybeans, and grasses and legumes that tolerate wetness. Shallow surface drains are needed to remove excess surface water. In most places the soil is so clayey that tile drains do not remove excess water rapidly enough. Capability unit IIIw-71; woodland suitability group 3w1.

Fluvaquents

Fluvaquents (FL) consist of deep, poorly drained soils of the flood plains. These soils are too variable to be classified at the series level. They are in low positions on the flood plains along the north branch of the Raritan River and along Peapack Brook, Herzog Brook, and Mine Brook. Fluvaquents formed in sediment composed mainly of glacial till, granitic gneiss, and limestone. The sediment washed from the nearby uplands.

In unlimed areas these soils are strongly acid to medium acid. Natural fertility is high. Permeability is moderate to moderately rapid, and available water capacity is moderate. The seasonal high water table is at a depth of 0 to 1 foot late in fall, in winter, and early in spring. Streams normally overflow on these soils several times each year. Depth to bedrock is more than 6 feet in most places.

The native vegetation consists of forests of such hardwoods as pin oak, white oak, sycamore, maple, ash, and river birch.

Fluvaquents are associated with Udifluvents and Ochrepts, with poorly drained Cokesbury soils, with moderately well drained and somewhat poorly drained Califon soils, and with moderately well drained Bartley soils. Fluvaquents have a gray subsoil, which is lacking in the Udifluvents and Ochrepts. Fluvaquents lack the distinct horizons common to the Cokesbury, Califon, and Bartley soils.

Most areas of these soils have been cleared and are used for pasture. Good permanent pastures have been established where artificial drainage has been installed. Reeds and cattails grow in some of the undrained areas. A few areas have been filled and are used as residential, commercial, and industrial sites. Capability unit VIw-86; woodland suitability group 2w2.

Keyport Series

The Keyport series consists of deep, moderately well drained soils. These nearly level to gently sloping soils are on broad upland flats and slight rises. They formed in small areas of acid marine sediment surrounded by soils that formed on the local shale and diabase bedrock.

In a representative profile in a wooded area, the surface layer is very dark grayish-brown silt loam 2 inches thick. The subsurface layer is 6 inches of yellowish-browm silt loam. The upper 6 inches of the subsoil is brownish-yellow silt loam. The lower part of the subsoil, between depths of 14 and 46 inches, is mottled, brownish-yellow clay loam and light yellowish-brown heavy clay loam. The substratum, between depths of 46 and 60 inches, is mottled, yellowish-brown clay loam.

In unlimed areas these soils are very strongly acid or extremely acid. Natural fertility is medium. The effective rooting zone is deep. Permeability is slow, and the available water capacity is high. These soils have a seasonal high water table at a depth of 1½ to 4 feet.

About half the acreage of Keyport soils has been cleared for farming. The native vegetation consists of forests of such hardwood trees as mixed oaks, sweetgum, beech, yellow-poplar, maple, and hickory. The soils are suited to corn, small grains, and grasses and legumes that tolerate wetness.

Representative profile of Keyport silt loam, 0 to 2 percent slopes, 50 yards east of Route 27, one-half mile south of 10 Mile Run:

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; common fine roots; 2 percent rounded quartzose pebbles; very strongly acid; clear, wavy boundary.

A2—2 to 8 inches, yellowish-brown (10YR 5/6) silt loam; moderate, medium, granular structure and weak, medium, subangular blocky; friable; common fine roots; 2 percent rounded quartzose pebbles; very strongly acid; clear, wavy boundary.

B1—8 to 14 inches, brownish-yellow (10YR 6/6) silt loam; moderate, medium, subangular blocky structure; friable; few fine roots; few thin clay films on ped faces and coatings on sand grains; 2 percent rounded quartzose pebbles; extremely acid; diffuse, wavy boundary.

B21t—14 to 20 inches, brownish-yellow (10YR 6/6) clay loam; common, medium, distinct, light brownish-gray (2.5Y 6/2) and yellowish-brown (10YR 5/8) mottles; moderate, coarse, angular and subangular blocky structure; firm; many moderately thick clay films on ped faces; 3 percent rounded quartzose pebbles; extremely acid; gradual, wavy boundary.

B22t—20 to 46 inches, light yellowish-brown (10YR 6/4) heavy clay loam; many, coarse, distinct, light brownish-gray (2.5Y 6/2) and yellowish-brown (10YR 5/8) mottles; strong, coarse, angular blocky structure; firm; many moderately thick clay films on ped faces; 3 percent rounded quartzose pebbles; extremely acid; gradual, wavy boundary.

C—46 to 60 inches, yellowish-brown (10YR 5/4) clay loam; many,

coarse, distinct, light brownish-gray (2.5Y 6/2) and yellowish-brown (10YR 5/8) mottles; massive; friable; 5 percent rounded quartzose pebbles; extremely acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 8 feet. Coarse fragments larger than 2 millimeters in diameter are few or absent in the solum.

The A horizon has a hue of 10YR or 2.5Y, a value of 3 to 5, and a chroma of 2 or 3.

The B horizon has a hue of 2.5Y, 10YR, or 7.5YR; a value of 4 to 6; and a chroma of 4 to 6. This horizon is heavy clay loam, silty clay, heavy silty clay loam, or clay.

The C horizon has a hue of 10YR, a value of 4 to 6, and a chroma of 2 to 8. This horizon is sandy clay loam, silty clay loam, or clay loam.

Keyport soils are adjacent to the poorly drained, gray Elkton soils; the moderately well drained and somewhat poorly drained Mount Lucas soils; and the somewhat poorly drained Lehigh soils. Nearby on slight rises are the moderately deep, well-drained Penn soils and the deep, well-drained Neshaminy soils.

Keyport soils are not so gray in the B horizon as Elkton soils. They are much deeper over bedrock than Lehigh and Mount Lucas soils. Mottling distinguishes the Keyport soils from Neshaminy and Penn soils.

Keyport silt loam, 0 to 2 percent slopes (KfA).—This nearly level soil is on broad upland flats and slight rises. It has the profile described as representative of the series.

Included with this soil in mapping are small areas where the surface layer is sandy loam, gravelly sandy loam, or loam and some areas of stony soils. Also included are small areas of well-drained and poorly drained soils.

The organic-matter content is medium. The surface layer is generally easy to till, but wetness early in spring and after heavy rain delays plowing and cultivation. Runoff is slow, and the hazard of erosion is slight.

This soil is used most extensively for general farm crops. Because excess water is seasonally perched above the subsoil, alfalfa and fall-sown small grains are subject to frost heaving. Shallow surface drains and land smoothing can be used to remove surface water. Capability unit IIw-70; woodland suitability group 2w1.

Keyport silt loam, 2 to 6 percent slopes (KfB).—This gently sloping soil is on slight rises and undulating uplands.

Included with this soil in mapping are small areas where the surface layer is sandy loam, gravelly sandy loam, and loam and some areas of stony soils. Also included are small areas of Elkton and Neshaminy soils.

The organic-matter content is medium. The soil is generally easy to till, but wetness early in spring and after heavy rain delays plowing or cultivation. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for general field crops, pasture, and as woodland. Management is needed that reduces excess water and controls erosion. Drainage by diversion terraces and shallow surface drains can be used to remove excess water. In cultivated areas contour cultivation and minimum tillage are needed to control runoff and erosion. Capability unit IIe-71; woodland suitability group 2w1.

Klinesville Series

The Klinesville series consists of shallow, well-drained soils on narrow divides and rolling uplands (fig. 6). They formed in material weathered from red shale, siltstone, or fine-grained sandstone. The soils on narrow divides are gently sloping, and those on rolling uplands are gently sloping to very steep.

Figure 6.—**Shallow, droughty Klinesville soils planted to corn.**

In a representative profile in a cultivated area, the surface layer is reddish-brown shaly loam 7 inches thick. The subsoil is 7 inches of reddish-brown shaly loam. The substratum, between depths of 14 and 18 inches, is yellowish-red very shaly loam. Fractured red-shale bedrock is at a depth of 18 inches.

In unlimed areas these soils are very strongly acid or strongly acid in the surface layer and very strongly acid or medium acid in the subsoil. Natural fertility is medium, and organic-matter content is low. The effective rooting depth is shallow. Permeability is moderately rapid, and the available water capacity is low. These soils have a seasonal high water table at a depth of more than 4 feet.

Most areas of Klinesville soils are used as pasture or are wooded. The native vegetation consists of forests of such deciduous trees as mixed oaks, beech, maple, and hickory. Idle fields seed in readily with redcedar. Much former cropland is reverting to woodland. The low available water capacity is the feature of these soils that most limits crop growth. The soils are well suited to small grains. They are also suited to hay and pasture plants, but such plants grow slowly because of the low available water capacity.

Representative profile of Klinesville shaly loam, 2 to 12 percent slopes, in Franklin Township; one-half mile south of tracks of the Central Railroad Company of New Jersey at Middlebush:

Ap—0 to 7 inches, reddish-brown (5YR 4/4) shaly loam; weak, fine, granular structure; friable; many fine roots; 25 percent shale fragments; slightly acid; abrupt, smooth boundary.

B2—7 to 14 inches, reddish-brown (5YR 4/4) shaly loam; weak, fine, subangular blocky structure; friable; common fine roots; 45 percent shale fragments; medium acid; gradual, wavy boundary.

C—14 to 18 inches, yellowish-red (5YR 4/6) very shaly loam;

massive; friable; few fine roots; 75 percent shale fragments; strongly acid; gradual, wavy boundary.
R—18 inches, yellowish-red (5YR 4/6) partly weathered fractured shale bedrock.

Thickness of the solum and depth to bedrock range from 12 to 20 inches. Coarse fragments make up 15 to 60 percent of the solum and 45 to 60 percent of the C horizon.

The A horizon has a hue of 5YR to 10R, a value of 3 or 4, and a chroma of 3 or 4.

The B2 horizon has a hue of 5YR to 10R, a value of 3 or 4, and a chroma of 3 or 4. It ranges from weak, fine and medium, subangular blocky structure to coarse, platy.

The thin C horizon, present in thick profiles, has a hue of 5YR to 10R, a value of 3 or 4, and a chroma of 3 to 6. It is shaly or very shaly silt loam.

Klinesville soils generally are next to the well-drained, moderately deep Penn soils and near the deep, well-drained Bucks and Royce soils. They are associated with Readington and Abbottstown soils. Nearby soils are the mottled, somewhat poorly drained Reaville soils on broad flats and slight rises and the gray, mottled, poorly drained Croton soils along drainageways and in slight depressions.

Klinesville soils are shallower and more shaly than Penn, Bucks, and Royce soils. They do not have the mottled horizon that is commonly in Reaville and Croton soils. They are shallower and more shaly than Readington and Abbottstown soils and do not have the fragipan that is commonly in those soils.

Klinesville shaly loam, 2 to 12 percent slopes (KlC).—This soil is on divides, hilltops, and undulating to gently rolling uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas where the subsoil is clay loam or silt loam and a few areas where the color of the surface layer is brown or yellowish brown. Also included are areas of Penn and Reaville soils.

Runoff is slow or medium on this soil. The hazard of erosion is moderate.

This soil is used mainly for pasture, hay, and small grains. Suitable hay crops are birdsfoot trefoil and orchardgrass. Contour stripcropping and diversion terraces are beneficial in conserving moisture, maintaining organic-matter content, and controlling runoff and erosion. Capability unit IVe-66; woodland suitability group 4d1.

Klinesville shaly loam, 12 to 18 percent slopes (KlD).—This soil is on hillsides and sharp breaks on the strongly sloping uplands. It has a profile similar to the one described as representative of the series, but it is a little shallower to bedrock and is more shaly.

Included with this soil in mapping are some narrow bands of soils that are less than 10 inches deep. Also included are areas of Penn soils and some wet spots caused by seeps and springs.

The content of organic matter is low in the surface layer. Runoff is rapid. The hazard of erosion is severe in plowed and cultivated areas.

This soil is better suited to woods and pasture than to other uses. Productivity is low in most places because of the low available water capacity. Capability unit VIe-66; woodland suitability group 4d1.

Klinesville shaly loam, 18 to 35 percent slopes (KlE).—This soil is on hillsides and sharp breaks on hilly uplands. It has a profile similar to the one described as representative of the series, but depth to bedrock averages 12 to 14 inches.

Included with this soil in mapping are areas where shale bedrock is at a depth of less than 10 inches. Also included are small areas of Penn soils and wet spots caused by seeps and springs.

Runoff is very rapid. The hazard of erosion is very severe in plowed and cultivated areas.

This soil is better suited to trees than to other uses because the available water capacity is low, runoff is very rapid, and the hazard of erosion is very severe. The use of farm machinery is limited and control of weeds is difficult on these steep and very steep soils. Capability unit VIIe-66; woodland suitability group 4d1.

Lamington Series

The Lamington series consists of deep, poorly drained soils that have a very firm fragipan in the lower part of the subsoil. These soils are nearly level. They are in depressions in stream terraces of the Lamington, Millstone, and Raritan Rivers. Lamington soils formed in old stream sediment that washed mostly from uplands. They are underlain by strata of sand, silt, and gravel over red shale and siltstone.

In a representative profile in a cultivated area, the surface layer is dark reddish-gray silt loam 10 inches thick. The upper part of the subsoil is 3 inches of mottled, pinkish-gray heavy silt loam and 10 inches of pinkish-gray silty clay loam. The lower part of the subsoil, between depths of 23 and 45 inches, is a firm, compact and brittle fragipan of reddish-gray light clay loam. The substratum, between depths of 45 and 60 inches, is stratified sand that contains thin lenses of silt loam.

In unlimed areas these soils are strongly acid or very strongly acid. Natural fertility is medium. The effective rooting depth is restricted by the fragipan. Permeability is moderate in the upper part of the soil and slow in the lower part of the subsoil. The available water capacity is moderate. These soils have a seasonally high perched water table.

About half the acreage of Lamington soils has been cleared for farming. The native vegetation consists of forests of such deciduous trees as mixed oaks, ash, beech, and maple. If drained, the soils are suited to corn, soybeans, grasses, and legumes that tolerate wetness.

Representative profile of Lamington silt loam, in Branchburg Township; one-half mile south of intersection of Lone Road and Meadow Road, one-fourth mile west of Meadow Road, and 300 feet east of Chambers Brook:

Ap—0 to 10 inches, dark reddish-gray (5YR 4/2) silt loam; weak, fine, granular structure; friable; many fine and medium roots; 1 percent rounded pebbles; medium acid; abrupt, smooth boundary.
B1g—10 to 13 inches, pinkish-gray (5YR 7/2) heavy silt loam; common, medium, distinct, reddish-brown (5YR 4/4) mottles; weak, fine, subangular blocky structure; friable; common fine roots; 2 percent rounded pebbles; medium acid; clear, wavy boundary.
B2tg—13 to 23 inches, pinkish-gray (5YR 7/2) silty clay loam; common, medium, distinct, reddish-brown (5YR 4/3) mottles; moderate, medium, subangular blocky structure; slightly firm, sticky and plastic; few fine roots; common thin clay films on ped faces; 2 percent rounded pebbles; strongly acid; clear, wavy boundary.
Bxg—23 to 45 inches, reddish-gray (5YR 5/2) light clay loam; common, medium, distinct, reddish-brown (5YR 4/3) mottles; weak, very coarse, prismatic structure parting to moderate, medium, angular blocky; firm, compact and brittle; few thin clay films on some ped faces; 5 percent rounded pebbles; strongly acid; gradual, wavy boundary.
C—45 to 60 inches, reddish-brown (2.5YR 5/4) stratified sand that contains thin lenses of silt loam; single grained; loose; strongly acid.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock is more than 5 feet, and depth to the fragipan ranges from 18 to 25 inches. Coarse fragments make up less than 10 percent of the solum and 0 to 30 percent of the C horizon.

The A horizon has a hue of 5YR or 7.5YR, a value of 4 or 5, and a chroma of 1 or 2.

The B1 horizon has a hue of 5YR or 7YR, a value of 5 to 7, and a chroma of 1 or 2. This horizon ranges from silt loam to silty clay loam. The B2tg horizon has a hue of 5YR to 7.5YR, a value of 4 to 7, and a chroma of 1 or 2. It ranges from silty clay loam to clay loam. The Bxg horizon has a hue of 5YR to 7.5YR, a value of 4 to 6, and a chroma of 1 to 6. High-chroma mottles have a value of 3 to 5 and a chroma of 3 to 6. The fragipan is commonly light clay loam but ranges to silt loam or heavy loam. Structure is weak to moderate, very coarse, prismatic parting to medium, angular blocky or moderate, thick platy.

The C horizon has a hue of 10R to 5YR, a value of 4 to 6, and a chroma of 3 to 6. This horizon is sand, sandy loam, and silt loam that contains varying amounts of gravel and cobbles.

Lamington soils are on stream terraces with the well drained Birdsboro soils and the moderately well drained to somewhat poorly drained, mottled Raritan soils. Nearby on the adjacent flood plains are the poorly drained Bowmansville soils and the somewhat poorly drained or moderately well drained Rowland soils.

Lamington soils have a grayer B horizon than Raritan soils. They have a fragipan, which is not present in Birdsboro soils. They are not subject to the frequent flooding that is common on Bowmansville and Rowland soils, and they have a distinctly more clayey B horizon than those soils.

Lamington silt loam (La).—This nearly level, poorly drained soil is on old oxbows and stream meanders on low terraces along the valleys of the major streams.

Included with this soil in mapping are small areas where the surface layer is loam and silty clay loam. Also included are areas of Raritan soils.

The organic-matter content is medium. The soil is generally in poor tilth because of wetness and the high content of silt and clay. It is likely to clod or crust if plowed when too wet. Runoff is very slow, and the erosion hazard is slight. In places water is temporarily ponded on the surface.

This soil is used mainly for pasture. In undrained areas it is poorly suited to small grains, alfalfa, and most cultivated crops. Suitable crops are corn, soybeans, red clover, Ladino clover, and reed canarygrass. Excessive wetness has been reduced by use of surface drains and, in some places, underdrains or a combination of the two. Capability unit IVw-86; woodland suitability group 1w1.

Lansdowne Series

The Lansdowne series consists of deep, moderately well drained to somewhat poorly drained soils. These soils are nearly level to gently sloping. They are on broad uplands, on low-lying flats, in depressions, and along drainageways. They formed in a mantle of old red glacial till over red shale, siltstone, or fine-grained sandstone.

In a representative profile in a cultivated area, the surface layer is dark reddish-brown silt loam 9 inches thick. The subsoil, 35 inches thick, is dense, mottled, yellowish-red and dark-red heavy silty clay loam, silty clay, or clay. The substratum, between depths of 44 and 55 inches, is dusky-red shaly clay loam. Dark-red shale bedrock is at a depth of 55 inches.

In unlimed areas these soils are strongly acid or medium acid. Natural fertility is medium, and the organic-matter content is moderate. These soils are generally easy to till. Permeability is moderate in the surface layer and slow in the subsoil, and the available water capacity is moderate. These soils have a perched seasonal high water table at a depth of 1 foot to 2½ feet late in fall, in winter, and early in spring. The effective rooting depth of some plants is restricted by the seasonal high water table.

More than half the acreage of Lansdowne soils has been cleared for farming. The native vegetation consists of forests of such deciduous hardwood trees as pin oak, red, oak, white oak, beech, maple, sweetgum, and ash. The soils are suited to crops that tolerate some wetness. They are used mainly for hay and pasture. Row crops are suited where artificial drainage has been installed. This soil is better suited to such water-tolerant grasses and legumes as birdsfoot trefoil, Ladino clover, reed canarygrass, timothy, and bluegrass than to other plants.

Representative profile of Lansdowne silt loam, 0 to 2 percent slopes, in Montgomery Township; 150 yards east of Unionville Cemetery and 20 feet south of Dutchtown Zion Road:

Ap—0 to 9 inches, dark reddish-brown (5YR 3/3) silt loam; moderate, medium, granular structure; friable; many fine roots; medium acid; abrupt, smooth boundary.

B21t—9 to 14 inches, yellowish-red (5YR 4/6) heavy silty clay loam; few, fine, distinct, grayish-brown (10YR 5/2) and light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; friable, plastic, few fine roots; common, thin, reddish-gray (5YR 5/2) clay films on ped faces, in root channels, and in pores; 2 percent fine rounded pebbles of granite gneiss, quartzite, and red shale; strongly acid; clear, wavy boundary.

B22t—14 to 25 inches, yellowish-red (5YR 4/6) silty clay; common, medium, distinct, reddish-gray (5YR 5/2) and reddish-brown (2.5YR 4/4) mottles; moderate, coarse, angular blocky structure; friable; slightly sticky, plastic; common, thin, reddish-gray (5YR 5/2) clay films on ped faces and in pores; 2 percent fine rounded pebbles of granite gneiss, quartzite, and red shale; strongly acid; clear, wavy boundary.

B23t—25 to 38 inches, yellowish-red (5YR 4/6) clay; common, medium, prominent, reddish-gray (5YR 5/2), yellowish-brown (10YR 5/6), and light-gray (10YR 6/1) mottles; moderate, coarse, prismatic structure parting to moderate, coarse, angular blocky; firm, plastic, common, thin, reddish-gray (5YR 5/2) clay films on ped faces and in pores; 3 percent rounded pebbles of granite gneiss, quartzite, and red shale; few rounded quartzite cobbles; strongly acid; abrupt, wavy boundary.

B24t—38 to 44 inches, dark-red (2.5YR 3/6) silty clay; common, medium, prominent, yellowish-brown (10YR 5/6) and light-gray (10YR 6/1) mottles; weak, coarse, prismatic structure; firm, plastic; few, thin, reddish-gray (5YR 5/2) clay films on ped faces; strongly acid; clear, wavy boundary.

IIC—44 to 55 inches, dusky-red (10R 3/4) shaly clay loam; fine, distinct, gray (10YR 6/1) mottles, weak, very coarse, prismatic structure; firm, plastic; reddish-gray (5YR 5/2) coatings along prism faces; 20 percent shale fragments; medium acid; clear, wavy boundary.

R—55 inches, dark-red (2.5YR 3/6) jointed and partly weathered red shale bedrock; reddish-gray (5YR 5/2) coatings on fractured shale.

The solum ranges from 40 to 55 inches in thickness. Depth to shale bedrock is more than 40 inches. Coarse fragments are dominantly rounded pebbles and cobbles ¼ inch to 6 inches in diameter. They make up 2 to 15 percent of the solum and 10 to 30 percent of the C horizon. Weathered fragments generally increase with increasing depth.

The Ap horizon is dark reddish brown (5YR 3/3) to very dark grayish brown (10YR 3/2).

The B2 horizon ranges from dark reddish brown (2.5YR 3/4) to strong brown (7.5YR 5/6). The B horizon is heavy silty clay loam, silty clay, heavy clay loam, and clay.

The C horizon ranges from dusky-red (10YR 3/4) to reddish-brown (5YR 4/3) clay loam, sandy loam, and shaly clay loam.

Landsdowne soils are near or adjacent to the deep, well-drained Norton soils and the moderately deep, well-drained Penn soils on undulating and hilly uplands. Nearby in slight depressions are the deep, moderately well drained Readington soils; the somewhat poorly drained, mottled Abbottstown soils; and the poorly drained, gray Croton soils. Mottling distinguishes Lansdowne soils from Norton and Penn soils. Lansdowne soils have a finer textured B horizon than Readington, Abbottstown, and Croton soils. Also, they are not so gray as Croton soils.

Lansdowne silt loam, 0 to 2 percent slopes (LbA).—This nearly level soil is in low-lying areas on broad upland flats and in depressions and drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are areas where the surface layer is silty clay loam. Also included are areas of Reaville and Norton soils.

Excessive wetness reduces the time during which this soil can be plowed and cultivated. It is often too wet early in spring to be worked along with the adjacent well-drained soils. Runoff is very slow, and the hazard of erosion is slight. In places the effective rooting depth of some plants is limited by a seasonal high water table.

This soil is used for the commonly grown field crops, hay, and pasture. If adequately drained, it is well suited to hay and pasture. Open ditches and surface drains are needed to reduce excess water. Drainage is needed if high-value crops are to be grown. Capability unit IIIw-70; woodland suitability group 3w1.

Lansdowne silt loam, 2 to 6 percent slopes (LbB).—This soil has a profile similar to the one described as representative of the series, but in this soil the depth to gray mottles is about 15 inches.

Included with this soil in mapping are areas where the surface layer of eroded soils has some of the finer textured material from the subsoil mixed in with it. These eroded soils crust more easily than the noneroded ones. Also, seed germination is lower and plant growth is slower in the eroded soils. Areas of Reaville and Norton soils are also included in mapping.

Runoff is slow on this soil, and the hazard of erosion is slight.

This soil is used for the commonly grown field crops, hay, and pasture, If the soil is adequately drained, it is well suited to corn, soybeans, and hay. Cover crops and contour cultivation are needed to control runoff and erosion and to maintain the organic-matter content and good tilth. Because these soils have slow permeability in the subsoil, open ditches and surface drainage are more effective than other methods of disposing of excess water. Capability unit IIIw-70; woodland suitability group 3w1.

Lawrenceville Series

The Lawrenceville series consists of deep, moderately well drained soils that have an extremely firm, brittle fragipan in the lower part of the subsoil. These soils are gently sloping to sloping. They are on the undulating uplands near Rocky Hill and on the foot slopes of the Sourland Mountains. They formed in a silty mantle, generally over material weathered from shale, sandstone, basalt, diabase, or metamorphosed shale.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 6 inches thick. The subsurface layer is 9 inches of brown silt loam. The upper part of the subsoil, between depths of 15 and 31 inches, is mottled, brown silt loam. The lower part, between depths of 31 and 48 inches, is a firm, compact and brittle fragipan of brown heavy silt loam. Shale bedrock is at a depth of 48 inches.

In unlimed areas these soils are very strongly acid or strongly acid in the upper part and very strongly acid to medium acid in the lower part. Natural fertility and the organic-matter content are medium. The soils are easy to till. The effective rooting depth is restricted by the fragipan. Permeability is moderately slow in the fragipan, and the available water capacity is moderate. These soils have a seasonal perched water table at a depth of 1½ to 4 feet late in fall, in winter, and early in spring. Plowing and cultivation are delayed in spring and following heavy rain.

Most areas of Lawrenceville soils have been cleared for farming. The native vegetation consists of forests of such hardwood trees as white, red, and black oak; yellow-poplar; beech; ash; maple; and hickory. If adequately drained, the soils are well suited to corn, soybeans, small grains, and vegetables and to fruit, nursery plants, and other specialized crops. In undrained areas small grains and alfalfa are subject to frost heaving and winterkill.

Representative profile of Lawrenceville silt loam, 2 to 6 percent slopes, in Hillsborough Township; 30 feet south of intersection of Long Hill Road and Neshanic-Wertsville Road:

Ap—0 to 6 inches, dark-brown (7.5YR 3/2) silt loam; moderate, medium, granular structure; friable; many fine roots; medium acid; abrupt, smooth boundary.

A2—6 to 15 inches, brown (7.5YR 5/4) silt loam; weak, medium, subangular blocky structure; friable; many fine roots; strongly acid; clear, wavy boundary.

B1—15 to 21 inches, brown (7.5YR 4/4) silt loam; few, fine, faint, reddish-yellowish (7.5YR 6/8) mottles; moderate, medium, subangular blocky structure; friable; common fine roots; very strongly acid; clear, wavy boundary.

B2t—21 to 31 inches, brown (7.5YR 4/4) heavy silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium and coarse, angular blocky structure; firm; few fine roots; 5 percent shale fragments ⅛ inch to 2 inches in diameter; clay films on ped faces and in root channels; very strongly acid; gradual, wavy boundary.

Bx—31 to 48 inches, brown (7.5YR 4/4) heavy silt loam; many, medium, distinct, reddish-yellow (7.5YR 6/6) mottles and common, medium, distinct, pinkish-gray (7.5YR 6/2) and reddish-yellow (7.5YR 6/8) mottles; weak, very coarse, prismatic structure; extremely firm, compact and brittle; 10 percent shale fragments less than 1 inch in diameter; clay films on ped faces; very strongly acid; clear, smooth boundary.

R—48 inches, dusky-red (2.5YR 3/2) fractured shale bedrock.

The solum ranges from 40 to 55 inches in thickness. Depth to bedrock ranges from 4 to 6 feet, and depth to the fragipan ranges from 25 to 35 inches. Coarse fragments make up less than 5 percent of the upper part of the solum and as much as 10 percent of the lower part of the B horizon and the C horizon.

The A horizon has a hue of 7.5YR or 10YR, a value of 3 to 5, and a chroma of 2 or 3.

The B1 and B2 horizons have a hue of 7.5YR to 10YR, a value of 4 or 5, and a chroma of 3 to 6. The Bt horizon ranges from silt loam to light silty clay loam. The Bx horizon has a hue of 7.5YR or 10YR, a value of 3 or 4, and a chroma of 2 to 4. Low- and high-chroma mottles are in the lower part of the B horizon.

The C horizon, present in some profiles, has a hue of 7.5YR to 10YR, a value of 4 to 7, and a chroma of 1 to 4. This horizon includes silt loam, fine sandy loam, and sandy loam.

Lawrenceville soils are adjacent to the somewhat poorly drained Chalfont soils and the poorly drained Croton soils. Nearby on the adjacent uplands are the deep, moderately well drained Readington soils and the deep, somewhat poorly drained Abbottstown soils.

Lawrenceville soils are less gray in the B horizon than Chalfont and Croton soils and less red than Readington soils. Low-chroma mottles are deeper in Lawrenceville soils than they are in Abbottstown soils.

Lawrenceville silt loam, 2 to 6 percent slopes (LeB).—This gently sloping soil is on the lower slopes of broad upland flats and slight depressions along the base of the Sourland Moutains and near Rocky Hill. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of nearly level soils and some small areas of moderately eroded soils. Also included are areas of Chalfont and Croton soils.

This soil is used mainly for corn, soybeans, hay, and pasture. Runoff is slow, and the hazard of erosion is slight. Contour farming, stripcropping, alternating of crops, and use of diversion terraces are needed to control erosion. Capability unit IIe-71; woodland suitability group 2w1.

Lawrenceville silt loam, 6 to 12 percent slopes (LeC).—This strongly sloping soil is on undulating uplands in the Sourland Mountains and near Rocky Hill.

Included with this soil in mapping are areas of Lawrenceville soils that are moderately eroded and small areas where slopes are more than 12 percent. Also included are areas of Chalfont and Readington soils.

Seeps and lower slope areas remain wet during the early part of the growing season. This soil is used mainly for corn, soybeans, hay and pasture plants, and as woodland. Runoff is medium, and the hazard of erosion is moderate. Erosion control and drainage are needed where areas are farmed intensively. Diversion terraces and stripcropping can be used to control erosion and reduce wetness. Capability unit IIIe-71; woodland suitability group 2w1.

Lehigh Series

The Lehigh series consists of deep, moderately well drained and somewhat poorly drained soils. These gently sloping to strongly sloping soils are on low ridges and hillsides. They formed in material weathered from hard, gray or black, metamorphosed shale.

In a representative profile in a cultivated area, the surface layer is dark grayish-brown silt loam 8 inches thick. Between depths of 8 and 21 inches, the subsoil is mottled, grayish-brown and dark grayish-brown silt loam. Between depths of 21 and 34 inches, the subsoil is dark-gray shaly silty clay loam. The substratum, between depths of 34 and 45 inches, is dark-gray very shaly silt loam. Dark-gray metamorphosed shale is at a depth of 45 inches.

In unlimed areas these soils are strongly acid or medium acid. Natural fertility is medium, and the organic-matter content is medium or low. Permeability is slow in the subsoil, and the available water capacity is moderate. These soils have a water table perched at a depth of ½ foot to 4 feet during winter and early in spring.

Less than half the acreage of Lehigh soils has been cleared for farming. Many areas are idle and are reverting to woodland. The native vegetation consists of forests of such hardwood trees as mixed upland oaks, hickory, and yellow-poplar. The soils are suited to the commonly grown field crops, spring-sown small grains, hay, and pasture. Excess water delays plowing and cultivation.

Representative profile of Lehigh silt loam, 2 to 6 percent slopes, one-fourth mile west of Route 206 on Cherry Valley Road:

Ap—0 to 8 inches, dark grayish-brown (2.5Y 4/2) silt loam; weak, fine, granular structure; friable; many fine roots; 5 percent shale fragments; strongly acid; abrupt, smooth boundary.

B1—8 to 12 inches, grayish-brown (2.5Y 5/2) silt loam; few, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, fine, subangular blocky structure; friable; many fine roots; 10 percent shale fragments; strongly acid; clear, wavy boundary.

B21t—12 to 21 inches, dark grayish-brown (10YR 4/2) silt loam; few, medium, distinct, light-gray (N 7/0) and dark-brown (7.5YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; few fine roots; 15 percent shale fragments; few moderately thick clay films on ped faces and in pores; strongly acid; clear, wavy boundary.

B22t—21 to 34 inches, dark-gray (N 4/0) shaly silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; friable; few fine roots; common moderately thick clay films on ped faces and in pores; 20 percent shale fragments; strongly acid; gradual, wavy boundary.

C—34 to 45 inches, dark-gray (N 4/0) very shaly silt loam; common, coarse, distinct, dark yellowish-brown (10YR 4/4) mottles; very weak, coarse, subangular blocky structure; firm; 60 percent shale fragments that range from 5 to 30 centimeters in diameter; strongly acid; clear, wavy boundary.

R—45 inches, dark-gray (N 4/0) fractured metamorphosed shale.

Low-chroma colors in this soil are inherited from the parent material and are not a result of wetness.

The solum ranges from 20 to 36 inches in thickness. Depth to bedrock ranges from 3½ to 5 feet. Coarse fragments make up 1 to 15 percent of the A horizon and the upper part of the B horizon, 20 to 30 percent of the lower part of the B horizon, and 40 to 60 percent of the C horizon.

The A horizon is typically dark grayish brown (2.5Y 4/2) but in places is very dark grayish brown (10YR 3/2).

The B horizon is typically dark gray (N 4/0). In places, however, hue is 5Y, 2.5Y, or 10YR; and along with this hue, value is 4 or 5, and chroma is 0, 1, or 2. This horizon is silt loam, silty clay loam, and their shaly equivalents.

The C horizon is typically dark gray (N 4/0) but in places is dark grayish brown (2.5Y 4/2). This horizon is shaly and very shaly silt loam and light silty clay loam. Diameter of shale fragments ranges from 2 to 30 centimeters.

Lehigh soils are adjacent to the well-drained Neshaminy soils, which are in higher positions. Nearby in slight depressions are the deep, poorly drained Croton and Watchung soils.

Mottles and the gray colors of the solum distinguish Lehigh soils from Neshaminy soils. Lehigh soils are less gray than Croton and Watchung soils. They do not contain the basalt or diabase coarse fragments that are common in Watchung soils.

Lehigh silt loam, 2 to 6 percent slopes (LhB).—This gently sloping soil is on broad upland flats and in depressions. It has the profile described as representative of the series.

Included with this soil in mapping are areas where the surface layer is shaly silt loam and areas of Croton, Reaville, Penn, and Lawrenceville soils.

The organic-matter content is medium. The surface layer is generally in good tilth. Seeps and areas on the lower slopes and in depressions remain wet during the early part of the growing season. Runoff is slow, and the hazard of erosion is slight. Some plant roots are restricted by the perched water table.

This soil is used mostly for hay and pasture. Many areas are idle or abandoned and are reverting to weeds, shrubs, and trees. Where this soil is adequately drained, it is suited to corn, soybeans, small grains, and pasture. If drainage is impractical, grasses and legumes that tolerate wetness should be planted. Drainage and erosion control are needed if this soil is intensively used. Drainage by diversion terraces or by other methods can be used to remove excess water, and tile drains can be used to carry water away from seep spots. In places bedrock interferes with installation of tile drains. Capability unit IIIw-70; woodland suitability group 3w1.

Lehigh silt loam, 6 to 15 percent slopes (LhC).—This sloping soil is on hills and ridges. It has a profile similar to the one described as representative of the series, but it is a few inches thinner over bedrock than the representative soil, and it has more shale fragments in the surface layer.

Included with this soil in mapping are small areas of Reaville, Penn, and Lawrenceville soils. Also included are some areas of eroded soils that are low in organic-matter content.

Many seeps and springs are near the bases of slopes and

in places where bedrock is nearest the surface. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for the commonly grown crops and hay and pasture. It is well suited to perennial hay and pasture consisting of grasses and legumes that tolerate wetness. Erosion control and drainage are needed if this soil is to be intensively used. Diversion terraces, stripcropping, and minimum tillage are useful in controlling runoff and erosion. Capability unit IIIe-70; woodland suitability group 3w1.

Meckesville Series

The Meckesville series consists of deep, moderately well drained soils that have a very firm fragipan in the lower part of the subsoil. These gently sloping to strongly sloping soils are on undulating and rolling uplands. They formed in a thick mantle of weathered granite gneiss till and in the underlying reddish-brown gravelly conglomerate.

In a representative profile in a cultivated area, the surface layer is dark-brown gravelly loam 8 inches thick. The subsoil is 37 inches thick. In sequence from the top, it is 3 inches of strong-brown heavy loam, 15 inches of dark-brown clay loam that has mottles below a depth of 19 inches, and 19 inches of a firm or very firm fragipan of mottled, reddish-brown clay loam and light clay loam. The substratum, between depths of 45 and 50 inches, is mottled, reddish-brown loam. Dark reddish-brown, fractured, gravelly and cobbly conglomerate is at a depth of 50 inches.

In unlimed areas these soils are strongly acid. Natural fertility is high. The effective rooting depth is restricted by the fragipan. Permeability is slow in the fragipan, and the available water capacity is moderate. These soils have a seasonal high water table at a depth of 1½ to 4 feet.

More than half the acreage of Meckesville soils has been cleared for farming. The native vegetation consists of forests of such hardwood trees as mixed oaks, yellow-poplar, ash, and hickory. The soils are well suited to corn, small grains, vegetables, hay, and pasture.

Representative profile of Meckesville gravelly loam, 2 to 6 percent slopes, in Bedminster Township; 100 yards north of the intersection of Larger Cross Road and Spook Hollow Road, 200 feet east of Larger Cross Road, and 150 feet north of woods, in the Brady Estate:

Ap—0 to 8 inches, dark-brown (7.5YR 4/2) gravelly loam; moderate, medium, granular structure; very friable; many roots; 15 percent pebbles; slightly acid; abrupt, smooth boundary.

B1—8 to 11 inches, strong-brown (7.5YR 5/6) heavy loam; weak, medium, subangular blocky structure; friable; worm channels with dark-brown (7.5YR 4/2) filling; common roots; 10 percent pebbles; slightly acid; clear, wavy boundary.

B21t—11 to 19 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; friable; few roots; few thin clay films on ped faces; less than 15 percent pebbles; medium acid; clear, wavy boundary.

B22t—19 to 26 inches, dark-brown (7.5YR 4/4) clay loam; few, fine, faint, light-brown (7.5YR 6/4) mottles; moderate, medium, subangular blocky structure; firm; few roots; thin continuous clay films on ped faces; 10 percent pebbles; strongly acid; abrupt, wavy boundary.

IIBx1—26 to 33 inches, reddish-brown (5YR 4/4) clay loam; few, medium, distinct, reddish-yellow (7.5YR 6/8) and brown (7.5YR 5/4) mottles; moderate, coarse, prismatic structure parting to moderate, thick, platy; firm, compact and brittle; very few roots; few thin clay films on ped faces; common black stains in lower part of horizon; less than 15 percent pebbles; strongly acid; clear, wavy boundary.

IIBx2—33 to 45 inches, reddish-brown (5YR 4/4) light clay loam; many, coarse, distinct, pinkish-gray (5YR 6/2) and reddish-yellow (5YR 6/8) mottles; moderate, coarse, prismatic structure parting to moderate, thick, platy; very firm; mottles along root channels and structure faces; stains throughout horizon; less than 15 percent pebbles; strongly acid; gradual, wavy boundary.

IIC—45 to 50 inches, reddish-brown (5YR 4/4) loam; many, coarse, distinct, pinkish-gray (5YR 6/2) and reddish-yellow (5YR 6/8) mottles; weak, coarse, prismatic structure; friable; less than 15 percent pebbles; strongly acid.

R—50 inches, dark reddish-brown (5YR 3/4), fractured, gravelly and cobbly conglomerate.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock ranges from 4 to 6 feet. Coarse fragments make up 10 to 30 percent of the material throughout the soil profile.

The A horizon has a hue of 7.5YR or 10YR, a value of 3 to 5, and a chroma of 2 to 4.

The Bt horizon has a hue of 7.5YR, 10YR, or 5YR; a value of 3 to 5; and a chroma of 3 to 6. The Bt horizon is typically clay loam but ranges to heavy loam, gravelly sandy clay loam, and gravelly silty clay loam. The Bx horizon has a hue of 5YR or 2.5YR, a value of 3 or 4, and a chroma of 3 to 6. Low-chroma mottles are along the structure faces or are absent. The Bx horizon is typically light clay loam but in places is heavy loam and sandy clay loam. Structure is weak and moderate, coarse and very coarse, prismatic and moderately thick and very thick, platy. Consistence is typically firm or compact and brittle, but in places it is very firm or extremely firm.

The C horizon has a hue of 5YR, 2.5YR, or 10R; a value of 3 or 4; and a chroma of 2 to 8. This horizon is commonly loam but in places is gravelly or cobbly loam or sandy clay loam.

Meckesville soils are near or adjacent to the moderately deep Penn soils and the shallow Klinesville soils on gently undulating and rolling uplands. Nearby are the red, gravelly and cobbly Pattenburg soils on hillsides and ridges and the deep, somewhat poorly drained Califon soils in slight depressions and drainageways. Meckesville soils, unlike Penn, Klinesville, and Pattenburg soils, have a moderately developed fragipan. They are better drained and less gray than Califon soils.

Meckesville gravelly loam, 2 to 6 percent slopes (MeB).—This gently sloping soil is on broad, undulating uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of eroded soils where most of the original surface layer has been removed by erosion and some small areas of soils that do not have a gravelly plow layer. Included along Douglas Road in Bernardsville Borough are small areas where the subsoil and layer below it are brown. Also included are small areas of Pattenburg, Penn, and Califon soils.

The organic-matter content is medium. The surface layer is generally easy to till, but gravel and cobbles interfere with tillage operations where they make up more than 25 percent of the surface layer. Runoff is slow. The hazard of erosion is slight. Slow permeability causes the subsoil to remain wet for several days after periods of heavy rain.

This soil is used for most of the general field crops, such as corn, soybeans, hay, and pasture. In cultivated areas cropping sequences and diversion terraces are needed to maintain the organic-matter content and good tilth, control runoff and erosion, and reduce wetness. Capability unit IIe-51; woodland suitability group 2o1.

Meckesville gravelly loam, 6 to 12 percent slopes (MeC).—This soil has a profile similar to the one described as representative of the series, but it has more pebbles and cobbles on the surface, has a thinner surface layer, and is shallower over the reddish-brown fragipan.

Included with this soil in mapping are areas where pebbles and cobbles make up less than 15 percent of the surface layer and also some small areas where the soils have lost most of their original surface layer through erosion. Small areas of Pattenburg and Penn soils are also included.

The organic-matter content is medium. The surface layer is generally easy to till and seldom clods or crusts. Gravel and cobbles, however, interfere with tillage operations where they make up more than 25 percent of the plow layer. Runoff is medium. The hazard of erosion is moderate.

This soil is suited to all the general crops common to the county. Most of the acreage is cultivated or in hay or pasture. In cultivated areas contour stripcropping, terraces, and minimum tillage are needed to maintain the organic-matter content and good tilth and to control runoff and erosion. Capability unit IIIe-51; woodland suitability group 2o1.

Mount Lucas Series

The Mount Lucas series consists of deep, moderately well drained and somewhat poorly drained soils. These nearly level to strongly sloping soils are on hillsides and ridges and on the lower slopes in the Watchung and Sourland Mountains. They formed in material weathered from dark igneous diabase and basalt bedrock.

In a representative profile in a wooded area, the surface layer is dark grayish-brown and grayish-brown silt loam 8 inches thick. Between depths of 8 and 23 inches the subsoil is mottled, light yellowish-brown and yellowish-brown silt loam and heavy silt loam, and between depths of 23 and 35 inches it is mottled, dark-brown light silty clay loam. The substratum, between depths of 35 and 56 inches, is mottled, brown cobbly loam. Hard bedrock is at a depth of 56 inches.

In unlimed areas these soils are strongly acid to slightly acid in the upper part and medium acid to neutral in the lower part. Natural fertility is high. Permeability is moderately slow, and the available water capacity is high. These soils have a seasonal high water table at a depth of 1 foot to 4 feet. Although the seasonal water table restricts the development of some roots, the effective rooting zone is deep. Excessive wetness early in spring and following heavy rain delays plowing and cultivation.

Most areas of Mount Lucas soils are wooded. The native vegetation consists of forests of such deciduous trees as mixed oaks, yellow-poplar, beech, ash, and maple. The soils are not generally suited to intense cultivation because of wetness and stoniness. They are better suited to row crops, hay, and pasture than to other uses. Alfalfa and fall-sown small grains are subject to frost heaving in the somewhat poorly drained areas.

Representative profile of Mount Lucas silt loam, 2 to 6 percent slopes, in Warren Township; 300 feet east of Flintlock Road and 50 feet north of Red Hill Road:

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; common very fine roots; 10 percent angular basalt pebbles and cobbles; strongly acid; clear, wavy boundary.

A2—2 to 8 inches, grayish-brown (10YR 5/2) silt loam; moderate, thick, platy structure; friable; common fine roots; 10 percent angular basalt pebbles and cobbles; strongly acid; gradual, wavy boundary.

B1—8 to 14 inches, light yellowish-brown (10YR 6/4) silt loam; few, medium, faint, light-gray (10YR 7/2) mottles; weak, thin, platy structure; friable; common fine roots; 10 percent angular basalt pebbles and cobbles; strongly acid; gradual, wavy boundary.

B21t—14 to 23 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, medium, distinct, light-gray (10YR 7/2) and light yellowish-brown (10YR 6/4) mottles; moderate, medium, subangular blocky structure; friable; few fine roots; few thin clay films on ped faces and in root channels; 10 percent angular basalt pebbles and cobbles; strongly acid; clear, wavy boundary.

B22t—23 to 35 inches, dark-brown (7.5YR 4/4) light silty clay loam; common, medium, distinct, brown (7.5YR 5/2), dark-brown (7.5YR 4/2), and strong-brown (7.5YR 5/8) mottles; moderate, medium, angular blocky structure; friable; few fine roots; common thin clay films on ped faces and in root channels; many black stains; 10 percent angular basalt pebbles and cobbles; medium acid; clear, smooth boundary.

C—35 to 56 inches, brown (7.5YR 5/4) cobbly loam; common, medium, distinct, grayish-brown (10YR 4/2), light yellowish-brown (10YR 6/4), and strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; few thin clay films on ped faces; 25 percent coarse basalt cobbles; medium acid; gradual, wavy boundary.

R—56 inches, black (N 2/0), highly fractured, fine-grained basalt bedrock.

The solum ranges from 30 to 38 inches in thickness. Depth to bedrock ranges from 4 to 6 feet. Coarse fragments make up 5 to 30 percent of the A and B horizons and 20 to 40 percent of the C horizon. They range from pebbles to boulders in size. Depth to low-chroma mottles ranges from 8 to 20 inches.

The A horizon has a hue of 10YR or 7.5YR, a value of 4 or 5, and a chroma of 2 or 3. This horizon is silt loam or gravelly silt loam.

The B horizon has a hue of 10YR to 5YR, a value of 4 or 5, and a chroma of 3 to 6. The Bt horizon is heavy silt loam, silty clay loam, clay loam, and their gravelly equivalents.

The C horizon has a hue of 5YR to 10YR, a value of 4 or 5, and a chroma of 3 or 4. This horizon ranges from loam to sandy loam and their gravelly or cobbly equivalents.

Mount Lucas soils generally are associated with the well-drained, unmottled Neshaminy soils on hillsides and ridges and with the mottled, poorly drained Watchung soils in swales. They are less gray than Watchung soils. Mottling distinguishes Mount Lucas soils from Neshaminy soils.

Mount Lucas silt loam, 2 to 6 percent slopes (MoB).—This gently sloping soil is on slight rises and at the base of slopes and along drainageways in the Watchung and Sourland Mountains. It has the profile described as representative of the series.

Included with this soil in mapping are some areas where coarse fragments make up more than 15 percent of the surface layer. Also included are areas of Watchung and Neshaminy soils.

The organic-matter content of this soil is medium. The surface layer is generally easy to till, but coarse fragments interfere with tillage operations where they make up more than 20 percent of this layer. Runoff is slow. The hazard of erosion is slight. The rooting depth of some plants is limited by the seasonal high water table.

This soil is used mainly for corn, soybeans, apples, and hay and pasture plants. In cultivated areas contour cultivation and minimum tillage help to control runoff and erosion. Wetness has been reduced by surface drains or drain tile. Capability unit IIe-71; woodland suitability group 2w1.

Mount Lucas gravelly silt loam, 6 to 12 percent slopes (MpC).—This soil has a profile similar to the one described as representative of the series, but it has more gravel and cobbles on the surface than that soil, and the depth to bedrock is about 4 feet.

Included with this soil in mapping are some areas of stony soils and a few areas of severely eroded soils that have lost most of their original surface layer through erosion. Also included are areas of Neshaminy and Watchung soils.

The organic-matter content is medium. The surface layer is generally easy to till, but coarse fragments interfere with tillage operations where they make up more than 20 percent of the surface layer. This soil dries out slowly, and seepage at the foot of some slopes persists until early in summer. Tile drains are helpful in areas where

moisture is made excessive by seeps and springs. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for corn, small grains, hay and pasture plants, and as woodland. In cultivated areas stripcropping in combination with minimum tillage and diversion terraces is needed to control runoff and erosion. Cover crops and cropping sequences are needed to maintain organic-matter content and good tilth. Capability unit IIIe-71; woodland suitability group 2w1.

Mount Lucas-Watchung very stony silt loams, 2 to 12 percent slopes (MuB).—This mapping unit is about 65 percent Mount Lucas soils and 35 percent Watchung soils, but the proportion varies somewhat from place to place. The Mount Lucas and Watchung soils occurred generally in such a complex pattern that it was not practical to map them separately at the scale used. These soils are on undulating uplands, on hillsides, and at the base of steeper slopes in the Watchung and Sourland Mountains. They have profiles similar to the ones described as representative of their respective series, but stones are spaced 5 to 30 feet apart on the surface.

Included with these soils in mapping are areas where the surface layer is less than 15 percent gravel and cobbles and some small areas of Neshaminy soils.

The organic-matter content is high in these soils. They dry out slowly in spring, and seepage at the foot of some slopes persists until early in summer. Runoff is medium, and the hazard of erosion is moderate.

This mapping unit is mainly in woodland cover. The stones and outcrops make cultivation impractical. The soils are well suited to woodland and fairly well suited to pasture. Where the soils are used for pasture, light machinery is needed for disking, planting, liming, and fertilizing. Moisture-tolerant grasses and legumes are better suited than other plants. Capability unit VIIs-77; woodland suitability group 2w1.

Neshaminy Series

The Neshaminy series consists of deep, well-drained soils. These gently sloping to very steep soils are on hillsides and ridgetops of the Watchung Mountains, the Sourland Mountains, and the gently rolling uplands near Rocky Hill (fig. 7). They formed in material weathered from dark igneous rocks, such as basalt and diabase.

In a representative profile in a wooded area, the surface layer is dark grayish-brown silt loam 4 inches thick. The subsurface layer is 6 inches of brown silt loam. The upper 12 inches of the subsoil is strong-brown and yellowish-red gravelly silt loam, and the lower 24 inches is yellowish-red

Figure 7.—**Diversion terrace on gently sloping Neshaminy gravelly loam. Steeply sloping Neshaminy soils are in the background.**

gravelly clay loam. The substratum, between depths of 46 and 96 inches, is yellowish-red cobbly loam. Fractured bedrock is at a depth of 96 inches.

In unlimed areas these soils are medium acid to strongly acid in the upper part and medium acid in the lower part. Natural fertility is high. Permeability is moderately slow, and the available water capacity is high. The native vegetation is forests of such hardwood trees as yellow-poplar, white oak, red oak, ash, maple, and hickory.

Less than half the acreage of Neshaminy soils has been cleared for farming. Gently sloping to strongly sloping, nonstony Neshaminy soils are well suited to corn, small grains, vegetables, hay, and pasture. Steep, very stony Neshaminy soils are better suited to woodland and pasture than to other uses.

Representative profile of Neshaminy silt loam, 6 to 12 percent slopes, in Bernards Township; in a woodlot one-half mile east of Somerville Road on the north side of Interstate Highway 78:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; 15 percent rounded basalt pebbles, mostly less than 3 inches in diameter; common fine and coarse roots; strongly acid; clear, wavy boundary.

A2—4 to 10 inches, brown (10YR 5/3) silt loam; weak, medium, granular structure; friable; 15 percent rounded basalt pebbles; common fine roots; strongly acid; clear, wavy boundary.

B1—10 to 14 inches, strong-brown (7.5YR 5/6) gravelly silt loam; weak, thin, platy structure; friable; 20 percent rounded and angular basalt pebbles; few fine roots; strongly acid; gradual, wavy boundary.

B21t—14 to 22 inches, yellowish-red (5YR 4/6) gravelly silt loam; moderate, medium, subangular blocky structure; friable; 25 percent angular basalt pebbles and cobbles; few fine roots; common thin clay films on ped faces and in root channels; few, fine, black stains on ped faces and coarse fragments; strongly acid; gradual, wavy boundary.

B22t—22 to 46 inches, yellowish-red (5YR 4/6) gravelly clay loam; moderate, medium, angular blocky structure; friable; 30 percent pebbles and cobbles; common thin clay films on ped faces; few, fine, black stains on ped faces and coarse fragments; medium acid; gradual, wavy boundary.

C—46 to 96 inches, yellowish-red (5YR 5/6) cobbly loam; weak, medium, subangular blocky structure; friable; 40 percent pebbles and cobbles, 3 to 10 inches in diameter; few, fine, black stains on ped faces and coarse fragments; medium acid; diffuse, irregular boundary.

R—96 inches, black (5YR 2/1) highly fractured basalt bedrock.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock ranges from 4 to 10 feet. Coarse fragments make up 5 to 35 percent of the upper part of the solum, 15 to 35 percent of the lower part of the solum, and commonly more than 50 percent of the C horizon. Gravel and cobbles predominate, and stones increase in amount with increasing depth.

The A horizon has a hue of 10YR to 5YR, a value of 3 to 5, and a chroma of 2 to 4. This horizon is mainly silt loam, but in places it is gravelly silt loam. Very stony phases are common.

The B horizon commonly has a hue of 5YR but ranges from 2YR to 7.5YR, generally becoming redder with increasing depth. It has a value of 4 or 5 and a chroma of 4 to 6. This horizon is cobbly clay loam, gravelly clay loam, loam, and silt loam.

Neshaminy soils occur with the moderately well drained and somewhat poorly drained, mottled Mount Lucas soils on lower slopes and with the poorly drained, gray, mottled Watchung soils in low-lying flats, in depressions, and along drainageways. They also occur with the well-drained Neshaminy fragipan variant, which is at lower elevations nearer the base of the slopes, and the somewhat poorly drained, mottled Amwell rock substratum soils on lower slopes and in slight depressions.

Neshaminy soils do not have the mottles that are commonly in Mount Lucas soils or the low-chroma matrix that is commonly in Watchung soils. They lack the mottles that are commonly in the Amwell soils that have a rock substratum, and they are much deeper to bedrock than those soils. They do not have the fragipan of the fragipan variant to the Neshaminy soils and of the Amwell soils that have a rock substratum.

Neshaminy silt loam, 2 to 6 percent slopes (NeB).—This gently sloping soil is on undulating uplands and low ridges in the Watchung and Sourland Mountains. Basalt or diabase gravel and cobbles are scattered over the surface and throughout the profile.

Included with this soil in mapping are some areas of moderately eroded soils, some areas where slopes are less than 2 percent, and some gravelly spots. Also included are areas of Mount Lucas soils and the Neshaminy fragipan variant.

The organic-matter content is medium. The surface layer is generally easy to till, but gravel and cobbles interfere with tillage and harvesting operations where they make up more than 20 percent of the surface layer. The soil is used mainly as woodland and for pasture and, less extensively, to grow corn, soybeans, and hay. It can be plowed and cultivated early in spring and soon after light showers. Runoff is slow and the hazard of erosion is slight in cultivated areas. Erosion control is needed and is generally easily applied on this soil. Stripcropping or contour cultivation is needed on long slopes to control erosion. Capability unit IIe-55; woodland suitability group 2o1.

Neshaminy silt loam, 6 to 12 percent slopes (NeC).—This strongly sloping soil is on rolling uplands and hillsides in the Watchung and Sourland Mountains. It has the profile described as representative of the series. Basalt or diabase gravel and cobbles are scattered over the surface and throughout the profile.

Included with this soil in mapping are areas of gravelly or cobbly loam. Also included are a few areas of moderately eroded soils in which the strong-brown subsoil has been mixed with the surface layer in plowing. Also included are areas of Mount Lucas soils and soils of the Neshaminy series, fragipan variant.

The organic-matter content is medium. The surface layer is generally easy to till, but gravel and cobbles interfere with tillage and harvesting operations where they make up more than 20 percent of the surface layer. This soil is used mainly as woodland and for pasture. It can be plowed and cultivated throughout a wide range of moisture conditions without clodding or crusting. Runoff is medium, and the hazard of erosion is moderate. In cultivated areas contour cultivation, stripcropping, and minimum tillage are needed to control runoff and erosion. Capability unit IIIe-55; woodland suitability group 2o1.

Neshaminy very stony silt loam, 18 to 35 percent slopes (NhE).—This steep to very steep soil is on hilly uplands of the Watchung and Sourland Mountains. It has a profile similar to the one described as representative of the series, but stones and boulders are scattered over the surface and throughout the profile. The stones are 5 to 30 feet apart.

Included with this soil in mapping are areas of soils that have a surface layer of gravelly silt loam or silt loam. Also included are some areas of soils of the Neshaminy series, fragipan variant.

The organic-matter content is medium to high. Runoff is rapid. The hazard of erosion is severe if these slopes have been cleared and left bare.

Most of the acreage is wooded, and this soil is better suited to woodland than to other uses. Removal of stones

and boulders is not practical for farm use. Capability unit VIIs-61; woodland suitability group 2o1.

Neshaminy-Mount Lucas very stony silt loams, 2 to 12 percent slopes (NkC).—This mapping unit is 50 to 70 percent Neshaminy soils and 30 to 50 percent Mount Lucas soils. These gently sloping to strongly sloping soils are in such an intricate pattern that it is not practical to map them separately at the scale desired. They have profiles similar to the ones described as representative for their respective series; but many stones and boulders, spaced 5 to 30 feet apart, are scattered over the surface (fig. 8) and throughout the profile. In many places the surface layer is gravelly silt loam.

The organic-matter content is medium to high. The high content of stones and a few boulders make plowing impractical. Runoff is slow to medium. The hazard of erosion is slight to moderate.

Most of this mapping unit is wooded. A few small areas are used to grow apples and for pasture. Removing the stones and boulders is generally not practical, but light farm machinery can be used in some areas for planting, liming, and fertilizing. This soil is better suited to woodland and pasture than it is to field crops. Capability unit VIs-61; woodland suitability group 2o1.

Neshaminy-Mount Lucas very stony silt loams, 12 to 18 percent slopes (NkD).—This mapping unit is 50 to 70 percent Neshaminy soils and 30 to 50 percent Mount Lucas soils. These moderately steep soils are in such an intricate pattern that it is not practical to map them separately at the scale desired. They are on uplands and hillsides of the Watchung and Sourland Mountains. These soils have profiles similar to the ones described as representative of their respective series, but stones and boulders are scattered over the surface and throughout the profile. In many areas the surface layer is gravelly silt loam. The stones are generally 5 to 30 feet apart.

Included with these soils in mapping are areas of soils of the Neshaminy series, fragipan variant, and soils of the Watchung series.

The organic-matter content is medium to high. Runoff is rapid. The hazard of erosion is severe if these soils have been cleared and left bare.

Most areas of this mapping unit are wooded, and the soils are well suited to woodland. A few areas are used for pasture and fruit. Removing the stones and boulders is generally not practical for farm use, but light farm machinery can be used in some areas for disking, planting, fertilizing, and liming. Capability unit VIs-61; woodland suitability group 2o1.

Neshaminy Variant

The Neshaminy variant consists of deep, well-drained and moderately well drained soils. These soils are gently sloping to sloping. They are on hilly uplands and slopes at the base of the Watchung Mountains. The surface layer and most of the subsoil formed in silty and gravelly trap-rock colluvium, and the lower part of the subsoil formed in residuum derived from basalt or diabase.

In a representative profile in a cultivated area, the surface layer is brown silt loam 9 inches thick. The upper part of the subsoil, to a depth of 32 inches, is strong-brown and yellowish-red silt loam and heavy silt loam that has mottles below a depth of 25 inches. The lower part of the subsoil, between depths of 32 and 40 inches, is a firm, compact and brittle fragipan of strong-brown cobbly silt loam. Fractured basalt bedrock is at a depth of 40 inches.

In unlimed areas these soils are medium acid. Natural

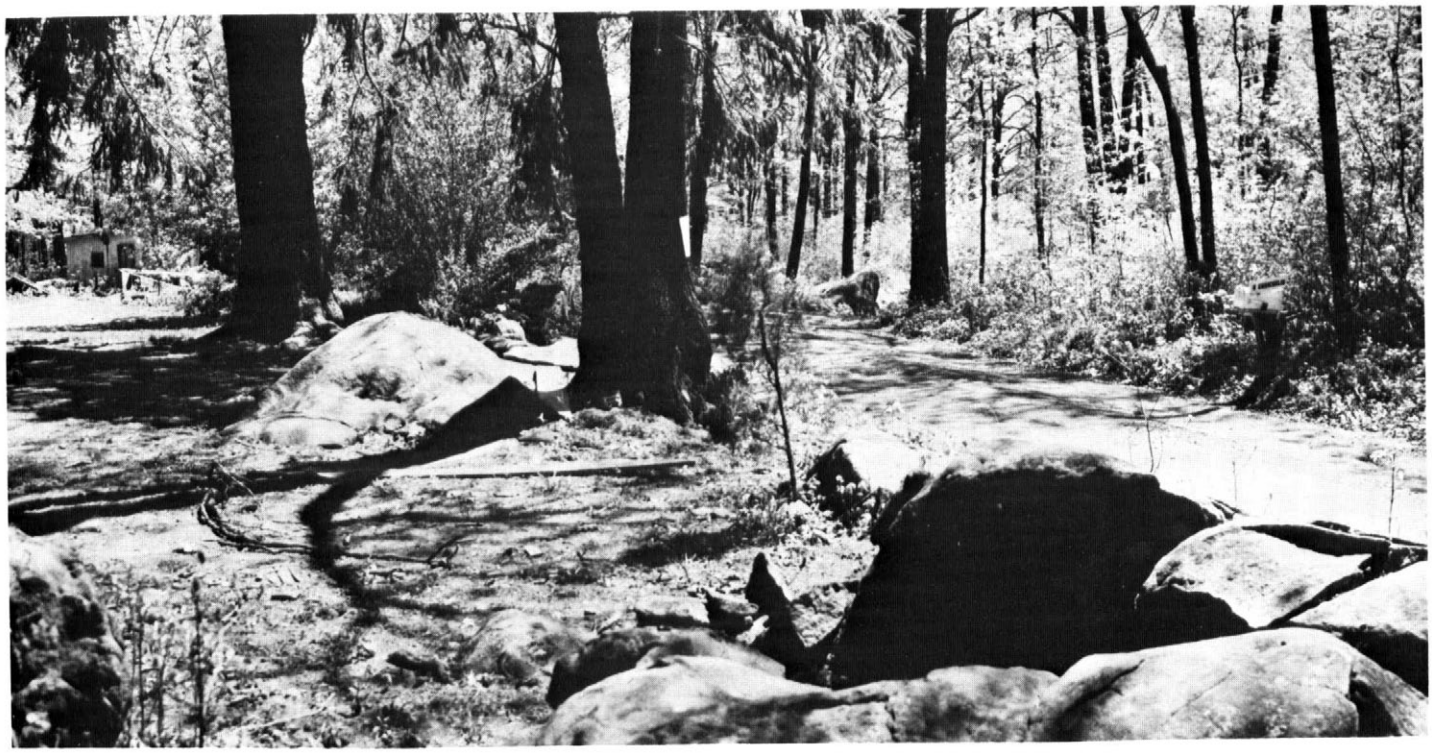

Figure 8.—Area of Neshaminy and Mount Lucas very stony soils.

fertility is high, and the organic-matter content is medium. These soils are generally easy to till. Permeability is moderate in the surface layer and upper part of the subsoil and slow in the lower part of the subsoil. The available water capacity is moderate. These soils have a seasonal high water table that is perched at a depth of 2 feet to more than 5 feet late in winter and in spring. The fragipan restricts root development and the downward movement of water, and water moves laterally over the pan.

Less than half the acreage of these soils has been cleared for farming. The native vegetation consists of forests of such hardwood trees as yellow-poplar; black, red, and white oaks; ash; maple; and hickory. The soils are well suited to corn, soybeans, small grains, fruits, and vegetables. Most of the sloping areas have been cleared for farming or pasture.

Representative profile of Neshaminy silt loam, fragipan variant, 6 to 12 percent slopes, in Bridgewater Township; 200 yards south of Middlebrook Road and 50 feet west of Crum Road:

Ap—0 to 9 inches, brown (10YR 5/3) silt loam; moderate, medium, granular structure; friable; many fine roots; 3 percent rounded basalt pebbles; few cobbles; medium acid; abrupt, smooth boundary.

B1—9 to 15 inches, strong-brown (7.5YR 5/6) silt loam; weak, fine, subangular blocky structure; friable; many fine roots; 3 percent rounded basalt pebbles; few cobbles; medium acid; clear, wavy boundary.

B21t—15 to 25 inches, yellowish-red (5YR 5/6) heavy silt loam; weak, medium, subangular blocky structure; friable; few fine roots; few thin clay films on ped faces; 5 percent rounded basalt pebbles; medium acid; gradual, wavy boundary.

B22t—25 to 32 inches, yellowish-red (5YR 5/6) heavy silt loam; few, fine, faint, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; common thin clay films on ped faces and in pores; some black stains on ped faces; 5 percent rounded basalt pebbles; medium acid; clear, wavy boundary.

IIBx—32 to 40 inches, strong-brown (7.5YR 5/6) cobbly silt loam; common, medium, distinct, pinkish-gray (7.5YR 7/2) and light-brown (7.5YR 6/4) mottles; weak, medium, prismatic structure parting to weak, medium, platy; firm, compact and brittle; few black stains on ped faces and on coarse fragments; 20 percent angular basalt cobbles; medium acid; clear, wavy boundary.

R—40 inches, black (5YR 2/1) highly fractured basalt bedrock.

The solum ranges from 36 to 50 inches in thickness. Depth to bedrock ranges from 3½ to 4½ feet, and depth to the Bx horizon ranges from 25 to 35 inches. Coarse fragments make up 2 to 25 percent of the upper part of the solum and 15 to 35 percent of the lower part.

The A horizon ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4).

The B horizon has a hue of 5YR to 7.5YR, a value of 4 or 5, and a chroma of 4 to 6. Texture ranges from heavy silt loam and light silty clay loam to cobbly silt loam. The Bx horizon is moderately developed. It has a hue of 5YR to 7.5YR and a value and chroma of 4 to 6. Mottles are absent in many areas. In some places the boundary between the fragipan and the basalt bedrock is abrupt and smooth. A thin C horizon is present in places.

Soils of the Neshaminy variant are near or adjacent to the deep, somewhat poorly drained, mottled Amwell soils that have a rock substratum and are on slight rises and lower slopes. They are also near or adjacent to the deep, poorly drained, mottled Watchung soils. Nearby, at higher elevations, are the deep, well-drained Neshaminy soils and the deep, moderately well drained or somewhat poorly drained Mount Lucas soils.

Unlike the soils of the Neshaminy variant the Neshaminy and Mount Lucas soils do not have a fragipan. Soils of the Neshaminy series, fragipan variant, are browner and do not have the mottled, gray B horizon that is commonly in Amwell and Watchung soils. They are shallower to bedrock than the well-drained Neshaminy soils.

Neshaminy silt loam, fragipan variant, 2 to 6 percent slopes (NmB).—This gently sloping soil is on broad undulating hillsides and lower slopes at the base of the Watchung Mountains.

Included with this soil in mapping are some areas of gravelly soils, some areas where slopes are more than 6 percent, and some areas of somewhat poorly drained soils.

This soil is used mainly as woodland and for pasture. Corn, soybeans, small grains, and vegetables are grown in cultivated areas. Where pebbles and cobbles make up more than 20 percent of the surface layer, they interfere with cultivation or harvesting operations. Runoff is slow, and the hazard of erosion is slight. In cultivated areas contour stripcropping and minimum tillage are needed to control runoff and erosion. Diversion terraces and tile drains are needed to intercept the lateral movement of water above the fragipan and to reduce wetness caused by seeps. In places hard bedrock interferes with shallow excavations and installation of tile drains. Capability unit IIe-55; woodland suitability group 2o1.

Neshaminy silt loam, fragipan variant, 6 to 12 percent slopes (NmC).—This sloping soil is on hillsides and strong slopes at the base of the Watchung Mountains. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that are gravelly or cobbly. Also included are small areas of somewhat poorly drained soils in depressions and drainageways and on lower slopes.

Where pebbles and cobbles make up more than 20 percent of the surface layer, they interfere with tillage. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage is used for hay, permanent pasture, and wooded areas. In cultivated areas contour cultivation, stripcropping, and minimum tillage are needed to control runoff and erosion. Diversion terraces are needed to reduce wetness caused by seeps and to intercept the lateral movement of water above the fragipan. In places hard bedrock interferes with shallow excavations. Capability unit IIIe-55; woodland suitability group 2o1.

Norton Series

The Norton series consists of deep, well-drained soils. These soils are nearly level to strongly sloping and occupy undulating and rolling uplands on the Piedmont Plateau. They formed in a mantle of glacial till over red shale, siltstone, or fine-grained sandstone.

In a representative profile in a cultivated area, the surface layer is reddish-brown loam 10 inches thick. The subsoil is about 53 inches thick. The upper 14 inches is mainly very firm, dark reddish-brown heavy silty clay loam, and the lower 39 inches is very firm, weak-red heavy silty clay loam and weak-red and yellowish-red silty clay loam. The substratum, between depths of 63 and 70 inches, is friable, dark reddish-brown shaly loam. Fractured red-shale bedrock is at a depth of 70 inches.

In unlimed areas these soils range from very strongly acid to strongly acid in the surface layer and from very strongly acid to medium acid below. Natural fertility is medium. Permeability is slow, and the available water capacity is high.

More than half the acreage of Norton soils has been cleared for farming. The native vegetation consists of forests of such hardwood trees as white oak, red oak, beech, ash, maple, and hickory. If left idle, Norton soils

seed in readily with redcedar. The soils are well suited to corn, soybeans, small grains, vegetables, and nursery and other specialized crops. They are not well suited to potatoes because of the slow permeability.

Representative profile of Norton loam, 0 to 2 percent slopes, in Hillsborough Township; 50 feet south of barn on west side of Beekman Lane, one-half mile north of New Amwell Road, and 2,250 feet south of Lehigh Valley Railroad:

Ap—0 to 10 inches, reddish-brown (5YR 4/3) loam; weak, fine, granular structure; friable; 2 percent quartzose pebbles; strongly acid.

B1—10 to 14 inches, weak-red (2.5YR 4/2) silty clay loam; weak, coarse, subangular blocky structure, vertically elongated, parting to moderate, fine, subangular and angular blocky; extremely hard in place, friable when removed, slightly sticky and plastic; some roots in crevices; patchy clay films; 5 percent shale fragments and some quartzose pebbles; strongly acid; gradual, smooth boundary.

B21t—14 to 24 inches, dark reddish-brown (2.5YR 3/4) heavy silty clay loam; 30 percent reddish-brown (2.5YR 4/4) mottles and 2 percent black (N 2/0) mottles; moderate, medium, prismatic structure parting to moderate, thick, platy; extremely hard, very firm, sticky and plastic; roots in crevices; dense; small, black, dull clay films; 2 percent quartzose pebbles; strongly acid; clear, wavy boundary.

B22t—24 to 44 inches, weak-red (2.5YR 4/2) heavy silty clay loam; weak and moderate, coarse and medium, imperfect prismatic structure and a few horizontal partings; extremely hard, very firm, sticky and plastic; very few roots; dense; thick shiny clay films on faces of all peds; 5 percent quartzose pebbles; very strongly acid; diffuse, smooth boundary.

B23t—44 to 63 inches, weak-red (2.5YR 4/2) and yellowish-red (5YR 4/6) silty clay loam; massive and some weak, coarse, prismatic structure; extremely hard, very firm, sticky and plastic; dense; 5 percent quartzose pebbles; thin smooth clay films on faces of all peds; very strongly acid; clear, wavy boundary.

IIC1—63 to 70 inches, dark reddish-brown (2.5YR 3/4) shaly loam; massive; 20 percent fragments of red shale ½ inch to several inches in diameter on coating surfaces; medium acid; gradual, irregular boundary.

IIR—70 inches, coarsely fractured red shale; all crevices somewhat thinly coated.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 3½ to 10 feet. Coarse fragments make up 2 to 15 percent of the solum and 2 to 60 percent of the substratum.

The Ap horizon ranges from dark reddish brown (2.5YR 3/4) to dark reddish gray (5YR 4/2). In wooded areas the A1 horizon is commonly very dark gray (5YR 3/1) or black (5YR 2/1).

The Bt horizon has a hue of 10R to 5YR, a value of 3 or 4, and a chroma of 2 to 6. This horizon is typically heavy silty clay loam but in places is clay loam and clay.

The C horizon has a hue of mainly 2.5YR, a value of 3, and a chroma of 4 to 6. Texture ranges from shaly or very shaly loam to sandy loam.

The deep, well-drained Norton soils are associated with the moderately deep Penn soils in gently sloping landscape and on hilly uplands. Nearby on slight rises and broad flats are the deep, moderately well drained to somewhat poorly drained, mottled Lansdowne soils; the moderately deep, moderately well drained or somewhat poorly drained Reaville soils; and the deep, poorly drained, gray Croton soils.

Norton loam, 0 to 2 percent slopes (NoA).—This nearly level soil is on broad flats in the undulating uplands. It has the profile described as representative of the series.

Included with this soil in mapping are areas where the surface layer is silt loam or gravelly silt loam and some areas of Lansdowne soils.

The organic-matter content is medium. The surface layer is generally easy to till, but it becomes hard, cloddy, and difficult to till if plowed when wet. Runoff is slow. The hazard of erosion is slight. Because of the slow permeability, the subsoil remains wet for some time after periods of heavy rain.

This soil is used mostly for general field crops, such as corn, soybeans, hay, and pasture. Alfalfa is subject to damage by severe frost heaving. In cultivated areas cropping systems and management of crop residue are needed to maintain the organic-matter content and good tilth. Capability unit I-51; woodland suitability group 3o1.

Norton loam, 2 to 6 percent slopes (NoB).—This gently sloping soil is on the foothills of the Highlands.

Included with this soil in mapping are some areas of moderately eroded soils where the present surface layer is a mixture of the original reddish-brown surface layer and the reddish-brown clay loam subsoil. Soils in these areas benefit from added organic matter.

The organic-matter content of the surface layer is medium. This layer is generally easy to till, but it becomes hard, cloddy, and difficult to till if plowed when wet. Runoff is slow, and the hazard of erosion is slight. In cultivated areas cropping systems and diversion terraces are needed to control runoff and erosion. Capability unit IIe-51; woodland suitability group 3o1.

Norton loam, 6 to 12 percent slopes (NoC).—This strongly sloping soil is on rolling uplands. It has a profile similar to the one described as representative of the series, but erosion has removed some of the original surface layer and the depth to bedrock is about 4 feet.

Included with this soil in mapping are areas of moderately eroded soils and small areas of Penn and Lansdowne soils.

The organic-matter content is medium. The surface layer is generally easy to till, but it becomes hard, cloddy, and difficult to till if plowed when wet. Also, preparation of a good seedbed is difficult. Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly to grow corn, soybeans, and hay. In cultivated areas contour stripcropping, terraces, and minimum tillage are needed to control runoff and erosion. Capability unit IIIe-51; woodland suitability group 3o1.

Norton loam, 6 to 12 percent slopes, eroded (NoC2).—This soil has a profile similar to the one described as representative of the series, but much of the original surface layer has been lost through erosion and the depth to bedrock is about 4 feet.

Included with this soil in mapping are areas of Penn and Readington soils. Also included are scattered areas of severely eroded soils. Such soils require special erosion-control practices and restoration management.

The organic-matter content is low. The surface layer clods or crusts readily, and seed germination is poor. Runoff is moderately rapid, and the hazard of erosion is moderately severe. This soil is used mainly to grow corn, soybeans, and hay. In cultivated areas this soil needs special erosion-control practices. Stripcropping, terraces, and minimum tillage are needed to control runoff and erosion. A management system that includes sod in the cropping sequence can be used to restore the organic-matter content. Capability unit IIIe-51; woodland suitability group 3o1.

Parker Series

The Parker series consists of deep, somewhat excessively drained soils. These soils are gently sloping to very steep and are on hillsides and ridges of the High-

lands. They formed in material weathered from granite gneiss.

In a representative profile in a wooded area, the surface layer is very dark grayish-brown very gravelly sandy loam 4 inches thick. The subsurface layer is 3 inches of dark yellowish-brown very gravelly loam. The subsoil is yellowish-brown very gravelly sandy loam that extends to a depth of 26 inches. The substratum, between depths of 26 and 50 inches, is yellowish-brown very cobbly sandy loam. Fractured granite gneiss bedrock is at a depth of 50 inches.

In unlimed areas these soils are very strongly acid or strongly acid. Natural fertility is medium. The rooting zone is deep. Permeability is moderately rapid, and the available water capacity is low.

Less than half the acreage of Parker soils has been cleared for farming. The native vegetation consists of forests of such hardwood trees as yellow-poplar, white oak, black oak, red oak, maple, and hickory. Hemlocks grow on north-facing slopes and in coves of the deep gorges along Ravine Creek. The nonstony Parker soils are fairly well suited to general farm crops, fruit, and trees. The steep, very stony Parker soils are better suited to pasture and woodland than to farming.

Representative profile of Parker very gravelly sandy loam, 3 to 15 percent slopes, in Far Hills Township; on the east side of Lake Road, 2,000 feet north of Ravine Lake dam:

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) very gravelly sandy loam; moderate, fine, granular structure; friable; few fine roots; 55 percent angular pebbles and cobbles of granite gneiss; strongly acid; clear, wavy boundary.

A2—4 to 7 inches, dark yellowish-brown (10YR 4/4) very gravelly loam; moderate, medium, granular structure; friable; few fine and coarse roots; 55 percent angular pebbles and cobbles of granite gneiss; strongly acid; clear, wavy boundary.

B2—7 to 26 inches, yellowish-brown (10YR 5/6) very gravelly sandy loam; weak, medium, subangular blocky structure; friable; few coarse roots; 60 percent angular pebbles and cobbles of granite gneiss; strongly acid; diffuse, irregular boundary.

C—26 to 50 inches, yellowish-brown (10YR 5/8) very cobbly sandy loam; weak, medium, subangular blocky structure; friable; 60 percent angular pebbles and cobbles of granite gneiss; strongly acid; diffuse, irregular boundary.

R—50 inches, very pale brown (10YR 7/3) and black (10YR 2/1) highly fractured granite gneiss bedrock; some weathered faces are strong brown (7.5YR 5/8).

The solum ranges from 25 to 35 inches in thickness. Depth to bedrock ranges from 4 to 10 feet. Coarse fragments make up 35 to 60 percent of the soil.

The A horizon has a hue of 10YR to 7.5YR, a value of 3 or 4, and a chroma of 2 to 4.

The B horizon has a hue of 10YR to 7.5YR, a value of 4 to 6, and a chroma of 3 to 6. This horizon is gravelly or very gravelly sandy loam.

The C horizon has a hue of 10YR to 7.5YR, a value of 4 to 6, and a chroma of 4 to 8. This horizon is very cobbly sandy loam or very gravelly sandy loam.

Parker soils are associated with the deep, well-drained, gently sloping to steep Edneyville soils; the somewhat poorly drained, mottled Califon soils along drainageways and on lower slopes; and the poorly drained, gray, mottled Cokesbury soils on low-lying flats, in depressions, and along drainageways.

Parker soils do not have the mottles that are common in Califon and Cokesbury soils. They are coarser textured in the B horizon than Edneyville soils.

Parker very gravelly sandy loam, 3 to 15 percent slopes (PbC).—This gently sloping to strongly sloping soil is on undulating uplands and narrow ridges in the Highlands. It has the profile described as representative of the series. Granite gneiss, pebbles, and cobbles are scattered over the surface and throughout the profile.

Included with this soil in mapping are some areas of eroded soils. Also included are areas of Edneyville and Califon soils.

The organic-matter content is moderate. The surface layer is generally easy to till, but pebbles and cobbles interfere with tillage. This soil can be plowed and cultivated throughout a wide range of moisture conditions. Low available water capacity in many places limits growth of crops. Runoff is medium, and the hazard of erosion is moderate in cultivated areas.

Most areas of this soil are wooded or are abandoned fields that are reverting to woodland. Some areas are used for field crops, fruit, hay, and pasture. This soil is suited to hay and pasture of drought-resistant grasses and legumes. It is only fair for corn, soybeans, and other late-maturing crops. Contour cultivation and stripcropping are needed if this soil is farmed. Capability unit IVs-58; woodland suitability group 3f1.

Parker rocky sandy loam, 25 to 35 percent slopes (PcE).—This soil has a profile similar to the one described as representative of the series, but rock outcrops are common and more pebbles, cobbles, and stones are on the surface of this soil than on the surface of the soil described as representative of the series.

Included with this soil in mapping are areas of very cobbly and stony soils. In some areas stones are 10 to 30 feet apart and patches of exposed bedrock, about 200 feet apart, occupy as much as 4 percent of the surface area. Also included are areas of soils that are moderately deep to bedrock and have slopes of less than 25 percent and some areas of Edneyville soils.

The organic-matter content is medium. Runoff is very rapid. The hazard of erosion is very severe if the soil has been cleared and left without protective cover.

Most of the acreage is wooded, and this soil is well suited to woodland. Removing the stones and boulders is generally not practical for farm uses. Capability unit VIIs-60; woodland suitability group 3x1.

Parker-Edneyville very stony soils, 15 to 25 percent slopes (PeD).—Of the total acreage of this complex, 65 percent is Parker soils and 35 percent is Edneyville soils. These steep soils occur in such an intricate pattern that it was not practical to map them separately. Profiles are similar to the ones described as representative of each respective series, but more cobbles and stones are on the surface and in the subsoil. The stones are generally 5 to 30 feet apart.

Included with these soils in mapping are areas of less stony soils. Also included are some areas where slopes are more than 25 percent.

The organic-matter content is medium. Tillage operations are impeded by the many stones. The main limiting factor for crops is the low available water capacity of the Parker soil. Runoff is rapid. The hazard of erosion is severe in cleared areas.

Most areas of this mapping unit are wooded. A few small areas are used for fruit and pasture. Stoniness and the steep slopes are the major limitations for farm use. This soil is suited to hay and pasture of drought-resistant grasses and legumes. Clearing the trees and removing the stones is generally not practical for farming. Capability unit VIs-22; woodland suitability group 3x1.

Parsippany Series

The Parsippany series consists of deep, poorly drained soils. These nearly level soils are on flats in an old glacial lake, Lake Passaic, where they are subject to frequent stream flooding. They formed in glacial lake sediment derived mainly from red shale, granite gneiss, and basalt.

In a representative profile the surface layer is very dark grayish-brown and dark-gray heavy silt loam. The subsoil is about 46 inches thick. In sequence from the top, it is 5 inches of mottled, gray silty clay loam; 9 inches of mottled, gray silty clay; 11 inches of reddish-brown silty clay; and 21 inches of brown and strong-brown silty clay loam. The substratum, between depths of 50 and 70 inches, is reddish-brown heavy silt loam that contains a few strata of very fine sand and silt.

In unlimed areas these soils are medium acid to very strongly acid in the upper layers and slightly acid to neutral in the lower part of the subsoil and in the substratum. Natural fertility is high. Permeability is slow in the subsoil, and the available water capacity is high. These soils have a perched seasonal high water table at or near the surface late in fall, in winter, early in spring, and following periods of heavy rain. Some areas are ponded from winter to spring. Most areas of Parsippany soils are near major streams and are subject to frequent overflow. The stream water rises slowly in these areas and remains high for long periods.

Less than half the acreage of Parsippany soils has been cleared for farming. The native vegetation consists of forests of such mixed deciduous trees as sweetgum, pin oak, white oak, red maple, beech, and hickory. Cultivated areas require drainage, but suitable outlets are difficult to find. Also, because permeability is slow, drainage is difficult. If the soils are adequately drained, they are well suited to corn, soybeans, hay, and pasture. The soils are not suited to alfalfa or fruit. Winter small grains are subject to damage from severe frost heaving. The soils are suitable for dug ponds.

Representative profile of Parsippany silt loam in Warren Township; 250 feet east of Dead River Road and 100 feet south of Dead River, at the edge of a woodlot:

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; weak, very fine, granular structure; friable; slightly sticky and nonplastic; many fibrous roots and few medium and coarse roots; strongly acid; clear, wavy boundary.

A3g—2 to 4 inches, dark-gray (10YR 4/1) heavy silt loam; moderate, medium and fine, subangular blocky structure; friable, slightly sticky and nonplastic; common fine and medium roots; many silt and sand grains stained with very dark grayish brown (10YR 3/2); very strongly acid; gradual, wavy boundary.

B1g—4 to 9 inches, gray (10YR 6/1) silty clay loam; many, coarse, prismatic, strong-brown (7.5YR 5/6) mottles and common, fine, faint, dark-gray (10YR 4/1) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky and plastic; many medium and fine roots; few vertically oriented gray streaks; sand and silt grains stained or coated; very strongly acid; gradual, wavy boundary.

B21gt—9 to 18 inches, gray (5YR 5/1) silty clay; many dark-brown (7.5YR 4/4) and brown (7.5YR 5/2) mottles on faces and interiors of peds; moderate, medium, subangular blocky structure and moderate, fine, angular blocky; firm, slightly sticky and very plastic; few fine roots; few vertically oriented gray streaks; thick nearly continuous clay films in root channels and on faces of peds; medium acid; gradual, wavy boundary.

B22t—18 to 29 inches, reddish-brown (5YR 4/4) silty clay; many, coarse, faint, strong-brown (7.5YR 5/6) and common, coarse, prominent, grayish-brown (10YR 5/2) mottles; moderate, coarse, subangular blocky structure and weak, very thick, platy; very firm, slightly sticky and slightly plastic; few fine roots; thick reddish-brown (5YR 4/3) clay films and few black (N 2/0) stains on faces of peds; few vertically oriented gray streaks; 3 percent fine gravel composed mostly of traprock, granitic gneiss, and shale; medium acid; gradual, wavy boundary.

B3t—29 to 50 inches, nearly equal proportions of brown (7.5YR 5/4) and strong-brown (7.5YR 5/6) silty clay loam; massive and weak, thick, platy structure; very firm, sticky and plastic; few roots mostly in or near vertically oriented streaks; patchy thick clay films in voids and along some vertical streaks; few, vertically oriented, reddish-brown (5YR 4/3) and brown (7.5YR 5/2) streaks; cut mass sprinkled with black or rust-colored dots; slightly acid; gradual, wavy boundary.

C—50 to 70 inches, reddish-brown (5YR 4/3) varved heavy silt loam that has a few ½- to 1-inch lamellae of very fine sand and silt; neutral.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock ranges from 4 to 20 feet or more. Coarse fragments make up 0 to 5 percent of the solum and as much as 20 percent of some parts of the C horizon.

The A horizon has a hue of 7.5YR or 10YR, a value of 3 or 4, and a chroma of 1 to 3.

The B horizon has a hue of 10YR to 5YR, a value of 4 to 6, and a chroma of 1 to 4. The B horizon ranges from silty clay loam to clay. It has moderate or strong, medium or coarse, subangular or angular blocky structure. Low- and high-chroma mottles are in the upper part of the B horizon.

The C horizon has a hue of 5YR to 7.5YR, a value of 4 or 5, and a chroma of 3 or 4. This horizon ranges from loamy sand to clay in texture. In places it is as much as 20 percent gravel.

Parsippany soils are near or adjacent to the deep, somewhat poorly drained Whippany soils on slightly higher elevations and the Parsippany very poorly drained variant.

Parsippany soils have a grayer B horizon than Whippany soils. They are not so gray as the soils of the Parsippany variant.

Parsippany silt loam (Ph).—This nearly level soil is on low-lying flats and in slight depressions in the old glacial lake, Lake Passaic.

Included with this soil in mapping are small areas of Whippany soils and small areas of deep silty soils along Lord Sterling Road. Also included are areas of soils that have a surface layer of loam and silty clay loam.

The organic-matter content is moderate to high. The surface layer is generally fairly easy to till. Natural fertility is high. Runoff is very slow, and the hazard of erosion is slight.

This soil is used mainly as woodland and for hay and pasture. Wetness and flooding limit the use of this soil for farming and other purposes. Outlets for drainage are difficult to obtain. Open ditches are most effective in removing excess water. Capability unit IVw-80; woodland suitability group 3w1.

Parsippany Variant

The Parsippany variant consists of deep, very poorly drained soils. These nearly level soils are on flats and in slight depressions in an old glacial lake, Lake Passaic, where they are subject to frequent flooding. They formed in glacial lake sediment derived mainly from red shale, granite gneiss, and basalt.

In a representative profile in a wooded area, the surface layer is brown silt loam 6 inches thick. The subsurface layer is 5 inches of gray, mottled silty clay loam. The subsoil is mottled gray silty clay that extends to a depth of 36 inches. The substratum, between depths of 36 and 60 inches, is mottled, dark-gray silty clay.

In unlimed areas these soils are medium acid to strongly

acid in the solum and slightly acid to neutral in the substratum. Natural fertility is high. Permeability is slow in the subsoil, and the available water capacity is high. These soils have a perched seasonal water table at or near the surface in fall, winter, and spring and following periods of heavy rain. Many areas are ponded from early in fall until late in spring. Most areas of these soils are near major streams and are subject to frequent overflow. Water rises slowly in the streams and remains high for long periods. An accumulation of alluvium as much as 10 inches thick is common on these soils.

Very little of the acreage of the soils in the Parsippany variant has been cleared for farming. The native vegetation consists of forests of such mixed deciduous trees as sweetgum, pin oak, white oak, red maple, beech, and hickory. Cultivated areas require drainage. Because of their low position, slow permeability, and inadequate outlets, improved drainage is difficult to establish on these soils. They are well suited to water-tolerant trees, shrubs, and grasses. Dug ponds or impoundments are frequently located on these soils.

Representative profile of Parsippany silt loam, very poorly drained variant, in Warren Township; 40 feet east of Dead River Road, one-fourth mile north of Interstate 78, and 400 feet south of bridge over Dead River:

A1—0 to 6 inches, brown (7.5YR 4/2) silt loam; moderate, medium, granular structure; friable; common fine roots; strongly acid; clear, wavy boundary.

A2g—6 to 11 inches, gray (5Y 5/1) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; common fine roots; strongly acid; clear, wavy boundary.

B21g—11 to 18 inches, gray (5Y 5/1) silty clay; common, fine, distinct, light-gray (5Y 7/1) and yellowish-brown (10YR 5/8) mottles; strong, medium, angular blocky structure; slightly firm; few fine roots along ped faces; few thick clay films on ped faces; strongly acid; clear, wavy boundary.

B22gt—18 to 36 inches, gray (5Y 5/1) silty clay; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; strong, medium, angular blocky structure; slightly firm; few fine roots along ped faces; common thin clay films on ped faces; common black organic stains on ped faces; strongly acid; gradual, wavy boundary.

C—36 to 60 inches, dark-gray (N 4/0) silty clay; few, fine, faint, gray (10YR 5/1) mottles; massive; slightly firm; few fine roots; neutral.

The solum ranges from 20 to 40 inches in thickness. Depth to bedrock ranges from 10 to 20 feet or more. Coarse fragments make up less than 2 percent of the A and B horizons and as much as 10 percent of the C horizon.

The A horizon has a hue of 7.5YR, 10YR, 2.5Y, or 5Y; a value of 2 to 5; and a chroma of 1 or 2.

The B horizon is typically gray (5Y 5/1) but includes a hue of 2.5Y or 10YR and a chroma of 0 or 1. This horizon is commonly silty clay but in places is clay, clay loam, and silty clay loam.

The C horizon has a hue of 10YR, 2.5Y, 5Y, or is neutral (N/0); a value of 4 or 5; and a chroma of 0 or 1. Typically, this horizon is silty clay, but in places it is silty clay loam or clay.

The Parsippany variant is associated with the poorly drained Parsippany soils at slightly higher elevations. On nearby slight rises and gentle slopes are the moderately well drained and somewhat poorly drained Whippany soils.

Soils of the Parsippany variant have a thick, gray B horizon and a gray C horizon, which distinguishes them from Whippany and Parsippany soils.

Parsippany silt loam, very poorly drained variant (Pk).—This nearly level soil is on low-lying flats and in depressions in the old glacial lake, Lake Passaic.

Included with this soil in mapping are scattered areas of soils that have 6 to 12 inches of black organic matter on the surface and small areas where water is ponded most of the year. Also included are areas of soils that have a surface layer of silty clay loam or clay loam and small areas of Parsippany and Whippany soils.

The organic-matter content is high to very high. Runoff is very slow, and the hazard of erosion is slight.

Wetness and flooding limit the use of this soil for farming and many other purposes. Outlets for drainage are extremely difficult to obtain. Open ditches are most effective in removing excess water. Capability unit VIw-80; woodland suitability group 3w1.

Pattenburg Series

The Pattenburg series consists of deep, well-drained soils. These soils are strongly sloping to moderately steep. They are on rolling and hilly uplands. They formed in material weathered from highly quartzose conglomerate or fanglomerate.

In a representative profile in a cultivated area, the surface layer is dark reddish-brown gravelly loam 8 inches thick. The subsoil is dark reddish-brown gravelly loam 22 inches thick. The substratum, between depths of 30 and 44 inches, is friable, dark reddish-brown very gravelly loam. Fractured bedrock is at a depth of 44 inches.

In unlimed areas these soils are strongly acid. Natural fertility is medium. The rooting zone is deep. Permeability and the available water capacity are moderate.

Less than half the acreage of Pattenburg soils has been cleared for farming, and much of the acreage is presently forest or pasture. The native vegetation consists of forests of such hardwood trees as red, black, chestnut, and white oaks; beech; yellow-poplar; and hickory. The less sloping Pattenburg soils are fairly well suited to general crops.

Representative profile of Pattenburg gravelly loam, 6 to 12 percent slopes, in Bedminster Township; near the intersection of Division Road and Holland Road:

Ap—0 to 8 inches, dark reddish-brown (5YR 3/3) gravelly loam; moderate, fine, granular structure; friable; common fine roots; 20 percent rounded quartzite pebbles and cobbles; medium acid; abrupt, smooth boundary.

B1—8 to 12 inches, dark reddish-brown (5YR 3/4) gravelly loam; weak, fine, subangular blocky structure; friable; few fine roots; 25 percent rounded quartzite pebbles and cobbles; medium acid; clear, wavy boundary.

B2t—12 to 30 inches, dark reddish-brown (5YR 3/4) gravelly loam; weak, medium, subangular blocky structure; friable; few fine roots; 45 percent coarse fragments of rounded quartzite pebbles and cobbles; common thin clay films on most ped faces; strongly acid; clear, wavy boundary.

C—30 to 44 inches, dark reddish-brown (5YR 3/4) very gravelly loam; massive; very friable; 60 percent coarse fragments of rounded quartzite gravel and cobbles; strongly acid; gradual, wavy boundary.

R—44 inches, dark reddish-brown (5YR 3/4) conglomerate bedrock.

The solum ranges from 24 to 36 inches in thickness. Depth to bedrock is 3½ to 5 feet. Coarse fragments make up 15 to 60 percent of the soil.

The A horizon has a hue of 7.5YR to 2.5YR, a value of 3 or 4, and a chroma of 2 to 4 in cultivated areas. In wooded areas it is typically dusky red (2.5YR 3/2).

The B horizon has a hue of 2.5YR to 5YR, a value of 3 or 4, and a chroma of 4 to 6. This horizon is most commonly gravelly loam but in places is gravelly sandy loam.

The C horizon ranges from dusky red (2.5YR 3/2) to dark reddish brown (5YR 3/4).

Pattenburg soils are associated with the deep, well-drained Arendtsville and Meckesville soils on undulating uplands; the moderately deep, well-drained Penn soils; and the somewhat excessively drained, shallow Klinesville soils on rolling and hilly uplands. Nearby on nearly level to gently sloping uplands are the

deep, moderately well drained to somewhat poorly drained Califon soils.

Pattenburg soils contain more gravel and have a thinner profile than Arendtsville and Meckesville soils. They are deeper to bedrock than Penn and Klinesville soils. They do not have the mottles that are commonly in Califon soils.

Pattenburg gravelly loam, 6 to 12 percent slopes (PlC).—This soil is on rolling uplands and hillsides. It has the profile described as representative of the series.

Included with this soil in mapping are some areas of moderately eroded soils in which the dark reddish-brown subsoil has been mixed with the surface layer in plowing. Also included are areas of soils that have a subsoil that is less than 20 percent coarse fragments and areas of Klinesville, Penn, and Arendtsville soils.

The organic-matter content is low to medium. The surface layer is generally easy to till, and the soil can be plowed and cultivated early in spring and soon after light showers. Coarse fragments interfere with tillage operations. This soil is used mainly as woodland and for pasture. Corn and small grains are grown in cultivated areas. Runoff is medium, and the hazard of erosion is moderate. Contour cultivation and stripcropping can be used to control runoff and erosion in farmed areas. Capability unit IIIe-58; woodland suitability group 2o1.

Pattenburg gravelly loam, 12 to 18 percent slopes (PlD).—This moderately steep soil is in the hilly uplands on hillsides and sharp breaks. It has a profile similar to the one described as representative of the series, but it has a thinner subsoil and contains more pebbles and cobbles in the surface layer.

Included with this soil in mapping are some areas where slopes are more than 18 percent. Also included are areas where the subsoil contains less coarse fragments than the subsoil in the representative profile. Some areas of Klinesville and Penn soils are also included.

The organic-matter content is low to medium. The surface layer is easy to till and can be worked throughout a wide range of moisture content without clodding or crusting. Coarse fragments in the plow layer interfere with tillage operations.

The moderate available water capacity and rapid runoff limit the use of this soil for crops. Even a dry period of short duration adversely affects crop growth. Most of the acreage is wooded or is in permanent pasture. The soil is suitable for only occasional cultivation because of the severe hazard of erosion. It is better suited to pasture and woodland than to other uses. Contour cultivation and stripcropping help protect this soil from erosion in cultivated areas. Capability unit IVe-58; woodland suitability group 2o1.

Penn Series

The Penn series consists of moderately deep, well-drained soils. These nearly level to strongly sloping soils are on undulating and rolling uplands. They formed in material weathered from shale, siltstone, and fine-grained sandstone (fig. 9).

In a representative profile in a cultivated area, the surface layer is dark reddish-brown silt loam 8 inches thick. The upper 4 inches of the subsoil is reddish-brown silt loam, and the lower 13 inches is reddish-brown shaly loam. The substratum, between depths of 25 and 30 inches, is dark reddish-brown very shaly loam. Shale bedrock is at a depth of 30 inches.

In unlimed areas these soils are strongly acid in the surface layer and subsoil and strongly acid to slightly acid in the substratum. Natural fertility is medium, and the organic-matter content is moderate. In most places the soil is easy to till. Permeability and the available water capacity are moderate. The effective rooting depth is limited by the shale bedrock.

Most areas of Penn soils have been cleared for farming. The native vegetation consists of forests of such deciduous hardwood trees as white oak, red oak, black oak, beech, maple, and hickory. Redcedar seeds in readily in abandoned fields. The soils are suited to all the general crops, including corn, soybeans, small grains, hay, pasture, and vegetables and to fruit, nursery, and other specialized crops.

Representative profile of Penn silt loam, 2 to 6 percent slopes, in Hillsborough Township; 50 feet west of Willow Road and one-fourth mile north of Homestead Road:

Ap—0 to 8 inches, dark reddish-brown (5YR 3/2) silt loam; moderate, fine, granular structure; friable; common fine roots; 10 percent shale fragments; strongly acid; abrupt, smooth boundary.

B21t—8 to 12 inches, reddish-brown (5YR 4/3) silt loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; 10 percent shale fragments; common thin clay films on ped faces and in root channels; strongly acid; gradual, wavy boundary.

B22t—12 to 25 inches, reddish-brown (5YR 4/3) shaly loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; common thin clay films on ped faces and in root channels; 25 percent shale fragments; strongly acid; gradual, wavy boundary.

C—25 to 30 inches, dark reddish-brown (2.5YR 3/4) very shaly loam; very weak, fine, subangular blocky structure; friable; 60 percent shale fragments; few fine roots; strongly acid; clear, wavy boundary.

R—30 inches, dark reddish-brown (2.5YR 3/4) shale bedrock.

The solum ranges from 20 to 36 inches in thickness. Depth to bedrock ranges from 20 to 40 inches. Coarse fragments, mostly shale, make up 2 to 30 percent of the A and B horizons and 30 to 70 percent of the C horizon. In places rounded quartzose pebbles are present in these horizons.

The A horizon has a hue of 7.5YR to 2.5YR, a value of 3 or 4, and a chroma of 2 to 4. This horizon is mainly silt loam or shaly silt loam.

The B horizon commonly has a hue of 5YR but hue ranges to 2.5YR, and the horizon generally becomes redder with increasing depth. Value and chroma are 3 or 4 in this horizon. The Bt horizon is heavy silt loam, heavy loam, shaly silt loam, or shaly loam.

The thin C horizon, commonly very shaly loam, is between the solum and bedrock in most areas.

Penn soils generally are associated with the well-drained Bucks soils, the moderately well drained Readington soils, and the somewhat poorly drained Abbottstown and Reaville soils on broad flats and slight rises. In places they are near the poorly drained Croton soils along drainageways or in slight depressions. The shallow, well-drained Klinesville soils are on the ridgetops and bluffs along the major streams.

Penn soils are shallower than Readington, Abbottstown, Reaville, and Croton soils, and they do not have the gray, mottled B horizon that is typical of those soils. They are shallower, redder, and more shaly than Bucks soils. They are deeper and less shaly than Klinesville soils.

Penn silt loam, 0 to 2 percent slopes (PmA).—This soil has a profile similar to the one described as representative of the series, but shale fragments make up less than 5 percent of the surface layer.

Included with this soil in mapping are some areas of shaly loam soils and some areas of moderately eroded soils. Also included are areas of Norton, Readington, Klinesville, and Royce soils.

Runoff is slow, and the hazard of erosion is slight.

Figure 9.—Area of Penn and Klinesville soils. Fractured Brunswick shale is exposed.

This soil is used mainly to grow corn, soybeans, small grains, vegetables, and hay. Crop yields are reduced in dry years. Supplemental irrigation is needed to increase the growth of high-value crops. Capability unit IIs-65; woodland suitability group 3o1.

Penn silt loam, 2 to 6 percent slopes (PmB).—This gently sloping soil is on undulating uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils in which the surface layer and upper part of the subsoil are browner than in this soil and contain no shale fragments. Also included are areas of Norton, Readington, Klinesville, and Royce soils and small areas of eroded soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly to grow corn, soybeans, small grains, vegetables, and hay. Supplemental irrigation is needed to increase the growth of high-value crops. Such moderate erosion-control measures as contour cultivation and minimum tillage are needed if this soil is farmed or is developed for residential use. Capability unit IIe-65; woodland suitability group 3o1.

Penn silt loam, 6 to 12 percent slopes (PmC).—This strongly sloping soil is on rolling uplands. It has a profile similar to the one described as representative of the series, but depth to bedrock is about 2 feet. Thin fragments of shale, 1 inch to 3 inches long, are scattered on the surface and throughout the profile.

Included with this soil in mapping are areas of eroded soils that have lost half of their original surface layer and areas where more than 15 percent of the surface area is covered by shale fragments. Also included are small areas of Royce and Klinesville soils.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for hay and for corn and small-grain silage. Because of the moderately deep root zone, this soil is fairly suited to poorly suited to apple and peach orchards. If this soil is farmed or developed for residential use, erosion control is needed. Stripcropping and minimum tillage are needed to reduce runoff and curtail erosion. Capability unit IIIe-65; woodland suitability group 3o1.

Penn shaly silt loam, 2 to 6 percent slopes (PnB).—This gently sloping soil is on undulating uplands. It has a profile similar to the one described as representative of the series, but bedrock is at a depth of 20 to 30 inches and the surface layer is more than 15 percent shale fragments 1 inch to 3 inches long.

Included with this soil in mapping are some small areas where the surface layer is silt loam and small areas of Klinesville soils.

Because of the shale fragments and the moderately deep

rooting zone, the available water capacity is insufficient during long dry periods. Runoff is slow, and the hazard of erosion is slight. Shale fragments interfere with cultivation.

Supplemental irrigation is needed to increase the growth of high-value crops. Moderate erosion-control measures are needed for farmed areas and areas developed for residential use. Contour cultivation is needed to reduce runoff and erosion. Capability unit IIe-65; woodland suitability group 3o1.

Penn shaly silt loam, 6 to 12 percent slopes (PnC).—This strongly sloping soil is in wooded and cultivated areas on rolling uplands. It is similar to the soil described as representative of the series, but this soil contains more shale fragments in the solum and has a depth to bedrock of 20 to 30 inches. Shale fragments, 1 inch to 3 inches long, make up 20 to 30 percent of the surface layer.

Included with this soil in mapping are a few small areas of Klinesville and Reaville soils.

Because of the abundance of shale fragments and the moderate rooting depth, available water capacity is insufficient during long dry periods. Also, the shale fragments interfere with cultivation. Application of irrigation water as needed to maintain adequate moisture helps maintain fair growth and quality of crops. Irrigation has been used on golf courses. Runoff is medium, and the hazard of erosion is moderate.

This soil is less suited to crops than other Penn soils. Poor crop stands often result because of the shale fragments. Erosion control is needed in cultivated areas and areas that are developed as residential sites. Stripcropping and diversion terraces are needed to reduce runoff and erosion. Capability unit IIIe-65; woodland suitability group 3o1.

Quakertown Series

The Quakertown series consists of deep, well-drained soils. These soils are gently sloping to moderately steep and are on undulating and rolling uplands. They are in a narrow band, ½ to ¾ mile wide, that extends from Grand View Road westward to the Mercer County line. They formed in material weathered from siltstone, sandstone, and thinly bedded argillite.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 9 inches thick. The subsurface layer is 4 inches of brown silt loam. The subsoil, between depths of 13 and 36 inches, is dark yellowish-brown silt loam, yellowish-brown heavy silt loam, and dark-brown silt loam. The substratum, between depths of 36 and 45 inches, is brown channery fine sandy loam. Sandstone bedrock is at a depth of 45 inches.

In unlimed areas these soils are strongly acid. Natural fertility is medium. Permeability is moderately slow, and the available water capacity is high.

More than half the acreage of Quakertown soils has been cleared for farming. The native vegetation consists of forests of such hardwood trees as yellow-poplar, white oak, red oak, ash, maple, and hickory. The soils are well suited to most crops commonly grown in the county, such as corn, soybeans, vegetables, hay, and pasture.

Representative profile of Quakertown silt loam, 2 to 12 percent slopes, in Montgomery Township; 200 feet west of Springhill Road and 1,000 feet south of 90-degree turn:

Ap—0 to 9 inches, dark-brown (7.5YR 4/2) silt loam; moderate, fine, granular structure; friable; many fine roots; 5 percent sandstone fragments; strongly acid; abrupt, smooth boundary.

A2—9 to 13 inches, brown (7.5YR 4/4) silt loam; moderate, fine, granular structure; friable; many fine roots; 5 percent sandstone fragments; strongly acid; clear, wavy boundary.

B1—13 to 18 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky structure; friable; few thin clay films on ped faces; few very fine roots; 5 percent sandstone fragments; strongly acid; gradual, wavy boundary.

B2t—18 to 26 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable; few fine roots; common moderately thick clay films on ped faces; 5 percent sandstone fragments; strongly acid; clear, wavy boundary.

B3t—26 to 36 inches, dark-brown (7.5YR 4/4) silt loam; weak, coarse, prismatic structure parting to weak, thick, platy; firm and brittle; few thin clay films on ped faces; few black (10YR 2/1) stains on ped faces; few very pale brown (10YR 7/3) silt pockets; 10 percent sandstone fragments; strongly acid; clear, wavy boundary.

C—36 to 45 inches, brown (7.5YR 5/4) channery fine sandy loam; weak, thick, platy structure; firm; fine black (10YR 2/1) stains on ped faces; 20 percent sandstone fragments; strongly acid; gradual, wavy boundary.

R—45 inches, brown (7.5YR 5/4), fractured, partly weathered sandstone bedrock.

The solum ranges from 25 to 36 inches in thickness. Depth to bedrock is 3½ to 5 feet. Coarse fragments of siltstone, sandstone, or argillite make up 5 to 10 percent of the A and B horizons and 20 to 50 percent of the C horizon.

The Ap horizon has a hue of 7.5YR or 10YR, a value of 3 to 5, and a chroma of 2 to 4. The A1 horizon is typically dark brown (7.5YR 3/2).

The Bt horizon has a hue of 7.5YR or 10YR, a value of 4 or 5, and a chroma of 4 to 6. This horizon is commonly heavy silt loam but in places is heavy loam and light clay loam.

The C horizon is commonly brown (7.5YR 5/4), but in places hue is 10YR. This horizon is channery fine sandy loam or channery silt loam.

Quakertown soils occur with the moderately well drained Lawrenceville soils and the moderately well drained to somewhat poorly drained Chalfont soils on nearly level flats and with the poorly drained Croton soils in slight depressions.

Quakertown soils do not have the gray B horizon and the strongly developed fragipan that are commonly in Chalfont and Croton soils. They lack the low-chroma mottles that are commonly in Lawrenceville soils.

Quakertown silt loam, 2 to 12 percent slopes (QkC).—This gently sloping to strongly sloping soil is on undulating and rolling uplands near the base of the Sourland Mountains. It has the profile described as representative of the series.

Included with this soil in mapping are areas of nearly level soils and areas of moderately eroded soils in which the present plow layer is a mixture of the original dark-brown surface layer and the dark yellowish-brown subsoil. Also included are small areas of Lawrenceville, Chalfont, and Croton soils. Spot drainage may be needed in these areas. Other inclusions are areas of soils that have some bright-colored mottles in the subsoil.

The organic-matter content of the plow layer is medium. This layer is generally easy to till. Excess water stands for short periods in the subsoil, especially late in winter and early in spring. Drainage is needed in some areas if high-value crops are grown. Foundation drains are needed in places to assure dry basements. Runoff is slow or medium, and the hazard of erosion is slight or moderate.

This soil is used mainly to grow corn, soybeans, small grains, and hay. Erosion-control measures are needed where the more sloping parts of this soil are farmed or used for residential purposes. Stripcropping, minimum

tillage, and diversion terraces are needed to reduce runoff and control erosion. Capability unit IIIe-55; woodland suitability group 2o1.

Quakertown silt loam, 12 to 18 percent slopes (QkD).—This moderately steep soil is on hilly uplands near the base of the Sourland Mountains. It has a profile similar to the one described as representative of the series, but erosion has thinned the original surface layer.

Included with this soil in mapping are small areas where slopes are more than 18 percent, small areas of uneroded soils that are in permanent pasture or woodlots, and small areas of Lawrenceville and Chalfont soils.

The organic-matter content is low. The surface layer is generally easy to till. Runoff is rapid, and the hazard of erosion is severe.

This soil is used mainly to grow corn, soybeans, small grains, and hay. Because of the moderately steep slopes, it is suited to only occasional cultivation. The soil is better suited to small grains, hay, pasture, or trees than to other uses. Diversion terraces are needed to reduce runoff and curtail erosion on long slopes. Capability unit IVe-55; woodland suitability group 2o1.

Raritan Series

The Raritan series consists of deep, moderately well drained and somewhat poorly drained, nearly level to gently sloping soils. These soils are on stream terraces, mainly along the Lamington, Neshanic, and Raritan Rivers. They are generally about 10 to 50 feet above normal stream level. They formed in old stream sediment washed mostly from red shale and siltstone uplands.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 8 inches thick. The subsoil is 38 inches thick. In sequence from the top, it is 7 inches of mottled, yellowish-red silt loam; 13 inches of mottled, red clay loam; and 18 inches of firm, mottled, dark-red clay loam that is a fragipan. The substratum, between depths of 46 and 60 inches, is stratified red sand and gravel.

In unlimed areas these soils are very strongly acid or strongly acid in the upper part and very strongly acid to medium acid in the lower part. Natural fertility and the organic-matter content are medium. The rooting depth is restricted by the fragipan. The soils are easy to till. Permeability is moderately slow in the lower part of the subsoil, and the available water capacity is moderate. These soils have a seasonal high water table perched at a depth of ½ foot to 3 feet late in fall, in winter, and early in spring. Raritan soils are generally above the level of normal stream overflow. The lowest areas and areas near the confluence of streams are subject to overflow about once in 50 years. Such areas make up 10 to 15 percent of the total acreage of these soils.

More than half the acreage of Raritan soils has been cleared for farming. The native vegetation consists of forests of such deciduous hardwood trees as pin and red oaks, ash, beech, maple, and hickory. The soils are suited to the commonly grown field crops, including corn, soybeans, spring-sown small grains, and shallow-rooted grasses and legumes. Wetness limits the selection of crops. Unless these soils are adequately drained, alfalfa and fall-sown small grains are subject to frost heaving and winterkill.

Representative profile of Raritan silt loam, 0 to 4 percent slopes, in Hillsborough Township; 50 feet south of River Road and three-fourths of a mile east of Beekman Lane:

Ap—0 to 8 inches, dark-brown (7.5YR 4/4) silt loam; moderate, medium, granular structure; friable; 5 percent pebbles; common fine roots; strongly acid; abrupt, smooth boundary.

B1—8 to 15 inches, yellowish-red (5YR 5/6) silt loam; few, fine, faint, light yellowish-brown (5YR 6/3) mottles; weak, moderate, subangular blocky structure; friable; common fine roots; 5 percent rounded pebbles; few thin clay films on ped faces; strongly acid; clear, wavy boundary.

B2t—15 to 28 inches, red (2.5YR 4/6) clay loam; common, medium, distinct, pinkish-gray (7.5YR 6/2) mottles; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; 5 percent pebbles; many thin clay films on ped faces and in pores; strongly acid; clear, wavy boundary.

Bxt—28 to 46 inches, dark-red (2.5YR 3/6) clay loam; common, medium, distinct, reddish-gray (5YR 5/2) and yellowish-red (5YR 5/6) mottles; moderate, very coarse, prismatic structure parting to moderate, medium, angular blocky; brittle, firm and compact; 15 percent rounded pebbles of mixed origin; common thin clay films on ped faces; strongly acid; clear, wavy boundary.

IIC—46 to 60 inches, red (2.5YR 4/6) stratified sand and gravel; common, medium, distinct, reddish-gray (5YR 5/2) mottles; strongly acid.

The solum ranges from 42 to 56 inches in thickness. Depth to the fragipan ranges from 20 to 30 inches, and depth to bedrock ranges from 6 to 10 feet or more. Coarse fragments make up 0 to 15 percent of the A and B horizons, and gravel commonly makes up more than 35 percent of the C horizon, being much higher or less in some strata.

The A horizon ranges from dark reddish gray (5YR 4/2) to yellowish brown (10YR 5/4).

The Bt horizon ranges from red (2.5YR 4/6) to yellowish brown (7.5YR 5/6). The Bt and Bx horizons are commonly clay loam or loam. The Bx horizon is commonly dark red (2.5YR 3/6) but a hue of 5YR, a value of 3 or 4, and a chroma of 2 to 6 are present in places.

The IIC horizon ranges from dark reddish brown (2.5YR 3/4) to reddish brown (5YR 4/4). The stratified C horizon ranges from gravel to clay loam.

Raritan soils are on stream terraces with the well-drained Birdsboro soils and the poorly drained, gray Lamington soils. They are in slight depressions and are at lower elevations than Birdsboro soils but at higher elevations than Lamington soils.

Raritan soils, unlike Birdsboro soils, have a fragipan in the lower part of the subsoil. They do not have the gray B horizon that is commonly in Lamington soils.

Raritan silt loam, 0 to 4 percent slopes (RbA).—This soil is mainly nearly level but in places slopes are short and are as much as 4 percent.

Included with this soil in mapping are some areas of moderately eroded soils and some small areas where as much as 25 percent of the plow layer is gravel. Also included are small areas of Birdsboro and Lamington soils.

Wetness early in spring and after heavy rain delays plowing or cultivation for several days. Runoff is slow, and the hazard of erosion is slight. Ponding is common where this soil is nearly level.

Nearly all the acreage is used for crops, pasture, and hay or for urban purposes. Unless the soil is adequately drained, alfalfa and winter small grains in many years are seriously affected by ponded water and frost heaving. Surface or subsurface drains are needed to remove excess water. Capability unit IIw-71; woodland suitability group 3w1.

Readington Series

The Readington series consists of deep, moderately well drained soils. These gently sloping soils are in broad areas of the red-shale uplands, mainly in Branchburg Township.

They are in a narrow belt northeast to southwest along the western edge of the county. The surface layer and upper part of the subsoil formed mainly in a silty mantle. The lower part of the subsoil formed in material weathered mainly from shale, but in places it formed in material weathered from siltstone or fine-grained sandstone.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 8 inches thick. The subsoil is 36 inches thick. The upper 5 inches is dark-brown silt loam; the middle 12 inches is mottled, reddish-brown silt loam; and the lower 19 inches is a firm fragipan of mottled, dark reddish-brown heavy silt loam and shaly heavy silt loam. Partly weathered red shale bedrock is at a depth of 44 inches.

In unlimed areas these soils are very strongly acid to strongly acid. Natural fertility is high. Permeability is moderately slow in the fragipan, and the available water capacity is moderate. Excess water is perched above the fragipan late in winter and early in spring. The seasonal high water level is at a depth of 1½ to 4 feet. The firm fragipan restricts the development of roots.

Most areas of Readington soils have been cleared for farming. The native vegetation consists of forests of such hardwood trees as white, red, and black oaks; beech; maple; and hickory. The soils are fairly well suited to corn, soybeans, spring-sown small grains, vegetables, hay, and pasture.

Representative profile of Readington silt loam, 2 to 6 percent slopes, in Branchburg Township; on the south side of Whiton Road and east of woodlot, one-half mile south of U.S. Route 202:

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

B1—8 to 13 inches, dark-brown (7.5YR 4/4) silt loam; moderate, medium, subangular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; few fine roots; strongly acid; clear, smooth boundary.

B2t—13 to 25 inches, reddish-brown (5YR 4/4) silt loam; few, fine, faint, dark reddish-gray (5YR 4/2) mottles in the lower part; moderate, coarse and medium, subangular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; common thin clay films on ped faces and in worm channels; strongly acid; gradual, wavy boundary.

IIBx1t—25 to 35 inches, dark reddish-brown (2.5YR 3/4) heavy silt loam; common, medium, distinct, dark reddish-gray (5YR 4/2) and strong-brown (7.5YR 5/6) mottles and streaks in vertical cracks and on horizontal faces; moderate, very coarse, prismatic structure parting to moderate, medium, angular blocky; compact in place, firm; few, thin, patchy clay films on ped faces; strongly acid; gradual, wavy boundary.

IIBx2t—35 to 44 inches, dark reddish-brown (2.5YR 3/4) shaly heavy silt loam; common, medium, distinct, dark reddish-gray (5YR 4/2) and strong-brown (7.5YR 5/6) mottles; moderate, very coarse, prismatic structure parting to weak, thick, platy; firm, compact and brittle, slightly plastic and slightly sticky when wet; few thin clay films on ped faces; moderate, small, black (N 2/0) stains on ped faces; 20 percent shale fragments; strongly acid; abrupt, wavy boundary.

R—44 inches, dusky-red (2.5YR 3/2) partly weathered shale.

The solum ranges from 40 to 55 inches in thickness. Depth to bedrock ranges from 3½ to 5 feet, and depth to the fragipan ranges from 24 to 32 inches. Shale fragments make up 0 to 10 percent of the upper part of the solum and 10 to 20 percent of the lower part. The silty mantle ranges from 18 to 30 inches in thickness.

In wooded areas the A1 horizon is generally very dark and about 3 or 4 inches thick. The Ap horizon ranges from dark yellowish brown (10YR 4/4) to brown (7.5YR 4/2).

The B horizon has a hue of 2.5YR to 7.5YR, a value of 3 or 4, and a chroma of 3 or 4. This horizon ranges from silt loam to light silty clay loam. In places a thin C horizon is between the solum and bedrock.

Readington soils generally are near the well-drained Bucks soils and the somewhat poorly drained Abbottstown soils on lower slopes and flats and in slight depressions.

Readington soils differ from Bucks soils in having a fragipan. They are not so gray in the lower part of the B horizon as Abbottstown soils.

Readington silt loam, 2 to 6 percent slopes (RcB).—This gently sloping soil is on undulating uplands.

Included with this soil in mapping are areas where the surface layer and upper part of the subsoil are redder, contain more shale fragments, and have mottles nearer the surface. Also included are small areas of nearly level soils, some areas of strongly sloping soils, and small areas of Abbottstown and Bucks soils.

The surface layer is easy to till. The moderately high perched water table makes alfalfa and small grains subject to frost heaving. Runoff is slow, and the hazard of erosion is slight.

In cultivated areas erosion-control practices are needed to effectively control runoff and erosion. Drainage is needed for high-value crops. Diversion terraces and stripcropping are effective in reducing wetness, runoff, and erosion. Capability unit IIe-71; woodland suitability group 3w1.

Reaville Series

The Reaville series consists of moderately deep, moderately well drained and somewhat poorly drained soils. These nearly level and gently sloping soils are on upland flats, in depressions, and on concave lower slopes at the heads of drainageways. They formed in material weathered from red sandstone, siltstone, or shale.

In a representative profile in a cultivated area, the surface layer is dark-brown silt loam 8 inches thick. The upper 4 inches of the subsoil is mottled, brown silt loam, and the lower 9 inches is mottled, reddish-brown silty clay loam. The substratum, between depths of 21 and 27 inches, is dark reddish-brown very shaly loam. Shale bedrock is at a depth of 27 inches.

In unlimed areas these soils are strongly acid in the upper part and strongly acid to medium acid in the substratum. Natural fertility is medium. Permeability is moderate in the surface layer and moderately slow in the subsoil. The available water capacity is moderate. These soils have a seasonal high water table at a depth of ½ foot to 3 feet late in fall, in winter, and early in spring.

About half the acreage of Reaville soils has been cleared for farming. The native vegetation consists of forests of such deciduous hardwood trees as upland oaks, pin oak, sweetgum, beech, ash, maple, and hickory. Idle fields readily seed in with redcedar. The soils are well suited to hay and pasture crops consisting of grasses and legumes that tolerate wetness. Drainage is needed for high-level management, but it is restricted by the moderate depth to bedrock.

Representative profile of Reaville silt loam, 0 to 2 percent slopes, in Hillsborough Township; 200 feet north of Amwell Road and one-half mile west of Mountain Road:

Ap—0 to 8 inches, dark-brown (7.5YR 4/2) silt loam; moderate, fine, granular structure; friable; many fine roots; medium acid; abrupt, smooth boundary.

B1—8 to 12 inches, brown (7.5YR 5/2) silt loam; common, medium, distinct, yellowish-brown (10YR 5/4) and yellowish-red (5YR 5/8) mottles; moderate, fine, angular blocky structure; friable; few fine roots; few thin clay films on ped faces

and in root channels; 1 percent rounded pebbles; strongly acid; clear, wavy boundary.

B2t—12 to 21 inches, reddish-brown (5YR 4/3) silty clay loam; common, medium, faint, weak-red (2.5YR 4/2) mottles and common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, angular blocky structure; friable; few fine roots; common thin clay films on ped faces and in root channels; 2 percent gravel and shale fragments; strongly acid; clear, wavy boundary.

C—21 to 27 inches, dark reddish-brown (2.5YR 3/4) very shaly loam; massive; 60 percent shale fragments that have common, thick, pinkish-gray (7.5YR 6/2) silt coatings on faces of shale fragments; strongly acid; clear, wavy boundary.

R—27 inches, dark reddish-brown (2.5YR 3/4) fractured and partly weathered shale bedrock; black (10YR 2/1) stains on faces of shale fragments.

The solum ranges from 17 to 24 inches in thickness. Depth to bedrock ranges from 20 to 40 inches. Coarse fragments make up 2 to 10 percent of the solum and 35 to 70 percent of the C horizon.

The Ap horizon has a hue of 5YR or 7.5YR, a value of 4, and a chroma of 2 to 4.

The Bt horizon has a hue of 2.5YR or 5YR, a value of 4 or 5, and a chroma of 3 or 4. The Bt horizon is light silty clay loam or silt loam.

The C horizon is commonly dark reddish brown (2.5YR 3/4), but in places hue is 5YR. This horizon is shaly loam, shaly silt loam, and their very shaly equivalents.

Reaville soils are associated with the poorly drained Croton soils, the somewhat poorly drained Abbottstown soils, and the well-drained Penn soils.

Reaville soils are shallower to bedrock than Abbottstown and Croton soils and less gray in the B horizon than Croton soils. Mottling in the subsoil distinguishes Reaville soils from Penn soils.

Reaville silt loam, 0 to 2 percent slopes (ReA).—This nearly level soil is in low-lying areas and intermediate positions on broad upland flats. It has the profile described as representative of the series. In most places shale fragments make up 0 to 15 percent of the surface layer.

Included with this soil in mapping are areas where the surface layer is more than 15 percent fragments of red shale. Also included are some small poorly drained seep areas.

Cultivated areas of this soil are used mainly for soybeans, hay, and small-grain silage. Runoff is very slow, and the hazard of erosion is slight. Wetness is the main limitation of this soil for crops. The soil is too wet to be worked early in spring with the adjacent well-drained soils. It dries out rapidly, however, and in some years crop yields may be reduced by lack of available moisture. Wetness caused by spring and seeps can be reduced in places by installing drain tiles if the depth to bedrock is adequate. Diversion terraces are needed to intercept water coming from the slopes above. Capability unit IIIw-76; woodland suitability group 4w1.

Reaville silt loam, 2 to 6 percent slopes (ReB).—This gently sloping soil is on slight rises and lower slopes in the undulating uplands. Shale fragments in most places make up 0 to 15 percent of the surface layer.

Included with this soil in mapping are some areas of shaly soils, some areas of eroded soils, and some small areas where slopes are more than 6 percent. Also included are areas of Croton, Abbottstown, and Penn soils.

This soil is used mainly for soybeans, small-grain silage, and hay. Runoff is slow, and the hazard of erosion is slight. This soil is too wet to be worked early in spring along with the adjacent well-drained soils. It dries out rapidly, however, and growth of late-maturing crops may be restricted by lack of available moisture. Springs and seeps remain wet well into the growing season. Management is needed that controls surface runoff and erosion and reduces wetness. Diversion terraces and drain tiles are needed to reduce wetness. Capability unit IIIw-76; woodland suitability group 4w1.

Riverhead Series

The Riverhead series consists of deep, well-drained soils. These gently sloping to strongly sloping soils are in undulating uplands. They formed in glacial outwash material, mainly granitic material containing minor amounts of shale, sandstone, and quartzite.

In a representative profile in a wooded area, the surface layer is dark-brown sandy loam 3 inches thick. The subsurface layer is 7 inches of brown sandy loam. The subsoil is 26 inches of strong-brown light sandy loam and sandy loam. The mottled substratum, between depths of 36 and 60 inches, is brown fine sand.

In unlimed areas these soils are very strongly acid or strongly acid. Natural fertility is low. Permeability is moderately rapid, and the available water capacity is moderate.

Most areas of Riverhead soils are in urban areas or woodland, but some areas are cultivated. The native vegetation consists of forests of such hardwood trees as white oak, red oak, beech, maple, and hickory. The soils are suited to all the general crops grown in the county. They are well suited to fruit, vegetable, nursery, and other specialized crops.

Representative profile of Riverhead sandy loam, 3 to 15 percent slopes, in a wooded area of Bernardsville Township; 200 feet west of the intersection of Pennington Avenue and Orchard Street:

A1—0 to 3 inches, dark-brown (7.5YR 3/2) sandy loam; weak, fine, granular structure; very friable; common fine roots; 1 percent rounded pebbles; very strongly acid; clear, wavy boundary.

A2—3 to 10 inches, brown (7.5YR 4/4) sandy loam; moderate, medium, granular structure; very friable; common fine roots; 5 percent rounded pebbles; very strongly acid; clear, wavy boundary.

B1—10 to 15 inches, strong-brown (7.5YR 5/6) light sandy loam; weak, fine, subangular blocky structure; very friable; few fine and medium roots; 5 percent rounded pebbles; mica flakes common; very strongly acid; gradual, wavy boundary.

B2—15 to 36 inches, strong-brown (7.5YR 5/6) sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; mica flakes common; sand grains coated; 5 percent rounded pebbles; very strongly acid; gradual, wavy boundary.

C1—36 to 60 inches, strong-brown (7.5YR 5/6) fine sand; common, medium, distinct, pinkish-gray and strong-brown mottles; massive; very friable; mica flakes common; strongly acid.

The solum ranges from 30 to 36 inches in thickness. Depth to bedrock is more than 8 feet. Coarse fragments of mixed composition make up 5 to 10 percent of the A and B horizons.

The A1 horizon has a hue of 10YR or 7.5YR, a value of 3 or 4, and a chroma of 2 or 3. It has weak to moderate, fine and medium, granular structure.

In the B horizon value and chroma are 4 to 6. This horizon ranges from sandy loam to fine sandy loam.

The C horizon has a hue of 10YR to 7.5YR, a value of 4 to 6, and a chroma of 4 to 6. Texture is commonly fine sand but ranges to loamy sand and sandy loam.

Riverhead soils are associated with the moderately well drained to somewhat poorly drained Lansdowne soils at lower elevation, the poorly drained Parsippany soils in slight depressions and on low-lying flats, and the well-drained Neshaminy soils at higher elevation and in gently sloping landscapes. Nearby on slight rises are the deep, moderately well drained and somewhat poorly drained Mount Lucas soils.

Riverhead soils do not have the gray, mottled B horizon that is commonly in Lansdowne, Parsippany, and Mount Lucas soils. They are deeper to bedrock than Neshaminy soils, and they are not so red as those soils.

Riverhead sandy loam, 3 to 15 percent slopes (RhC).—This gently sloping to strongly sloping soil is on undulating uplands.

Included with this soil in mapping are some small areas of somewhat poorly drained soils, small areas where the surface layer is loam, some areas where slopes are less than 3 percent, and areas where slopes are more than 15 percent.

The organic-matter content is moderately high in the surface layer. This layer is generally in good tilth, and it warms up early in spring. It can be plowed and cultivated soon after heavy rain, and it does not generally crust or clod. Runoff is slow or medium, and the hazard of erosion is slight or moderate.

This soil is suited to a wide variety of crops, including corn, alfalfa, small grains, soybeans, vegetables, fruit, hay, pasture, and other specialized crops. Contour cultivation, minimum tillage, and cover crops are effective in maintaining the organic-matter content and good tilth and controlling runoff and erosion. Capability unit IIIe-58; woodland suitability group 3o1.

Rowland Series

The Rowland series consists of deep, moderately well drained and somewhat poorly drained soils. These nearly level soils are on flood plains of the rivers and major streams. They are about 3 to 8 feet above normal stream level and are subject to frequent stream overflow (fig. 10). They formed along the Raritan, Lamington, and Millstone Rivers and their tributaries in mixed sediment that washed from upland soils and in the underlying red shale, siltstone, or fine-grained sandstone.

In a representative profile in an area of bluegrass pasture, the surface layer is dark-brown silt loam about 10 inches thick. It is mottled in the lower 7 inches. The subsoil is friable, mottled dark reddish-brown silt loam about 30 inches thick. The substratum, between depths of 40 and 65 inches, is reddish-brown stratified sand and gravel.

In unlimed areas these soils are strongly acid or very strongly acid in the upper part and very strongly acid to medium acid in the substratum. Natural fertility is high. The rooting zone is deep. Permeability is moderate, and the available water capacity is high. The water table is at a depth of 1 foot to 3 feet late in winter and early in spring, and it does not drop much in summer unless the summer is extremely dry. Stream overflow generally occurs several times every spring and after most abnormally heavy rain in any season.

Most areas of Rowland soils have been cleared for farming. The native vegetation consists of forests of such hardwood trees as ash, white and pin oaks, walnut, willow, elm, sycamore, maple, and river birch. Because of flood damage these soils are not well suited to crops. The soils are well suited to pasture. Corn and soybeans are grown on some of the higher positions, but flood damage is likely. Sod production is a special use, but flood damage is likely every year. Flood control is impractical because the watershed is so extensive. These soils are used extensively for parks and are good sites for ground-water ponds.

Figure 10.—**Rowland soils planted to barley. Crops grown on these soils are often damaged by flooding.**

Representative profile of Rowland silt loam in Branchburg Township; in bluegrass pasture along the Raritan River, one-eighth mile north of Lehigh Valley Railroad and one-eighth mile east of County Road 567:

A11—0 to 3 inches, dark-brown (7.5YR 4/2) silt loam; moderate, fine, granular structure; friable; many fine roots; very strongly acid; abrupt, smooth boundary.

A12—3 to 10 inches, dark-brown (7.5YR 4/2) silt loam; few, fine, faint, dark reddish-brown (5YR 3/4) mottles; moderate, coarse, granular structure; friable; many roots; very strongly acid; gradual, wavy boundary.

B—10 to 40 inches, dark reddish-brown (5YR 3/4) silt loam; few, fine, faint, dark reddish-gray (5YR 4/2) mottles; weak, coarse, subangular blocky structure; friable; few roots; few, thin, discontinuous clay films on ped faces; common black stains on ped faces; very strongly acid; abrupt, wavy boundary.

IIC—40 to 65 inches, reddish-brown (5YR 4/3) stratified sand and gravel; single grained; loose; strongly acid.

The solum ranges from 28 to 40 inches in thickness. Depth to bedrock ranges from 4 to 8 feet. Coarse fragments make up 0 to 10 percent of the A and B horizons and 20 to 50 percent of the C horizon.

The A11 horizon has a hue of 7.5YR or 5YR, a value of 3 to 5, and a chroma of 2 to 4. The A12 horizon has a hue of 7.5YR or 5YR, a value of 4 or 5, and a chroma of 3 or 4.

The B horizon has a hue of 7.5YR, 5YR, or 2.5YR. Value and chroma are 3 or 4. Texture is silt loam or loam.

The C horizon has a hue of 5YR, 7.5YR, or 2.5YR; a value of 3 or 4; and a chroma of 3 or 4. This horizon, above a depth of 40 inches, is sandy loam to silt loam. Below a depth of 40 inches are gravelly, cobbly, and sandy strata.

Rowland soils are on slight rises and natural levees on flood plains near the streams. They are next to the dark-gray, poorly drained Bowmansville soils in slight depressions and old stream meanders.

Rowland soils do not have the gray B horizon that is commonly in Bowmansville soils.

Rowland silt loam (Ro).—This soil is generally nearly level, but there are minor hummocky areas and slopes of more than 2 percent. The soil is on flood plains along major streams.

Included with this soil in mapping are areas of sandy loam, loam, and gravelly loam soils. Also included are some areas of well-drained soils nearer the streams and at slightly higher elevations and areas of Bowmansville soils in depressions.

The organic-matter content is medium to high. The surface layer is generally easy to till. Runoff is slow, and the hazard of erosion is slight. During flooding, however, rapidly flowing water gouges the soil in some places and deposits material in other places. In places surface or underground drainage has been installed to remove the excess water more quickly and to lower the water table. Capability unit Vw-78; woodland suitability group 2w2.

Royce Series

The Royce series consists of deep, well-drained soils. These gently sloping soils are on high positions in the landscape on undulating and rolling uplands. They formed in a thin mantle of mixed marine sediment and in the underlying material weathered from red shale, siltstone, or fine sandstone.

In a representative profile in a cultivated area, the surface layer is dark reddish-brown silt loam 8 inches thick. The subsoil is about 40 inches thick. The upper 4 inches is dark reddish-brown silt loam, the middle 18 inches is dark reddish-brown and reddish-brown clay loam, and the lower 18 inches is reddish-brown and dusky-red shaly loam. Shale bedrock is at a depth of 48 inches.

In unlimed areas these soils are strongly acid to very strongly acid. Natural fertility is medium. The rooting zone is deep. Permeability is moderately slow, and the available water capacity is high.

Most areas of Royce soils have been cleared for farming (fig. 11). The native vegetation consists of forests of such hardwood trees as white, red, and black oaks; ash; beech; maple; and hickory. Idle areas seed in rapidly with redcedar. The soils are well suited to all general crops, including corn, soybeans, small grains, and vegetables, fruits, nursery, and other specialized crops.

Representative profiles of Royce silt loam, 2 to 6 percent slopes, in Franklin Township; south of Amwell Road, 75 yards east of Grouser Road and 1 mile south of Middlebush:

Ap—0 to 8 inches, dark reddish-brown (5YR 3/3) silt loam; weak, medium, granular structure; friable; many fine roots; many, medium, tubular pores; 5 percent white quartzose pebbles; slightly acid; abrupt, smooth boundary.

B1t—8 to 12 inches, dark reddish-brown (2.5YR 3/4) silt loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; few fine roots; common, medium, tubular pores; few, thin, discontinuous clay films in pores and on faces of peds; 5 percent white quartzose pebbles; slightly acid; gradual, wavy boundary.

B21t—12 to 20 inches, dark reddish-brown (2.5YR 3/4) clay loam, reddish brown (2.5YR 5/4) dry; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin patchy clay films on faces of peds and in pores; 10 percent white quartzose pebbles; strongly acid; clear, wavy boundary.

B22t—20 to 30 inches, reddish-brown (2.5YR 4/4) clay loam; moderate, coarse, subangular blocky structure; friable; thin discontinuous clay films on faces of peds; 5 percent white quartzose pebbles and some shale fragments; strongly acid; clear, wavy boundary.

IIB3—30 to 48 inches, reddish-brown (2.5YR 4/4) and dusky-red (10R 3/4) shaly loam; weak, coarse, subangular blocky structure; firm; thin patchy clay films on shale fragments and on faces of peds; 25 percent shale fragments; very strongly acid; clear, wavy boundary.

IIR—48 inches, dusky-red (10R 3/4) partly weathered relatively undisturbed shale.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 3½ to 6 feet. Coarse fragments of rounded quartzose gravel make up 5 to 20 percent of the A horizon and the upper part of the B horizon. Coarse fragments of mostly shale and siltstone chips make up 15 to 60 percent of the lower part of the B horizon and the C horizon.

The A horizon has a hue of 5YR, a value of 3, and a chroma of 3 or 4.

The B horizon has a hue of 5YR, 2.5YR, or 10R; a value of 3 or 4; and a chroma of 4 to 6. Common textures are heavy loam, clay loam, silt loam, and light silty clay loam.

The C horizon has a hue of 5YR, 2.5YR, or 10R; a value of 3 or 4; and a chroma of 4 to 6. Common textures are loam, silt loam, and their shaly and very shaly equivalents.

Royce soils are associated with the shallow, well-drained Klinesville soils, the well-drained Penn soils, and the moderately well drained Readington soils on lower slopes and broad flats and with the somewhat poorly drained Lansdowne soils on broad flats and in slight depressions.

Royce soils are deeper than Penn and Klinesville soils. They are redder than Readington and Lansdowne soils and do not have the mottles that are commonly in those soils.

Royce silt loam, 2 to 6 percent slopes (RyB).—This gently sloping soil is on slight rises on the undulating uplands.

Included with this soil in mapping are small areas of nearly level soils, a few areas of moderately eroded soils, and a few areas where the surface layer is loam. In some included areas quartzose gravel makes up more than 15 percent of the surface layer. Also included are some small areas of Birdsboro and Lansdowne soils.

Runoff is slow, and the hazard of erosion is slight.

In cultivated areas management is needed that controls runoff and erosion and maintains the organic-matter content. Contour cultivation, terraces, and cropping sequences are needed for these purposes. Capability unit IIe-55; woodland suitability group 2o1.

Udifluvents and Ochrepts

Udifluvents and Ochrepts (UD) consist of deep, somewhat poorly drained, moderately well drained, and well drained loamy soils on flood plains that generally are 3 to 8 feet above normal stream flow. These soils formed in sediment derived mainly from glacial till, granite gneiss, and limestone. The sediment washed from the nearby uplands.

In unlimed areas these soils are strongly acid. Natural fertility is high. Permeability is moderate to moderately rapid, and the available water capacity is moderate. The rooting zone is deep. The seasonal high water table is at a depth of 1 to 5 feet late in fall, in winter, and early in spring. Streams generally overflow on these soils at least once each year. Depth to bedrock is more than 6 feet in most places.

The native vegetation consists of forests of such hardwoods as ash, white oak, pin oak, walnut, sycamore, maple, river birch, yellow-poplar, and hemlock.

Udifluvents and Ochrepts are associated with such upland soils as Bartley, Cokesbury, Califon, and Edneyville, and Parker and with Fluvaquents on flood plains. Udifluvents and Ochrepts do not have the distinct horizonation that is common in the soils that are on higher positions in the landscape. They do not have the gray subsoil that is commonly in Fluvaquents.

Most areas of these soils have been cleared and are used for pasture. Large areas are reverting to woodland. Because flooding is a hazard, these soils are not farmed and most areas are used for pasture. Capability unit IIw-79; woodland suitability group 2w2.

Urban Land

Urban land (Um) consists of highly urbanized areas. Large areas of soil have been disturbed during construction, grading, and landscaping. The preparation and degree of disturbance generally reflect the density of development. In residential areas of single dwelling homes, 50 to 90 percent of the acreage is areas in which 1 foot to 5 feet or more of the soil has been removed or buried during construction. About 10 to 30 percent of this

Figure 11.—**Royce soils planted to cabbage. These soils are well suited to most crops grown in the county.**

is under structures or paving. In areas of such high-density developments as town centers, large shopping centers, or extensive industrial parks, about 10 percent of each area is relatively undisturbed soil, and the balance is either under paving and structures or consists of mixed soil material resulting from deep excavations or filling.

Included with this land type in mapping are areas of Penn, Klinesville, Reaville, and Croton soils. Also included are areas surrounding the manmade lakes on the Duke Estates. These areas were subject to deep excavation and filling but have not been developed for residential, commercial, or industrial purposes. Not assigned to a capability unit, woodland suitability group, or a landscape planting group.

Watchung Series

The Watchung series consists of deep, poorly drained soils. These nearly level soils are on low-lying flats and in depressions and drainageways in the Watchung and Sourland Mountains. They formed in material weathered from dark-gray or black igneous rock.

In a representative profile in a cultivated area, the surface layer is very dark brownish-gray silt loam 9 inches thick. In sequence from the top, the subsoil is 4 inches of light brownish-gray silt loam, 12 inches of light brownish-gray heavy silty clay loam, and 11 inches of pinkish-gray heavy silty clay loam. The substratum, between depths of 36 and 60 inches, is mottled, strong-brown gravelly loam.

In unlimed areas these soils are very strongly acid to medium acid in the upper part, strongly acid to slightly acid in the lower part of the subsoil, and slightly acid to neutral in the substratum. Natural fertility is medium. Permeability is slow in the subsoil, and the available water capacity is high. These soils have a seasonal high water table at or near the surface late in fall, in winter, and early in spring.

Most areas of Watchung soils are wooded and are too wet for other uses. The native vegetation consists of forests of such hardwood trees as pin oak, ash, beech, maple, and sycamore. The soils are suited to crops that tolerate wetness. If drained, they are suited to hay, pasture, corn, and soybeans.

Representative profile of Watchung silt loam in Bernards Township; one-fourth mile east of Mine Brook Road and 1 mile south of the intersection of Whitenack Road and Mine Brook Road, on Liberty Corner Road:

Ap—0 to 9 inches, very dark brownish-gray (10YR 3/2) silt loam; weak, fine, granular structure; friable; many fine roots; 5 percent diabase fragments; slightly acid; abrupt, smooth boundary.

B1—9 to 13 inches, light brownish-gray (10YR 6/2) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; friable; many fine roots; 5 percent rounded diabase fragments; slightly acid; clear, wavy boundary.

B21tg—13 to 25 inches, light brownish-gray (10YR 6/2) heavy silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) and pinkish-gray (7.5YR 6/2) mottles; moderate, medium, angular blocky structure; friable; few fine roots; many thick clay films on ped faces and in root channels; 10 percent rounded diabase fragments; medium acid; gradual, wavy boundary.

B22tg—25 to 36 inches, pinkish-gray (7.5YR 6/2) heavy silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; moderate, coarse, prismatic structure parting to moderate, coarse, angular blocky; firm; many thick clay films on ped faces; 10 percent diabase fragments slightly acid; clear, wavy boundary.

C—36 to 60 inches, strong-brown (7.5YR 5/6) gravelly loam; few, medium, distinct, pinkish-gray (7.5YR 6/2) mottles; weak, coarse, prismatic structure parting to weak, coarse, angular blocky; friable; few moderately thick clay films on ped faces; 15 percent angular diabase fragments; slightly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock ranges from 5 to 10 feet. Coarse fragments make up 0 to 10 percent of the solum and 10 to 20 percent of the substratum.

The A horizon is typically very dark grayish brown (10YR 3/2), but in places hue is 2.5Y, value is 3 or 4, and chroma is 1 to 3.

The matrix of the B horizon has a hue of 7.5YR to 10YR, a value of 5 or 6, and a chroma of 1 or 2. Mottles of the B horizon include those that have both low and high chromas. The B2 horizon textures include heavy silty clay loam and silty clay.

The C horizon has a hue of 7.5YR or 10YR, a value of 4 to 6, and a chroma of 1 to 6. It generally has low- and high-chroma mottles. This horizon is loam, clay loam, silty clay loam, and their gravelly equivalents.

Watchung soils are associated with Mount Lucas and Neshaminy soils. They differ from those soils in having a gray B horizon.

Watchung silt loam (Wc).—This nearly level soil is in narrow bands along drainageways, on low-lying flats, and in depressions in the Watchung and Sourland Mountains.

Included with this soil in mapping are areas where the surface layer is loam or gravelly loam and areas of wooded soils that are stony or very stony in most places. Also included are areas of Mount Lucas and Neshaminy soils.

This soil is used mainly for hay and pasture and as woodland. Runoff is very slow, and water is ponded in the depressions and on the low-lying flats. The hazard of erosion is slight. During the growing season this soil remains wet for a week or two following periods of heavy rain.

Wetness is the main limitation for crops. Surface drainage is needed to remove the excess water. Capability unit Vw-80; woodland suitability group 1w1.

Whippany Series

The Whippany series consists of deep, somewhat poorly drained soils. These soils are nearly level to gently sloping. They are in an old glacial lake, Lake Passaic, in the northeastern part of the county. They formed in glacial lake sediment derived mainly from red shale, granitic gneiss, and basalt.

In a representative profile in a wooded area, the surface layer is very dark gray silt loam 4 inches thick. The subsurface layer is 6 inches of yellowish-brown silt loam. The upper 13 inches of the subsoil is mottled, yellowish-brown light silty clay loam and silty clay loam; and the lower 22 inches is mottled, yellowish-brown silty clay. The substratum, between depths of 45 and 60 inches, is mottled, reddish-brown silty clay loam.

In unlimed areas these soils are medium acid to strongly acid in the upper part and slightly acid to neutral in the substratum. Natural fertility is high. Permeability is slow in the subsoil, and the available water capacity is high. These soils have a moderately high water table, and a seasonal high water table is at a depth of ½ foot to 1½ feet late in fall, in winter, and early in spring.

About half the acreage of Whippany soils has been cleared for farming. The native vegetation consists of forests of such mixed deciduous trees as sweetgum, pin oak, red maple, and beech. The soils are better suited to such row crops as corn and soybeans than to other uses. They are not well suited to alfalfa and fall-sown small grains, but they are fairly well suited to hay and pasture consisting of water-tolerant grasses and legumes.

Representative profile of Whippany silt loam, 0 to 4

percent slopes, in Warren Township; 40 feet south of Third Street and one-fourth mile west of Sterling Road:

A1—0 to 4 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, granular structure; friable; many fine roots; medium acid; clear, wavy boundary.

A2—4 to 10 inches, yellowish-brown (10YR 5/4) silt loam; moderate, coarse, granular structure; many fine roots; medium acid; clear, wavy boundary.

B1—10 to 14 inches, yellowish-brown (10YR 5/4) light silty clay loam; common, medium, distinct, dark-gray (10YR 4/1) and light-gray (10YR 6/1) mottles; moderate, fine, subangular blocky structure; friable, plastic when wet; few fine roots; few thin clay films on ped faces and in root channels; strongly acid; gradual, wavy boundary.

B21t—14 to 23 inches, yellowish-brown (10YR 5/6) silty clay loam; common, medium, distinct, dark-gray (10YR 4/1) and light-gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; firm, plastic; common thin clay films on ped faces; medium acid; gradual, irregular boundary.

B22t—23 to 45 inches, yellowish-brown (10YR 5/6) silty clay; many, medium, distinct, dark-gray (10YR 4/1) and light-gray (10YR 6/1) mottles; strong, coarse, angular and subangular blocky structure; firm, plastic when wet; common thin clay films on ped faces; medium acid; clear, wavy boundary.

Cg—45 to 60 inches, reddish-brown (5YR 5/4) silty clay loam; many, medium, prominent, light-gray (10YR 6/1) mottles; massive; firm, plastic when wet; slightly acid.

The solum ranges from 30 to 42 inches in thickness. Depth to bedrock ranges from 5 to 10 feet. Coarse fragments make up less than 5 percent of the soil material throughout the profile.

The A1 horizon has a hue of 10YR or 7.5YR and a value of 3 or 4. The A2 horizon has a hue of 10YR or 7.5YR, a value of 2 to 5, and a chroma of 2 to 4.

The B2t horizon has a hue of 10YR, 7.5YR, or 5YR; a value of 4 or 5; and a chroma of 4 to 6. This horizon is heavy silt loam, silty clay loam, clay loam, silty clay, and clay.

The C horizon has a hue of 7.5YR or 5YR, a value of 3 to 5, and a chroma of 3 to 8. This horizon is typically silty clay loam but ranges to silt loam, fine sand, fine gravel, and silty clay.

Whippany soils are near or adjacent to the deep, poorly drained, gray Parsippany soils, which are at slightly lower positions on the landscape. Nearby in broad depressions is the deep Parsippany very poorly drained variant.

Whippany soils differ from Parsippany soils and from the Parsippany variant in having a mainly yellowish-brown B horizon instead of a gray one.

Whippany silt loam, 0 to 4 percent slopes (WhA).—This nearly level to gently sloping soil is on broad flats and slight rises in an old glacial lake, Lake Passaic.

Included with this soil in mapping are small areas of deep silty soils along Lord Sterling Road. Also included are small areas of Parsippany soils and the Parsippany very poorly drained variant.

The organic-matter content is medium. The surface layer is generally easy to till. Runoff is slow, and the hazard of erosion is slight.

This soil is used for general field crops, pasture, and trees. Wetness is the major limitation for farming. Surface drains are most efficient in removing the excess water. In places this soil is very difficult to drain, because suitable outlets are lacking. Capability unit IIw-70; woodland suitability group 2w1.

Use and Management of the Soils

The soils of Somerset County are used mainly for cultivated crops, pasture, and trees. This section explains how the soils can be managed for those purposes, and it rates the soils according to their productivity for the principal crops. It also discusses the soils in relation to wildlife management, woodland management, engineering, and town and country planning (*10*). Those who want detailed information about management of the soil can refer to the section "Descriptions of the Soils."

This section is a general guide for managing the soils and does not suggest specific management for individual soils. Detailed information about managing the soils can be obtained from the local staff of the Soil Conservation Service, from the Agricultural Extension Service, or from the Agricultural Experiment Station, Cook College, Rutgers, the State University.

Management of Soils for Crops and Pasture

The principal concerns in managing the soils for crops and pasture are maintaining fertility, controlling erosion, and providing drainage. Practices that fit all of the soils that are suitable for crops and pasture are discussed in the mapping-unit descriptions.

Most soils in the county require additions of lime and fertilizer. The amounts depend on the natural content of lime and plant nutrients, past cropping and level of management, the need of the crop, and the level of yield desired. Suggestions for additions of lime and fertilizer are only general in this survey. Fields should be limed and fertilized according to the needs indicated by soil tests and in accordance with current recommendations of the Agricultural Extension Service and Cook College, Rutgers, the State University.

The soils of Somerset County are naturally medium in organic-matter content. This content can be maintained or increased through proper management of residue, which includes plowing in cover crops, growing a sod crop in the cropping sequence, and returning both animal manure and crop residue to the soil. Commercial fertilizer is beneficial to all crops. On soils subject to rapid leaching, fertilizer is more effective if added in more than one application during the growing season.

Tillage is needed to prepare a seedbed and control weeds, but it should be kept to a minimum because it generally tends to break down the structure of the soil. Also helpful in preventing breakdown of structure are adding organic matter and growing sod crops, cover crops, and green-manure crops.

All of the sloping soils in the county are susceptible to erosion and to loss of organic matter and plant nutrients from the surface layer where farmed. Because most erosion occurs while the cultivated crop is growing or soon after the crop has been harvested, a cropping sequence should be selected that keeps the loss of soil and water to a minimum. Such a sequence is more effective if it is used with one or more other practices of erosion control. These practices are contour cultivating, terracing, stripcropping, providing diversions and grassed waterways, using minimum tillage, properly using crop residue, planting cover crops, and applying fertilizer and lime when needed.

In Somerset County many of the soils are wet because of runoff from adjacent areas, a slowly permeable subsoil, a fluctuating water table, or a combination of these. In some places diversions can be used to prevent runoff from adjacent areas. Random or parallel shallow field ditches are needed in other places to lead the water to main natural waterways or to deep, open ditches. Examples of wet soils are the Abbottstown, Chalfont, Croton, Lansdowne, and Parsippany soils, which are underlain by a fragipan or are

slowly permeable in the subsoil. Soils that have a fragipan are difficult to drain, but they can be drained by open ditches and tile drains. Open ditches are more effective if they intercept the water as it moves horizontally on top of the pan. Where tile drains are practical, they generally provide better drainage than open ditches. For drainage by either system, suitable outlets are required.

Capability grouping

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

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

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

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

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

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol; for example, IIe-55 or IIIe-56. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

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

Class I. Soils having few limitations that restrict their use.

(No subclasses.)

Capability unit I-51. Nearly level, deep, well-drained loams that formed in glacial till and in material weathered from red shale; on uplands.

Capability unit I-55. Nearly level, deep, well-drained silt loams that formed in old alluvium; on terraces.

Capability unit I-56. Nearly level, deep, well-drained sandy loams that formed in glacial outwash material; on terraces.

Class II. Soils having moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Subclass IIe. Soils subject to moderate erosion unless protected.

Capability unit IIe-51. Gently sloping, deep, well-drained loams and moderately well drained gravelly loams that formed in glacial till and in material weathered from red shale; on uplands.

Capability unit IIe-55. Gently sloping, deep, well-drained silt loams and gravelly loams that formed in old alluvium and in material weathered from quartz conglomerate, diabase, and shale; on uplands and terraces.

Capability unit IIe-56. Gently sloping, deep, well-drained sandy loams that formed in glacial outwash material; on terraces.

Capability unit IIe-58. Gently sloping, deep, well-drained gravelly loams that formed in material weathered from granitic gneiss; on uplands.

Capability unit IIe-65. Gently sloping, moderately deep, well-drained silt loams and shaly silt loams that formed in material weathered from shale; on uplands.

Capability unit IIe-71. Gently sloping, deep, moderately well drained to somewhat poorly drained silt loams and gravelly loams that formed in material weathered from glacial till, granite gneiss, diabase, shale, and acid marine sediment; on uplands.

Subclass IIw. Soils moderately limited by excess water.

Capability unit IIw-70. Nearly level, deep, moderately well drained and somewhat poorly drained silt loams that formed in lacustrine sediment and acid marine sediment; on uplands.

Capability unit IIw-71. Nearly level, deep, moderately well drained and somewhat poorly drained silt loams that have a fragipan and that formed in material weathered from old alluvium; on terraces.

Capability unit IIw-73. Nearly level, deep, moderately well drained sandy loams that

formed in glacial outwash material; on terraces.

Capability unit IIw-79. Nearly level, deep, well-drained, moderately well drained, and somewhat poorly drained loams and sandy loams that formed in recent alluvium; on flood plains.

Subclass IIs. Soils moderately limited by droughtiness.

Capability unit IIs-65. Nearly level, moderately deep, well-drained silt loams that formed in material weathered from shale; on uplands.

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

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-51. Strongly sloping, deep, well drained and moderately well drained loams and gravelly loams that formed in glacial till and in material weathered from shale; on uplands.

Capability unit IIIe-53. Strongly sloping, deep, well-drained gravelly loams that formed in material weathered from quartzite conglomerate or fanglomerate; on uplands.

Capability unit IIIe-55. Strongly sloping and gently sloping to strongly sloping, deep, well-drained silt loams that formed in material weathered from old alluvium and in material weathered from diabase, basalt, sandstone, siltstone, and shale; on terraces and uplands.

Capability unit IIIe-56. Strongly sloping, deep, well-drained sandy loams that formed in glacial outwash material; on terraces.

Capability unit IIIe-58. Strongly sloping and gently sloping to strongly sloping, deep, well-drained sandy loams and gravelly loams that formed in glacial till and in material weathered from quartzose conglomerate and granite gneiss; on uplands.

Capability unit IIIe-65. Strongly sloping, moderately deep, well-drained silt loams and shaly silt loams that formed in material weathered from shale; on uplands.

Capability unit IIIe-70. Strongly sloping, deep, moderately well drained and somewhat poorly drained silt loams, gravelly loams, gravelly silt loams, and stony silt loams that formed in material weathered from metamorphosed shale, diabase, basalt, and argillite; on uplands.

Capability unit IIIe-71. Strongly sloping, deep, moderately well drained and somewhat poorly drained silt loams, loams, and gravelly silt loams, some of which have a fragipan, that formed in glacial till and in material weathered from granitic gneiss, diabase, limestone, sandstone, siltstone, and shale; on uplands.

Subclass IIIw. Soils severely limited by excess water.

Capability unit IIIw-70. Nearly level and gently sloping, deep, moderately well drained and somewhat poorly drained silt loams, gravelly loams, gravelly silt loams, and stony silt loams that formed in material weathered from metamorphosed shale, diabase, basalt, argillite, and shale; on uplands.

Capability unit IIIw-71. Nearly level and gently sloping, deep, somewhat poorly drained soils that have a fragipan and that formed in material weathered from sandstone, siltstone, and shale, and poorly drained soils that formed in acid marine sediment; on uplands.

Capability unit IIIw-76. Nearly level and gently sloping, moderately deep, moderately well drained and somewhat poorly drained soils that formed in material weathered from shale; on uplands.

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

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe-55. Moderately steep, deep, well-drained silt loams that formed in material weathered from sandstone, siltstone, and argillite; on uplands.

Capability unit IVe-58. Moderately steep and steep, well-drained gravelly loams that formed in material weathered from quartzose conglomerate or fanglomerate and granite gneiss; on uplands.

Capability unit IVe-66. Gently sloping to strongly sloping, shallow, well-drained shaly loams that formed in material weathered from shale, siltstone, or sandstone; on uplands.

Subclass IVw. Soils very severely limited by excess wetness.

Capability unit IVw-80. Nearly level and gently sloping, poorly drained silt loams that formed in lacustrine sediment and in material weathered from shale, siltstone, and sandstone; on uplands.

Capability unit IVw-86. Nearly level, deep, poorly drained silt loams that have a fragipan and that formed in old alluvium; on terraces.

Subclass IVs. Soils very severely limited by droughtiness.

Capability unit IVs-58. Gently sloping to strongly sloping, deep, somewhat excessively drained very gravelly sandy loams that formed in material weathered from granite gneiss; on uplands.

Class V. Soils subject to little or no erosion but having other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat.

Subclass Vw. Soils too wet for cultivation; drainage generally not feasible.

Capability unit Vw-78. Nearly level, deep, moderately well drained to somewhat poorly drained silt loams that formed in recent alluvium and that are subject to frequent flooding; on flood plains.

Capability unit Vw-80. Nearly level, deep, poorly drained loams that formed in material weathered from diabase and basalt; on uplands.

Class VI. Soils having severe limitations that make them generally unsuited to cultivation and that limit their use largely to pasture, woodland, or wildlife habitat.

Subclass VIe. Soils severely limited, mainly by risk of erosion, unless protective cover is maintained.
Capability unit VIe-66. Moderately steep, shallow, well-drained shaly loams that formed in material weathered from shale; on uplands.
Capability unit VIe-70. Steep, deep, moderately well drained and somewhat poorly drained stony silt loams that formed in a silt loam mantle over material weathered from argillite; on uplands.
Subclass VIw. Soils severely limited by excess water; generally unsuitable for cultivation.
Capability unit VIw-80. Nearly level, deep, very poorly drained silt loams that formed in lacustrine sediment; on uplands.
Capability unit VIw-86. Nearly level, deep, poorly drained silt loams, loams, and sandy loams that formed in recent alluvium and that are subject to frequent flooding; on flood plains.
Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by their low available water capacity, stoniness, or other characteristics.
Capability unit VIs-22. Steep, deep, somewhat excessively drained and well-drained, very stony soils that formed in material weathered from granite gneiss; on uplands.
Capability unit VIs-61. Gently sloping to moderately steep, deep, well drained, moderately well drained, and somewhat poorly drained very stony silt loams that formed in material weathered from diabase and basalt; on uplands.
Capability unit VIs-75. Gently sloping, deep, moderately well drained to somewhat poorly drained very stony loams that formed in glacial till and in material weathered from granite gneiss; on uplands.

Class VII. Soils having very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife habitat.
Subclass VIIe. Soils very severely limited, mainly by risk of erosion unless protective cover is maintained.
Capability unit VIIe-66. Steep to very steep, shallow, well-drained shaly loams that formed in material weathered from shale; on uplands.
Subclass VIIs. Soils very severely limited by low available water capacity, stones, or other soil features.
Capability unit VIIs-60. Very steep, deep, well-drained rocky sandy loams that formed in material weathered from granite gneiss; on uplands.
Capability unit VIIs-61. Steep to very steep, deep, well-drained very stony silt loams that formed in material weathered from diabase and basalt; on uplands.
Capability unit VIIs-77. Nearly level to strongly sloping, deep, moderately well drained, somewhat poorly drained, and poorly drained very stony loams and very stony silt loams that formed in glacial till and in material weathered from granite gneiss, diabase, and basalt; on uplands.

Estimated yields

Estimated productivity indexes, or ratings, of yields are shown in table 2 for the principal crops grown on the soils in Somerset County under two levels of management. The lowest rating is 1, and the highest is 10. Table 3 shows how each rating is converted to a range in yield.

In table 2 the ratings in columns A are based on yields expected under the management used by most farmers in the county. Average management, however, will not meet recommended standards in one or more of the following practices: soil drainage, fertilizer application, weed control, and erosion control. Ratings in columns B are based on yields expected under the best current management for the crop on that soil. The ratings in columns B do not represent the highest yields obtained under ideal conditions but are based on averages of yields obtained over a period of at least 4 years, allowing for exceptional weather and for pests and diseases. The differences between column A and column B for any crop may be the result of a single factor or a combination of factors. In general, all factors must be favorable to obtain the yields represented by the ratings in columns B.

Details of the practices that are recommended to obtain high yields are changed somewhat from year to year. Current, detailed recommendations are published each year in bulletins of the Agricultural Extension Service. In general, the recommended practices are: choosing varieties of crops that are suited to the soil and climate and that are resistant to the common pests and diseases; treating seed by sterilizing or inoculating when appropriate; planting seed at the proper rate and maintaining the proper number of plants per acre; applying fertilizer after choosing the formula, the amount per acre, and the time of application in relation to the soil, crop, plant population, and amount of available water in the soil; applying lime according to soil tests and needs of the crop; controlling pests, diseases, and weeds; installing drainage if the water table interferes with growth of crops; applying practices to control runoff and erosion; planting crops in an appropriate sequence, growing cover crops, and using minimum tillage where applicable; and keeping the soil in good tilth.

Estimates for soils on which records are not available are based on yields from similar soils. The county agricultural agent and other agricultural leaders helped in making all the estimates.

Woodland

The New Jersey Bureau of Forestry reports that about 60,000 acres, or about one-fifth of the county, is in forest. Large wooded areas are in the Sourland and Watchung Mountains and also in the steep Highlands. Idle land reseeds naturally to redcedar and ash. Oaks also seed in and eventually dominate this idle land. Yellow-poplar and ash are important species in places.

The soils of Somerset County have been placed in woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, need about the same management where vegetation is similar, and have the same potential productivity.

Each group is identified by a three-part symbol, such as 1w1, 2o1, 2w1, or 3x1. The potential productivity of the soils in the group is indicated by the first number in the symbol: 1, very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on field de-

TABLE 2.—*Estimated average yield ratings of principal crops under two levels of management*

[Ratings are from 1, the lowest, to 10, the highest. Yield equivalents for ratings are listed in table 3. Ratings in columns A are for common management; those in columns B are for the best current management. Absence of a rating indicates crop generally is not grown on the soil]

Soil	Corn				Wheat		Oats		Alfalfa		Mixed hay	
	Grain		Silage									
	A	B	A	B	A	B	A	B	A	B	A	B
Abbottstown silt loam, 0 to 2 percent slopes	4	6	4	6			4	6			6	8
Abbottstown silt loam, 2 to 6 percent slopes	4	6	4	6			4	6			6	8
Amwell gravelly loam, 2 to 6 percent slopes	5	7	5	7	7	8	8	9	6	7	7	8
Amwell gravelly loam, 6 to 12 percent slopes	4	6	4	6	6	7	7	8	5	6	6	7
Amwell gravelly silt loam, rock substratum, 2 to 6 percent slopes	5	7	5	7	7	8	8	9	6	7	7	8
Amwell gravelly silt loam, rock substratum, 6 to 12 percent slopes	4	6	4	6	5	6	7	8	5	6	6	7
Arendtsville gravelly loam, 2 to 6 percent slopes	8	10	8	10	5	7	5	7	4	6	4	6
Arendtsville gravelly loam, 6 to 12 percent slopes	7	9	7	9	4	6	4	6	4	6	4	6
Bartley loam, 3 to 15 percent slopes	7	9	7	9	8	9	8	9	7	9	7	9
Birdsboro silt loam, 0 to 2 percent slopes	8	10	8	10	8	9	9	10	7	9	8	10
Birdsboro silt loam, 2 to 6 percent slopes	8	10	8	10	8	9	9	10	7	9	8	10
Birdsboro silt loam, 6 to 12 percent slopes	7	9	7	9	7	8	8	9	6	8	8	10
Bowmansville silt loam												
Bucks silt loam, 2 to 6 percent slopes	8	10	7	9	8	10	8	10	8	10	8	10
Bucks silt loam, 6 to 12 percent slopes, eroded	7	9	6	8	7	9	7	9	7	9	7	9
Califon gravelly loam, 3 to 8 percent slopes	5	7	5	7	6	7	6	7	6	8	7	9
Califon very stony loam, 3 to 8 percent slopes												
Chalfont silt loam, 2 to 6 percent slopes	4	6	5	6			6	8			6	8
Chalfont silt loam, 6 to 12 percent slopes	4	5	4	5							6	8
Chalfont stony silt loam, 2 to 6 percent slopes												
Chalfont stony silt loam, 6 to 12 percent slopes												
Chalfont stony silt loam, 12 to 25 percent slopes												
Cokesbury very stony loam, 0 to 8 percent slopes												
Croton silt loam, 0 to 2 percent slopes	2	3	2	3							4	6
Croton silt loam, 2 to 6 percent slopes	2	3	2	3							4	6
Dunellen sandy loam, 0 to 2 percent slopes	8	10	7	9	8	10	9	10	8	10	8	10
Dunellen sandy loam, 2 to 6 percent slopes	7	9	6	8	7	9	8	9	7	9	7	9
Dunellen sandy loam, 6 to 12 percent slopes	6	8	5	7	6	8	7	8	6	8	6	8
Dunellen sandy loam, moderately well drained variant	7	9	6	8	7	9	8	9	7	8	8	9
Edneyville gravelly loam, 3 to 8 percent slopes	7	8	5	6	5	7	7	8	6	8	7	9
Edneyville gravelly loam, 8 to 15 percent slopes	6	7	4	5	4	6	6	8	5	7	6	8
Edneyville gravelly loam, 15 to 25 percent slopes	4				3	5	5	7	4	6	5	7
Elkton silt loam	4	7	4	7	4	7					5	8
Fluvaquents												
Keyport silt loam, 0 to 2 percent slopes	5	7	5	7	4	6	4	6	3	5	6	8
Keyport silt loam, 2 to 6 percent slopes	5	7	5	7	5	7	4	6	3	5	6	8
Klinesville shaly loam, 2 to 12 percent slopes		2		2	3	4	4	5	3	4	3	4
Klinesville shaly loam, 12 to 18 percent slopes					3	4	3	4	3	4	3	4
Klinesville shaly loam, 18 to 35 percent slopes												
Lamington silt loam	2	4	2	4		3		3			1	3
Lansdowne silt loam, 0 to 2 percent slopes	4	6	4	6	6	7	7	8	6	7	6	8
Lansdowne silt loam, 2 to 6 percent slopes	4	6	4	6	6	7	7	8	6	7	6	8
Lawrenceville silt loam, 2 to 6 percent slopes	6	7	5	6	7	8	8	9	7	8	8	9
Lawrenceville silt loam, 6 to 12 percent slopes	4	6	4	6	6	7	7	8	6	7	6	8
Lehigh silt loam, 2 to 6 percent slopes	4	5	4	5			5	6			5	7
Lehigh silt loam, 6 to 15 percent slopes	3	5	3	5	4	6	4	5			4	6
Meckesville gravelly loam, 2 to 6 percent slopes	6	8	6	8	8	9	8	9	7	8	8	9
Meckesville gravelly loam, 6 to 12 percent slopes	5	7	5	7	8	9	8	9	7	8	8	9
Mount Lucas silt loam, 2 to 6 percent slopes	5	7	5	7	7	8	8	9	6	7	7	8
Mount Lucas gravelly silt loam, 6 to 12 percent slopes	4	6	4	6	6	7	7	8	5	6	6	7
Mount Lucas-Watchung very stony silt loams, 2 to 12 percent slopes												
Neshaminy silt loam, 2 to 6 percent slopes	8	10	8	10	9	10	9	10	8	10	8	10
Neshaminy silt loam, 6 to 12 percent slopes	7	9	7	9	7	9	8	9	6	9	7	10
Neshaminy very stony silt loam, 18 to 35 percent slopes												
Neshaminy-Mount Lucas very stony silt loams, 2 to 12 percent slopes												
Neshaminy-Mount Lucas very stony silt loams, 12 to 18 percent slopes												
Neshaminy silt loam, fragipan variant, 2 to 6 percent slopes	8	10	8	10	9	10	9	10	8	10	8	10
Neshaminy silt loam, fragipan variant, 6 to 12 percent slopes	7	9	7	9	7	9	8	9	6	9	7	10
Norton loam, 0 to 2 percent slopes	6	8	5	7	6	8	6	8	5	8	7	9

TABLE 2.—*Estimated average yield ratings of principal crops under two levels of management*—Continued

Soil	Corn				Wheat		Oats		Alfalfa		Mixed hay	
	Grain		Silage		A	B	A	B	A	B	A	B
	A	B	A	B								
Norton loam, 2 to 6 percent slopes	6	8	5	7	6	8	6	8	5	8	7	9
Norton loam, 6 to 12 percent slopes	5	7	4	6	5	7	5	7	4	7	6	8
Norton loam, 6 to 12 percent slopes, eroded	4	7	3	6	4	7	4	7	4	8	6	8
Parker very gravelly sandy loam, 3 to 15 percent slopes	2	3	2	3	4	5	4	5	3	4	3	4
Parker rocky sandy loam, 25 to 35 percent slopes											2	3
Parker-Edneyville very stony soils, 15 to 25 percent slopes												
Parsippany silt loam	2	4	2	4							2	6
Parsippany silt loam, very poorly drained variant												
Pattenburg gravelly loam, 6 to 12 percent slopes	2	4	3	5	3	5	3	5	3	4	3	5
Pattenburg gravelly loam, 12 to 18 percent slopes		3			2	4	2	4	2	3	2	4
Penn silt loam, 0 to 2 percent slopes	5	6	5	6	5	7	6	8	6	8	6	8
Penn silt loam, 2 to 6 percent slopes	5	6	5	6	5	7	6	8	6	8	6	8
Penn silt loam, 6 to 12 percent slopes	3	5	3	5	4	7	4	7	3	7	3	7
Penn shaly silt loam, 2 to 6 percent slopes	5	6	5	6	5	7	6	8	6	8	6	8
Penn shaly silt loam, 6 to 12 percent slopes	4	5	4	6	5	6	5	7	5	7	5	7
Quakertown silt loam, 2 to 12 percent slopes	5	8	5	7	5	8	5	8	6	8	7	9
Quakertown silt loam, 12 to 18 percent slopes	4	7	4	6	4	7	4	7	5	7	6	8
Raritan silt loam, 0 to 4 percent slopes	5	7	4	6	6	7	6	7	6	7	6	8
Readington silt loam, 2 to 6 percent slopes	5	7	4	6	7	8	7	8	4	6	7	8
Reaville silt loam, 0 to 2 percent slopes	3	4	3	4			4	6			4	6
Reaville silt loam, 2 to 6 percent slopes	3	4	3	4			4	6			4	6
Riverhead sandy loam, 3 to 15 percent slopes					5	6	6	7	4	5	4	5
Rowland silt loam											4	7
Royce silt loam, 2 to 6 percent slopes	8	10	8	10	8	9	9	10	7	9	8	10
Udifluvents and Ochrepts											4	7
Urban land												
Watchung silt loam											2	3
Whippany silt loam, 0 to 4 percent slopes	4	6	4	6	6	7	7	8	6	7	6	8

termination of average site index. The site index of a given soil is the height, in feet, that the dominant or codominant trees of a given species reach in a natural, essentially unmanaged stand in 50 years. Site index can be converted into approximate expected growth and yield per acre in cords and board feet, as shown in table 4. For Somerset County, conversions of average site index into volumetric growth and yield are based on research by Schnur (*8*) for upland oaks and by McCarthy (*4*) for yellow-poplar.

The second part of the symbol identifying a woodland suitability group is a small letter. In this survey *x, f, w, d,* and *o* are used. Except for the letter o, the small letter indicates an important soil property that imposes a hazard or limitation in managing the soils of the group for trees. The letter *o* shows that the soils have few limitations that restrict their use for trees. The letter *x* means the soils have restrictions or limitations due to stones or rocks. The letter *w* means excessive wetness, either seasonal or all year. The soils have restricted drainage, have a high water table, or are subject to flooding. The letter *d* indicates the soils have restrictions or limitations due to a restricted rooting depth. The soils are shallow over hard rock or have a hardpan or other layers in the soil that restrict roots. The letter *f* shows that the main limitation is coarse fragments that make up more than 35 percent of the soil, thereby reducing the available water capacity in the soil.

The last part of the symbol, another number, differentiates woodland suitability groups that have identical first and second parts in their identifying symbol. Soils in woodland suitability group 2w1, for example, require somewhat different management than soils in group 2w2.

In table 5 each woodland suitability group in the county is rated for various management hazards or limitations. These ratings are slight, moderate, or severe, and they are described in the following paragraphs.

TABLE 3.—*Rating-yield per acre conversion table*

[The symbol > means more than]

Rating	Corn		Wheat	Oats	Hay	
	Grain	Silage			Alfalfa	Mixed hay
	Bu	*Tons*	*Bu*	*Bu*	*Tons*	*Tons*
(1) 1	50–60	10–12	10–15	35–40	1.0–1.5	1.2–1.5
2	60–70	12–14	15–20	40–45	1.5–2.0	1.5–1.8
3	70–80	14–16	20–25	45–50	2.0–2.5	1.8–2.0
4	80–90	16–18	25–30	50–55	2.5–3.0	2.0–2.2
5	90–100	18–20	30–35	55–60	3.0–3.5	2.2–2.5
6	100–110	20–22	35–40	60–65	3.5–4.0	2.5–2.8
7	110–120	22–24	40–45	65–70	4.0–4.5	2.8–3.0
8	120–130	24–26	45–50	70–75	4.5–5.0	3.0–3.2
9	130–140	26–28	50–55	75–80	5.0–5.5	3.2–3.5
10	>140	>28	>55	>80	>5.5	>3.5

[1] A rating of 1 may mean a yield of less than the amount shown; for example, less than 35 bushels of oats.

TABLE 4.—*Yields from upland oaks and yellow-poplar in fully stocked, natural stands*

Site index	Age of stand	Merchantable volume			
		Upland oaks		Yellow-poplar	
	Years	*Board feet*	*Cords*	*Board feet*	*Cords*
50	30	300	6		
	40	1,300	13		
	50	2,900	19		
	70	7,400	30		
60	20				
	30	800	10	900	8
	40	2,900	19	2,400	15
	50	5,700	26	5,100	21
	70	11,600	39		
70	20			600	7
	30	1,600	15	2,400	15
	40	5,000	25	5,100	23
	50	8,800	33	10,300	31
	70	16,000	47		
80	20			1,100	10
	30	3,000	20	4,900	21
	40	7,800	31	10,200	31
	50	12,400	41	16,000	41
	70	21,000	56		
90	20			1,800	13
	30	4,600	24	7,800	27
	40	10,800	37	14,800	39
	50	16,000	48	22,100	52
	70	26,200	65		
100	20			3,100	17
	30			11,000	32
	40			19,600	47
	50			29,100	62
	70				

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

Plant competition is the degree to which undesirable plants invade opening in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. Conifers and hardwoods are rated separately in table 5. *Slight* means that plant competition does not prevent adequate natural regeneration and early growth or interfere with seedling development; *moderate* means that competition delays natural or artificial establishment and growth rate but does not prevent the development of fully stocked normal stands; and *severe* means that competition prevents adequate natural or artificial regeneration unless the site is prepared properly and such maintenance practices as burning, spraying, disking, or girdling are used.

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

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

Table 5 lists suitable species to favor in existing stands and suitable species for planting. The estimated site index in table 5 is the height, in feet, that the dominant or codominant trees reach at 50 years of age on the soils of each group.

Wildlife habitat[2]

Somerset County has abundant and varied wildlife resources enjoyed by residents and visitors throughout the year. The welfare of a wildlife species depends largely on the amount and distribution of food, shelter, and water (*1*). If any of these elements is missing, inadequate, or inaccessible, the species is absent or scarce. The kinds of wildlife that live in a given area and the number of each kind are closely related to land use, to the resulting kinds and patterns of vegetation, and to the supply and distribution of water. These, in turn, are generally related to the kinds of soil.

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

This section rates the soils of Somerset County according to their suitability for seven elements of wildlife habitat and three kinds of wildlife. Then it explains the elements and the classes of wildlife and explains the ratings.

Uses of suitability ratings

The suitability ratings in this section evaluate some of the important factors necessary to produce desired populations of wildlife. They can be used as an aid in:

1. Planning the broad use of parks, refuges, nature-study areas, and other recreational developments for wildlife.
2. Selecting the better soils for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the relative intensity of management needed for individual habitat elements.
4. Eliminating sites that would be difficult or unfeasible to manage for specific kinds of wildlife.
5. Determining areas that are suitable for acquisition for use by wildlife.

Other important factors, such as present land use and existing wildlife populations, require onsite investigation for their evaluation and could not be considered in these interpretations. Soil suitability interpretations presented in this section must be used with other information and a knowledge of habitat requirements of wildlife species in planning specific developments.

[2] By EUGENE WHITAKER, biologist, Soil Conservation Service.

Elements of wildlife habitat

Each soil is rated in table 6 according to its suitability for various kinds of plants and other elements that make up wildlife habitat. The seven elements considered important are described in the paragraphs that follow.

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

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

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

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

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

Coniferous woody plants.—This element consists of cone-bearing evergreen trees and shrubs that are used by wildlife mainly as cover, although they also provide browse and seeds or fruitlike cones. Among them are Norway spruce, shortleaf pine, Scotch pine, redcedar, and juniper. Generally the plants are established naturally in areas where cover of weeds and sod is thin, but they may also be planted. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, and natural soil drainage.

Wetland food and cover plants.—Making up this group are wild, herbaceous, annual and perennial plants that grow on moist to wet sites. They produce food and cover extensively used mainly by wetland forms of wildlife. They include smartweed, wild millet, bulrush and other sedges, arrowarum, pickerelweed, waterwillow, wetland grasses, and cattails. Not included are submerged or floating aquatics. The major soil properties affecting this habitat element are natural soil drainage, surface stoniness, slope, and texture of the surface layer.

Shallow-water areas.—These are impoundments or excavations that provide areas of shallow water, generally not exceeding 5 feet in depth, near food and cover for wetland wildlife. Examples of such developments are shallow dugouts, level ditches, blasted potholes, and devices that keep the water 6 to 24 inches deep in marshes. The major soil properties affecting this habitat element are depth to bedrock, natural soil drainage, slope, soil permeability, and surface rockiness or stoniness.

Farm ponds of the impounded type and excavated or dugout type are not considered as a habitat element; however, they can be important for recreational activities, including fishing, and may also be a source of water for wildlife. If stocked with fish, such impoundments should be at least 6 feet deep over part of the area.

The ratings assigned to the soils on the basis of their suitability for the various wildlife habitat elements may be explained as follows:

On soils rated *good,* conditions are favorable for the establishment, maintenance, and vigorous growth of a wide variety of climatically adapted species, including those requiring annual planting, and expected growth rates and seed production are above average. For shallow-water areas a rating of *good* means soil conditions are favorable for natural wet areas that remain ponded for long periods or for the construction and maintenance of shallow-water areas requiring control of the water level.

On soils rated *fair,* conditions are generally favorable for climatically adapted species, but some management, such as protection from erosion, fertilization, or periodic renovation, is needed—especially for annuals. Expected growth rates and seed production are about average, but may be high for certain species. For shallow-water areas, a rating of *fair* means soil conditions either somewhat limit natural wet areas because of unreliable water levels, or they present difficulties in creating or maintaining shallow-water areas.

On soils rated *poor,* conditions severely limit the number of species and make planning, renovation, and management difficult. Expected growth rates and seed production are below average except for one or two species, and perennials of low food value may dominate wetland soils. For shallow-water areas, a rating of *poor* means soil conditions severely limit the choice of measures, present serious construction problems, or are major difficulties in maintaining desired water control.

On soils rated *very poor,* conditions are such that few or no species that are of value to wildlife can be established or will grow naturally except with very intensive and usually impractical management. Wetland plants do not grow on soils rated *very poor,* and soil conditions for shallow-water areas make it impossible or impractical to obtain sufficient water control to be of value to wildlife.

Classes of wildlife

Table 6 rates the soils according to their suitability for three kinds of wildlife in the county—openland, woodland, and wetland wildlife.

Openland wildlife.—Examples of openland wildlife are

TABLE 5.—*Woodland*

[Urban land (Um) is not assigned to a woodland

Woodland suitability group and mapping-unit symbols	Estimated average site index	Suitable species—	
		To favor in existing stands	For planting
Group 1w1: Deep, poorly drained soils; high available water capacity; slopes range from 0 to 2 percent. Bt, La, Wc.	Pin oak, 85 or more.	Pin oak, sycamore, red maple.	White pine, white spruce.
Group 2o1: Deep, well-drained soils; high or moderate available water capacity; slopes range from 0 to 35 percent. ArB, ArC, BdA, BdB, BdC, BuB, BuC2, DnA, DnB, DnC, Dw, EdB, EdC, EdD, MeB, MeC, NeB, NeC, NhE, NkC, NkD, NmB, NmC, PlC, PlD, QkC, QkD, RyB.	Upland oaks, 75–85; yellow-poplar, 85–95.	Yellow-poplar, red oak, ash.	White pine, yellow-poplar, black walnut, Austrian pine, Norway spruce, larch.
Group 2w1: Deep, moderately well drained and somewhat poorly drained soils on uplands; high or moderate available water capacity; slopes range from 0 to 12 percent. AmB, AmC, AnB, AnC, BaC, CaB, CcB, KfA, KfB, LeB, LeC, MoB, MpC, MuB, WhA.	Upland oaks, 75–85; yellow-poplar, 85–95.	Red oak, yellow-poplar, ash, Virginia pine.	White pine, Norway spruce, yellow-poplar.
Group 2w2: Deep, moderately well drained or somewhat poorly drained soils on flood plains; subject to occasional or frequent flooding; slopes range from 0 to 2 percent. FL, Ro, UD.	Upland oaks, 75–85.	Red oak, ash, pin oak	Pin oak, white pine
Group 3o1: Deep or moderately deep, well-drained soils; low to high available water capacity; slopes range from 0 to 18 percent. NoA, NoB, NoC, NoC2, PmA, PmB, PmC, PnB, PnC, RhC.	Upland oaks, 65–75.	Red oak	White pine, red pine, Virginia pine, shortleaf pine.
Group 3f1: Deep, well-drained soils containing much gravel and cobbles; low available water capacity; slopes range from 3 to 15 percent. PbC.	Upland oaks, 65–75.	Red oak, yellow-poplar, black oak, scarlet oak.	White pine, larch, Austrian pine, Norway spruce.
Group 3w1: Deep, moderately well drained, somewhat poorly drained, and poorly drained soils; moderate or high available water capacity; slopes range from 0 to 18 percent. AbA, AbB, CdB, CdC, CeB, CeC, CeE, CpB, CrA, CrB, Ek, LbA, LbB, LhB, LhC, Ph, Pk, RbA, RcB.	Upland oaks, 65–75; yellow-poplar, 75–85.	Red oak, ash, pin oak, yellow-poplar.	White pine, larch, Norway spruce, white spruce; for Cokesbury and Croton soils use only white pine or white spruce.
Group 3x1: Deep, rocky or very stony, somewhat excessively drained soils; moderate or low available water capacity; slopes range from 15 to 40 percent. PcE, PeD.	Upland oaks, 65–75.	Upland oaks, yellow-poplar.	White pine, yellow-poplar.
Group 4d1: Shallow, excessively drained, shaly soils; low available water capacity; slopes range from 2 to 35 percent. KlC, KlD, KlE.	Upland oaks, 55–65; Virginia pine, 55–65.	Black oak, chestnut oak	Virginia pine, black oak, chestnut oak.
Group 4w1: Moderately deep, moderately well drained and somewhat poorly drained soils; slopes range from 0 to 6 percent. ReA, ReB.	Upland oaks, 55–65; Virginia pine, 55–65.	Red oak, Virginia pine, redcedar.	Virginia pine, white pine

pheasant, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. These birds and mammals normally make their homes in areas of cropland, pasture, meadow, and lawns and in areas overgrown with grasses, herbs, and shrubs.

About 60 percent of the soils in the county are naturally *good* for the development of habitat for openland wildlife. Examples of these are the generally better farm soils, such as Birdsboro soils, and the gently sloping phases of Penn soils. Another 20 percent of the soils are rated *fair*, including soils that have poor drainage, such as Croton soils and the steeper phases of the Edneyville and other deep soils, on which some difficulties are to be expected in establishing and maintaining annual food plants. About 20 percent of the soils are rated *poor* for development of openland wildlife habitat. These soils include those that are steep, very stony, rocky, shallow, and subject to frequent flooding. No soils in Somerset County are rated *very poor* for openland wildlife habitat.

Woodland wildlife.—Among the birds and mammals that prefer woodland are woodcock, thrushes, vireos, scarlet tanager, woodpeckers, gray and red squirrels, gray fox, white-tailed deer, and raccoon. They obtain food and cover in stands of hardwoods, coniferous trees, or shrubs, or a mixture of these plants.

Somerset County's deep and moderately deep soils that

suitability grouping of soils

suitability group and is not included in this table]

Seedling mortality	Plant competition	Equipment limitations	Erosion hazard	Windthrow hazard
Severe	Severe	Severe	Slight	Slight or moderate.
Slight	Moderate for conifers Severe for hardwoods.	Moderate for EdD and NhE. Slight for others.	Moderate for EdD, NhE, and QkD. Slight for others.	Slight.
Slight	Moderate for hardwoods Severe for conifers.	Slight or moderate	Slight	Slight.
Slight	Moderate for hardwoods Severe for conifers.	Moderate	Slight	Slight.
Slight	Slight for hardwoods Moderate for conifers.	Slight	Slight	Slight.
Moderate	Slight	Slight	Slight	Slight.
Severe for Cokesbury and Croton soils. Slight for others	Moderate or severe for conifers. Slight to severe for hardwoods.	Moderate or severe	Slight	Slight or moderate.
Slight	Severe	Slight	Moderate	Slight.
Slight for KIC and KID Moderate for KIE.	Slight	Moderate	Slight	Slight.
Slight	Moderate	Moderate	Severe for conifers Moderate for hardwoods.	Slight.

have moderate or high available water capacity, such as Neshaminy and Penn soils, are rated *good* (about 90 percent of the county) for development of woodland habitat. Approximately 10 percent of the soils are rated *fair,* including the poorly drained Croton soils. No soils in the county are rated *poor* or *very poor* for woodland wildlife habitat.

Wetland wildlife.—Ducks, geese, herons, shore birds, mink, and muskrat are familiar examples of birds and mammals that normally make their homes in wet areas, such as ponds, marshes, and swamps.

Most of Somerset County, or about 80 percent, is not suited to the development of habitat for wetland wildlife. The nearly level, poorly drained soils (about 3 percent), such as Croton soils and Parsippany very poorly drained variant, are rated *good.* Poorly drained soils that have a slight slope, such as Bowmansville, Elkton, and Watchung soils, make up the 16 percent rated *fair* for wetland habitat. Only 1 percent of the county's soils are rated *poor* for this use.

Each rating under "Kinds of Wildlife" in table 6 is based on the ratings listed for the habitat elements in the first part of the table. For openland wildlife the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous plants, and hardwood and coniferous trees. The rating for woodland

TABLE 6.—*Suitability ratings of the soils for wildlife habitat and for kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat						Classes of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood and coniferous woody plants	Wetland food and cover plants	Shallow-water areas	Openland	Woodland	Wetland
Abbottstown:									
AbA	Fair	Good	Good	Good	Fair	Poor	Good	Good	Good.
AbB	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Amwell:									
AmB, AmC, AnB, AnC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Arendtsville:									
ArB	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
ArC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Bartley: BaC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Birdsboro:									
BdA, BdB	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
BdC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Bowmansville: Bt	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Bucks:									
BuB	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
BuC2	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Califon:									
CaB	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
CcB	Very poor.	Poor	Good	Good	Poor	Very poor.	Poor	Good	Very poor.
Chalfont:									
CdB, CdC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
CeB, CeC, CeE	Poor	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Cokesbury: CpB	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
Croton:									
CrA	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
CrB	Poor	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Dunellen:									
DnA, DnB	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
DnC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Dunellen variant: Dw	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Edneyville:									
EdB, EdC	Fair	Good	Good	Fair	Poor	Very poor.	Good	Fair	Very poor.
EdD	Poor	Fair	Good	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Elkton: Ek	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Fluvaquents: FL	Very poor.	Poor	Poor	Fair	Good	Fair	Poor	Fair	Fair.
Keyport:									
KfA	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
KfB	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Klinesville: KlC, KlD, KlE	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Good	Very poor.
Lamington: La	Poor	Fair	Fair	Fair	Good	Poor	Fair	Fair	Fair.
Lansdowne:									
LbA	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
LbB	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Lawrenceville:									
LeB	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
LeC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Lehigh: LhB, LhC	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

TABLE 6.—*Suitability ratings of the soils for wildlife habitat and for kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat						Classes of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood and coniferous woody plants	Wetland food and cover plants	Shallow-water areas	Openland	Woodland	Wetland
Meckesville:									
MeB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
MeC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Mount Lucas:									
MoB, MpC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
MuB	Very poor	Poor	Good	Good	Poor	Very poor	Poor	Good	Very poor.
Neshaminy:									
NeB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
NeC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
NhE, NkD	Very poor	Poor	Good	Good	Very poor	Very poor	Poor	Good	Very poor.
NkC	Very poor	Poor	Good	Good	Poor	Very poor	Poor	Good	Very poor.
Neshaminy variant:									
NmB, NmC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Norton:									
NoA, NoB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
NoC, NoC2	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Parker:									
PbC	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Good	Very poor.
PcE	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Good	Very poor.
PeD	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Good	Very poor.
Parsippany: Ph	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Parsippany variant: Pk	Poor	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Pattenburg:									
PlC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
PlD	Fair	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Penn: PmA, PmB, PmC, PnB, PnC.	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Quakertown:									
QkC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
QkD	Fair	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Raritan: RbA	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Readington: RcB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Reaville:									
ReA	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
ReB	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Riverhead: RhC	Poor	Fair	Fair	Poor	Poor	Very poor	Fair	Good	Very poor.
Rowland: Ro	Poor	Fair	Fair	Good	Fair	Fair	Fair	Good	Fair.
Royce: RyB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Udifluvents and Ochrepts: UD	Very poor	Poor	Poor	Good	Fair	Fair	Poor	Fair	Fair.
Urban land: Um. Too variable to be rated.									
Watchung: Wc	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Whippany: WhA	Fair	Good	Good	Good	Fair	Poor	Good	Good	Poor.

wildlife is based on the ratings listed for grasses and legumes, wild herbaceous plants, and hardwood and coniferous trees. For wetland wildlife the rating is based on the ratings shown for wetland food and cover plants and shallow-water areas.

On soils rated *good,* habitat is generally easily created, improved, or maintained. There are few or no soil limitations on habitat management, and satisfactory results are well assured.

On soils rated *fair,* habitat usually can be created, improved, or maintained; but the soils have moderate limitations that affect the creation, improvement, or maintenance of the habitat. A moderate intensity of management and fairly frequent attention may be required to assure satisfactory results.

On soils rated *poor,* habitat can usually be created, improved, or maintained, but soil limitations are rather severe. Habitat management may be difficult and expensive and may require intensive effort. Satisfactory results are questionable.

On soils rated *very poor,* it is impractical to create, improve, or maintain habitat because of the very severe soil limitations. Unsatisfactory results are most likely.

Not considered in the ratings are present land use, the location of a soil in relation to other soils, and the mobility of wildlife. When planning a specific area, the rating must be used with the ratings for the specific elements and information from onsite evaluation.

Engineering Uses of the Soils[3]

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

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

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

1. Select potential residential, industrial, commercial, and recreational uses.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 7, 8, and 9, which show, respectively, estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 8 and 11, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meanings to soil scientists that are not known to all engineers. Many of these terms commonly used in soil science are defined in the Glossary.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*13*) used by the Soil Conservation Service, Department of Defense, and other agencies, and the AASHTO system (*2*) adopted by the American Association of State Highway and Transportation Officials.

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

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups that range from A-1 to A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b; A-2-4, A-2-5, A-2-6, A-2-7; and A-7-5 and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 9; the estimated classification, without

[3] DONALD W. HASLEM, engineer, Soil Conservation Service, and others prepared this section.

group index numbers, is given in table 7 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

Soil properties significant to engineering

Several estimated soil properties significant in engineering are given in table 7. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kind of soil in other counties. Following are explanations of some of the columns in table 7.

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

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

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

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state, and the liquid limit is the moisture content at which it changes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 7, but in table 9 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 7 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

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

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

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

Test data

All engineering test data in this survey are from sampling and testing by the College of Engineering, Rutgers University (*6, 7*). Table 9 contains engineering test data for some of the major soil series in Somerset County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Moisture-density or compaction data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density.* As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 7.

Engineering interpretations

The estimated interpretations in table 8 are based on the engineering properties of soils shown in table 7, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Somerset County. In table 8 ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 8 lists those soil features not to be overlooked in planning, installation, and maintenance.

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

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such other series that appear in the first column of this table. Absence of data indicates that soil is too vari

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Abbottstown: AbA, AbB	3½–4½	½–1½	0–9	Silt loam	ML or CL	A-4 or A-6	0–2
			9–19	Silt loam, silty clay loam	ML or CL	A-4 or A-6	0–2
			19–35	Silt loam	ML or CL	A-4 or A-6	0–2
			35–48	Shaly silt loam	ML, CL, SM, or SC	A-4 or A-6	0–5
			48	Red shale bedrock.			
Amwell: AmB, AmC, AnB, AnC.	3½–>5	1–4	0–14	Gravelly loam	ML or CL	A-4 or A-6	0–10
			14–21	Clay loam	ML or CL	A-4 or A-6	0–10
			21–36	Loam	ML, CL, GM, or GC	A-4 or A-6	0–10
			36–60	Fine sandy loam	SM, SC, ML, CL, GM, or GC	A-4	0–10
Arendtsville: ArB, ArC	>5	>4	0–15	Gravelly loam	ML, CL, SM, or SC	A-4 or A-6	0–5
			15–43	Gravelly loam, gravelly sandy clay loam.	ML or CL	A-4, A-5, A-6, or A-7	0–5
			43–60	Gravelly sandy loam	GM or SM	A-2 or A-4	5–10
Bartley: BaC	>4	2–4	0–15	Loam	ML or CL	A-4 or A-6	0–5
			15–25	Loam	ML or CL	A-4 or A-6	0–5
			25–43	Clay loam	ML, CL, SM, or SC	A-4 or A-6	0–10
			43–50	Loam	SM or SC	A-2, A-4, or A-5	0–5
			50	Limestone bedrock.			
Birdsboro: BdA, BdB, BdC	>5	>4	0–12	Silt loam	ML or CL	A-4 or A-6	0–2
			12–38	Silt loam, silty clay loam	ML or CL	A-4 or A-6	0–2
			38–56	Sandy loam	SM or SC	A-2 or A-4	0–2
			56–70	Stratified sand and gravel	SM, GM, SC, or GC	A-2	0–1
Bowmansville: Bt	3½–>5	0–1 (Very frequently flooded.)	0–17	Silt loam	ML or CL	A-4 or A-6	0–5
			17–47	Clay loam, sandy clay loam, fine sandy loam.	ML, CL, SM, or SC	A-4 or A-6	0–5
			47–60	Stratified sand and gravel	SM, GM, SC, GC, GW-SM, GP-GM, SP-SM, or SW-SM	A-1 or A-2	0–5
Bucks: BuB, BuC2	3½–>5	>4	0–25	Silt loam	ML or CL	A-4	----------
			25–35	Silt loam	ML or CL	A-4	----------
			35–44	Shaly silt loam	GM, SM, ML, or CL	A-2 or A-4	5–15
			44	Shale bedrock.			
Califon: CaB, CcB	>5	½–2½	0–11	Gravelly loam	ML or CL	A-4 or A-6	0–10
			11–22	Loam	ML, CL, SC, or SM	A-4 or A-6	0–10
			22–52	Loam	SM, SC, ML, or CL	A-4 or A-6	0–10
			52–65	Gravelly sandy loam	SM, SC, ML, or CL	A-2 or A-4	0–10
Chalfont: CdB, CdC, CeB, CeC, CeE.	3½–>5	½–1½	0–15	Silt loam	ML or CL	A-4 or A-6	0–5
			15–40	Silt loam	ML or CL	A-4 or A-6	0–5
			40–50	Silt loam	ML or CL	A-4	0–10
			50	Argillite bedrock.			

significant to engineering

mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to able to be rated or that no estimate was made. The symbol > means greater than; < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit[1]	Plasticity index[2]	Permeability	Available water capacity	Reaction[3]	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
						Inches per hour	*Inches per inch of soil*	*pH*	
95–100	90–100	80–95	70–90	20–35	5–15	0.6–2.0	[4]0.18–0.22	4.5–5.0	Low.
95–100	90–100	85–95	70–85	20–35	5–15	0.2–0.6	0.18–0.22	4.5–5.0	Low.
95–100	80–90	70–90	60–80	20–35	5–15	<0.2	0.10–0.14	5.1–6.0	Low.
80–100	70–90	60–80	45–70	20–35	5–15	0.2–0.6	0.10–0.14	5.1–6.0	Low.
85–95	75–85	60–80	50–80	20–35	8–12	0.2–2.0	0.14–0.17	5.1–6.0	Low.
75–95	75–85	70–80	55–80	25–35	8–12	0.2–2.0	0.13–0.17	5.1–6.0	Low to moderate.
65–95	50–80	40–80	35–60	25–35	5–15	<0.2	0.08–0.12	5.1–6.5	Low.
65–95	65–80	40–80	35–55	20–30	5–10	2.0–6.0	0.08–0.12	5.1–6.5	Low.
75–95	70–90	55–80	45–70	20–35	5–15	2.0–6.0	0.13–0.17	<4.5–5.5	Low.
85–95	80–90	65–80	50–75	20–50	5–25	0.6–6.0	0.13–0.17	4.5–5.5	Low.
60–75	40–75	40–70	30–50	10–20	NP–5	2.0–6.0	0.05–0.10	4.5–5.5	Low.
95–100	85–95	75–95	60–90	30–50	5–20	0.6–2.0	[4]0.16–0.20	6.1–6.5	Moderate.
95–100	85–95	80–90	65–75	25–45	5–20	0.6–2.0	0.14–0.18	6.1–6.5	Moderate.
90–100	85–95	65–75	40–55	20–40	5–20	0.2–0.6	0.08–0.12	6.6–7.3	Low.
95–100	85–95	70–80	30–50	25–45	5–10	0.6–2.0	0.08–0.12	6.6–7.3	Low.
95–100	85–100	85–100	50–90	25–35	5–12	0.6–2.0	0.20–0.26	4.5–5.5	Low.
90–100	85–100	80–100	50–95	25–35	5–15	0.6–2.0	0.14–0.20	4.5–5.5	Low.
90–100	85–100	80–90	30–50	20–30	5–10	0.6–6.0	0.10–0.14	4.5–5.5	Low.
50–100	50–80	30–70	10–30	NL–10	NP–5	2.0–>6.0	0.06–0.10	4.5–5.5	Low.
95–100	90–100	90–100	75–95	20–30	NP–10	0.6–2.0	[4]0.20–0.26	4.5–5.5	Low.
95–100	90–100	80–100	35–95	25–35	5–15	0.2–0.6	0.20–0.24	4.5–6.0	Low.
40–100	40–100	40–80	5–30	10–20	NP–10	2.0–>6.0	0.03–0.10	4.5–6.0	Low.
95–100	95–100	90–100	60–90	25–35	4–10	0.2–2.0	0.18–0.24	4.5–5.5	Low.
80–100	70–100	70–100	60–95	25–35	4–10	0.2–2.0	0.18–0.24	4.5–5.5	Low.
60–90	60–80	20–80	15–70	20–30	2–10	0.2–2.0	0.08–0.16	4.5–5.5	Low.
80–100	75–90	70–80	50–70	20–30	8–12	0.6–2.0	[4]0.13–0.17	4.5–5.5	Low.
85–100	75–90	65–80	45–80	25–35	5–12	0.6–2.0	0.13–0.17	4.5–5.5	Moderate.
85–100	75–90	60–80	40–80	20–30	5–12	<0.2	0.06–0.10	4.5–5.5	Low.
85–95	75–90	60–90	30–70	15–25	5–10	0.6–2.0	0.06–0.10	4.5–5.5	Low.
90–100	90–100	75–100	70–95	25–40	5–15	0.2–2.0	[4]0.20–0.24	4.5–5.5	Low.
90–100	90–100	80–100	70–95	25–40	5–15	<0.2	0.08–0.12	4.5–5.5	Low.
80–100	70–90	70–80	60–80	25–35	5–10	0.2–2.0	0.08–0.12	4.5–5.5	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Cokesbury: CpB	>5	0–1	0–10	Gravelly loam	ML or CL	A-4 or A-6	0–10
			10–21	Clay loam	ML or CL	A-4 or A-6	0–10
			21–32	Loam	ML or CL	A-4 or A-6	0–10
			32–62	Gravelly sandy loam	SM, SC, ML, or CL	A-4, A-6, or A-2	5–10
Croton: CrA, CrB	3½–5	0–1	0–14	Silt loam	ML or CL	A-4 or A-6	0–2
			14–19	Silt loam, silty clay loam	ML or CL	A-4 or A-6	0–2
			19–33	Silty clay loam	ML or CL	A-4 or A-6	0–2
			33–42	Shaly clay loam	ML or CL	A-4 or A-6	0–5
			42	Red shale bedrock.			
Dunellen: DnA, DnB, DnC	>5	>4	0–14	Sandy loam	SM or SC	A-2 or A-4	0–2
			14–42	Sandy loam	SM, SC, ML, or CL	A-4 or A-2	0–2
			42–70	Loamy sand	SM	A-1 or A-2	0–10
Dunellen variant: Dw	>5	½–4	0–14	Sandy loam	SM or SC	A-2 or A-4	0–2
			14–36	Sandy loam	SM, SC, ML, or CL	A-2 or A-4	0–2
			36–60	Sandy loam	SM, ML, SC, or CL	A-2 or A-4	0–2
Edneyville: EdB, EdC, EdD	3½–>5	>4	0–11	Gravelly loam	SM, SC, ML, or CL	A-2 or A-4	0–2
			11–39	Gravelly loam, gravelly sandy clay loam.	SM, SC, ML, or CL	A-4 or A-6	0–5
			39–65	Gravelly sandy loam, sandy loam.	SM or SC	A-2 or A-4	0–5
			65	Granite bedrock.			
Elkton: Ek	>5	0–1	0–10	Silt loam	ML or CL	A-4 or A-6	0
			10–38	Silty clay loam, silty clay	CL, MH, CH, or ML	A-6 or A-7	0
			38–63	Silty clay loam	SM, SC, CL, CH, ML, or MH	A-6 or A-7	0
Fluvaquents: FL. Most properties are too variable to be estimated.	>6	0–1					
Keyport: KfA, KfB	>8	1½–4	0–14	Silt loam	ML or CL	A-4 or A-6	0
			14–46	Clay loam	ML, CL, MH, or CH	A-6 or A-7	0
			46–60	Clay loam	ML, CL, MH, CH, SM, or SC	A-4, A-5, A-6, or A-7	0
Klinesville: KlC, KlD, KlE	1–1½	>4	0–7	Shaly loam	ML, CL, SM, or SC	A-2, A-4, or A-6	0–10
			7–18	Shaly loam	GM, GP, SM, SC, ML, CL, or GC	A-1, A-2, or A-4	10–30
			18	Weathered red shale bedrock.			
Lamington: La	>5	0–1	0–10	Silt loam	ML or CL	A-4 or A-6	0
			10–23	Silt loam, silty clay loam	ML or CL	A-4, A-6, or A-7	0
			23–45	Clay loam	ML or CL	A-4 or A-6	0
			45–60	Stratified sand, silt loam	SM	A-2	0

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit[1]	Plasticity index[2]	Permeability	Available water capacity	Reaction[3]	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
						Inches per hour	*Inches per inch of soil*	*pH*	
90–100	75–85	65–85	50–80	25–35	8–12	0.6–2.0	0.12–0.16	4.5–5.5	Low.
85–100	75–95	70–80	50–70	25–35	5–12	0.6–2.0	0.16–0.20	4.5–5.5	Low.
85–100	75–95	70–85	50–70	25–35	5–12	<0.2	0.08–0.12	4.5–5.5	Moderate.
80–95	65–80	60–75	30–60	20–30	5–12	0.6–2.0	0.08–0.12	4.5–5.5	Low.
90–100	90–100	70–100	70–90	20–40	5–15	0.2–2.0	0.20–0.26	4.5–6.0	Low.
90–100	90–100	75–100	70–90	20–40	5–15	0.2–0.6	0.20–0.24	4.5–6.0	Moderate.
90–100	90–100	85–95	70–90	30–50	5–25	<0.2	0.06–0.10	4.5–6.0	Moderate.
80–100	65–80	65–80	60–80	20–40	5–20	0.2–0.6	0.06–0.10	4.5–6.0	Low.
85–100	85–100	60–80	30–40	15–30	5–10	2.0–6.0	0.12–0.15	5.1–5.5	Low.
95–100	80–95	65–80	30–60	20–30	5–10	0.6–2.0	0.10–0.14	5.1–5.5	Low.
70–95	50–95	30–60	15–30	[1] NL	[2] NP	>6.0	0.05–0.10	5.5–6.0	Low.
95–100	95–100	60–70	30–40	20–30	5–10	0.6–2.0	0.14–0.16	5.1–6.0	Low.
95–100	95–100	60–80	30–55	20–30	5–10	0.6–2.0	0.10–0.18	5.1–6.0	Low.
95–100	90–100	60–90	30–60	20–30	5–10	0.6–2.0	0.10–0.16	5.1–6.0	Low.
75–90	70–80	45–70	30–60	25–40	5–12	0.6–2.0	0.16–0.20	4.5–5.5	Low.
75–95	60–75	50–65	35–55	25–40	5–15	0.6–2.0	0.12–0.16	4.5–5.5	Low.
70–90	65–85	50–65	30–45	20–35	3–10	2.0–6.0	0.12–0.16	4.5–6.0	Low.
95–100	90–100	85–100	60–90	20–40	5–15	0.2–2.0	0.16–0.20	<4.5–5.0	Low.
95–100	90–100	85–100	70–100	30–60	5–35	<0.2	0.14–0.18	4.5–5.0	Moderate.
90–100	90–100	70–100	40–100	25–60	5–35	<0.2	0.12–0.16	4.5–5.0	Moderate.
95–100	95–100	85–95	60–85	20–40	5–15	0.2–2.0	0.16–0.20	<4.5–5.0	Low.
95–100	90–100	85–95	65–90	30–60	10–25	<0.2	0.12–0.18	4.5–5.0	Moderate.
90–100	85–100	80–95	40–80	20–60	5–15	<0.2–0.6	0.12–0.16	4.5–5.0	Moderate.
50–85	50–85	40–65	25–55	25–40	3–15	2.0–6.0	0.11–0.15	4.5–5.5	Low.
30–85	30–85	10–70	5–55	20–40	0–10	2.0–6.0	0.08–0.12	4.5–6.0	Low.
95–100	90–100	80–95	75–90	20–35	5–12	0.6–2.0	0.22–0.26	4.5–5.5	Low.
95–100	90–100	80–95	70–95	20–40	5–20	0.6–2.0	0.15–0.20	4.5–5.5	Moderate.
95–100	90–100	80–90	60–80	20–30	5–15	<0.2	0.06–0.10	4.5–5.5	Moderate.
95–100	90–100	60–80	15–30	NL–10	NP–5	2.0–>6.0	0.05–0.08	4.5–5.5	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Lansdowne: LbA, LbB	>3½	1–2½	0–9	Silt loam	ML or CL	A-4 or A-6	0–5
			9–44	Silty clay loam, silty clay, clay.	ML or CL	A-6 or A-7	0–5
			44–55	Shaly clay loam	ML, CL, SM, or SC	A-4	5–10
			55	Red shale bedrock.			
Lawrenceville: LeB, LeC	4–>5	1½–4	0–15	Silt loam	ML or CL	A-4 or A-6	0
			15–31	Silt loam	ML or CL	A-4 or A-6	0
			31–48	Silt loam	ML or CL	A-4 or A-6	0
			48	Shale bedrock.			
Lehigh: LhB, LhC	3½–5	½–4	0–12	Silt loam	ML or CL	A-4 or A-6	0–5
			12–34	Silt loam, shaly silty clay loam.	ML or CL	A-4 or A-6	0–5
			34–45	Very shaly silt loam	GM or GC	A-2, A-4, or A-6	0–20
			45	Metamorphosed shale.			
Meckesville: MeB, MeC	4–>5	1½–4	0–11	Gravelly loam, loam	ML or CL	A-4	0–5
			11–26	Clay loam	ML or CL	A-4 or A-6	0–5
			26–45	Clay loam	ML or CL	A-4 or A-6	0–5
			45–50	Loam	ML or CL	A-4	0–5
			50–60	Gravelly and cobbly conglomerate.			
*Mount Lucas: MoB, MpC, MuB. For Watchung part of MuB, see Watchung series.	4–6	1–4	0–8	Silt loam	ML or CL	A-4 or A-6	0–15
			8–35	Silt loam, silty clay loam	ML or CL	A-4 or A-6	0–15
			35–56	Cobbly loam	SM, SC, ML, or CL	A-2, A-4, or A-6	0–5
			56	Fractured basalt bedrock.			
*Neshaminy: NeB, NeC, NhE, NkC, NkD. For Mount Lucas parts of NkC and NkD, see Mount Lucas series.	4–>5	>5	0–14	Silt loam, gravelly silt loam	ML or CL	A-4 or A-6	0–10
			14–46	Gravelly silt loam, gravelly clay loam.	ML or CL	A-4 or A-6	0–15
			46–96	Cobbly loam	SM, SC, ML, or CL	A-6 or A-4	0–10
			96	Fractured basalt bedrock.			
Neshaminy variant: NmB, NmC.	3½–4½	2–>5	0–15	Silt loam	ML or CL	A-4 or A-6	0–2
			15–32	Silt loam	ML or CL	A-4 or A-6	0–3
			32–40	Cobbly silt loam	ML or CL	A-4 or A-6	5–20
Norton: NoA, NoB, NoC, NoC2.	3½–>5	>5	0–10	Loam	ML or CL	A-4 or A-6	0
			10–63	Silty clay loam	ML or CL	A-4, A-6, or A-7	0
			63–70	Shaly loam	ML, CL, SM, or SC	A-4 or A-6	0–10
			70	Fractured red shale bedrock.			
*Parker: PbC, PcE, PeD For Edneyville part of PeD, see Edneyville series.	4–>5	>5	0–7	Very gravelly sandy loam	GM, GC, SM, or SC	A-1 or A-2	5–10
			7–26	Very gravelly sandy loam	GM, GC, SM, or SC	A-2	5–10
			26–50	Very cobbly sandy loam	GM, GC, SM, or SC	A-1 or A-2	10–20
			50	Fractured granite gneiss.			
Parsippany: Ph	4–>5	0	0–4	Silt loam	ML or CL	A-4, A-7, A-5, or A-6	0
			4–50	Silty clay, silty clay loam	ML or CL	A-5, A-4, A-6, or A-7	0
			50–70	Silt loam	ML or CL	A-6 or A-4	0

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit[1]	Plasticity index[2]	Permeability	Available water capacity	Reaction[3]	Shrink-swell potential
No 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
						Inches per hour	*Inches per inch of soil*	*pH*	
95–100	85–100	80–90	65–90	25–45	10–15	0.6–2.0	0.22–0.25	5.1–6.0	Low.
90–100	85–100	80–100	70–95	25–45	10–15	<0.2	0.16–0.20	5.1–6.0	Moderate.
70–95	70–90	65–75	40–60	25–45	10–15	0.6–2.0	0.14–0.18	5.1–6.0	Low.
95–100	95–100	95–100	80–90	20–35	5–12	0.6–2.0	0.20–0.24	4.5–5.5	Low.
95–100	95–100	95–100	80–90	20–35	5–12	0.6–2.0	0.18–0.22	4.5–5.5	Low.
95–100	90–100	90–100	80–90	20–35	5–12	0.2–0.6	0.10–0.18	4.5–6.0	Low.
90–100	85–95	80–90	60–85	20–35	5–12	0.2–2.0	0.22–0.26	5.1–6.0	Low.
80–90	70–90	60–80	50–80	20–40	5–15	<0.2–0.6	0.14–0.18	5.1–6.0	Low to moderate.
40–75	20–60	20–50	20–50	20–35	5–12	2.0–6.0	0.08–0.12	5.1–6.0	Low.
85–95	70–90	60–80	55–75	20–35	3–10	0.6–2.0	0.18–0.22	5.1–5.5	Low.
80–95	70–90	60–80	50–80	25–35	5–15	0.6–2.0	0.14–0.18	5.1–5.5	Moderate.
80–95	70–90	65–85	55–75	25–35	5–12	<0.2	0.06–0.10	5.1–5.5	Moderate.
90–100	70–90	70–85	50–65	20–30	5–10	0.6–2.0	0.06–0.10	5.1–5.5	Low.
90–100	80–100	80–100	60–95	20–40	5–15	0.2–2.0	0.12–0.22	5.1–6.5	Low.
95–100	85–100	70–95	55–75	20–35	5–20	0.2–0.6	0.16–0.20	5.6–6.0	Moderate.
90–100	60–80	60–80	30–55	20–35	5–15	0.6–2.0	0.10–0.18	5.6–6.0	Low.
70–100	70–100	70–95	55–90	20–40	5–15	0.6–2.0	0.20–0.27	5.1–6.0	Low.
60–100	60–100	60–95	50–90	20–40	5–20	0.2–2.0	0.18–0.24	5.6–6.0	Moderate.
70–90	60–90	55–80	40–55	20–35	5–15	0.6–2.0	0.13–0.17	5.6–6.0	Low.
80–100	75–95	70–85	50–65	20–35	5–15	0.6–2.0	0.18–0.24	5.1–6.0	Low.
80–100	75–95	70–90	55–75	20–35	5–20	0.6–2.0	0.14–0.20	5.1–6.0	Moderate.
70–90	65–85	60–80	50–65	20–35	5–15	<0.2	0.08–0.12	5.1–6.0	Low.
95–100	90–100	75–90	60–90	20–40	8–12	0.2–2.0	0.18–0.22	4.5–5.5	Low.
95–100	90–100	85–100	60–95	30–45	10–20	<0.2	0.14–0.18	4.5–6.0	Moderate.
90–100	40–100	40–70	40–65	25–40	8–12	0.2–2.0	0.10–0.15	4.5–6.0	Low.
50–70	40–70	20–50	15–30	15–25	3–10	2.0–6.0	0.05–0.10	4.5–5.5	Low.
50–65	40–65	20–55	15–30	15–25	5–10	2.0–6.0	0.05–0.10	4.5–5.5	Low.
50–65	40–45	20–30	15–25	15–25	3–10	>6.0	0.04–0.08	4.5–5.5	Low.
95–100	95–100	70–90	65–95	35–45	8–16	0.2–0.6	0.18–0.22	5.1–6.0	Low.
95–100	95–100	70–95	55–95	30–45	5–25	<0.2	0.14–0.18	5.1–6.5	Moderate.
95–100	85–100	80–95	75–90	25–45	5–10	0.2–0.6	0.14–0.18	6.1–7.3	Moderate.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Parsippany variant: Pk	>5	0	0–6	Silt loam	ML or CL	A-6, A-7, A-4, or A-5	0
			6–36	Silty clay	CL or ML	A-6 or A-7	0
			36–60	Silty clay	CL or ML	A-6 or A-7	0
Pattenburg: PIC, PID	3½–5	>5	0–12	Gravelly loam	SM or GM	A-4	0–5
			12–30	Gravelly loam	GM, GC, SM, or SC	A-2 or A-4	0–5
			30–44	Very gravelly loam	GM, GC, SM, or SC	A-1, A-2, or A-4	0–5
			44	Weathered conglomerate bedrock.			
Penn: PmA, PmB, PmC, PnB, PnC.	1½–3½	>5	0–8	Silt loam, shaly silt loam	ML or CL	A-4	0–5
			8–25	Silt loam, shaly loam	ML or CL	A-4 or A-6	0–10
			25–30	Very shaly loam	GM, GC, SM, or SC	A-2, A-4, A-1, A-5, A-6, or A-7	0–20
			30	Shale bedrock.			
Quakertown: QkC, QkD	3½–5	>5	0–13	Silt loam	ML or CL	A-4 or A-6	0–5
			13–36	Silt loam	ML or CL	A-4 or A-6	0–10
			36–45	Channery fine sandy loam	ML, CL, GM, or GC	A-6 or A-4	5–15
			45	Sandstone bedrock.			
Raritan: RbA	>5	½–3	0–15	Silt loam	ML or CL	A-4	0
			15–28	Clay loam	ML or CL	A-4 or A-6	0
			28–46	Clay loam	ML or CL	A-4 or A-6	0
			46–60	Stratified sand, loamy sand, gravel.	SM, GM, SC, or GC	A-2 or A-4	0–10
Readington: RcB	3½–>5	1½–4	0–13	Silt loam	ML or CL	A-4	0
			13–25	Silt loam	ML or CL	A-4 or A-6	0
			25–44	Silt loam, shaly silt loam	ML or CL	A-4 or A-6	0
			44	Shale bedrock.			
Reaville: ReA, ReB	1½–3½	½–3	0–12	Silt loam	ML or CL	A-4, A-5, A-6, or A-7	0
			12–21	Silty clay loam	ML or CL	A-4 or A-6	0–5
			21–27	Very shaly loam	GM or GC	A-2, A-4, or A-6	5–20
			27	Shale bedrock.			
Riverhead: RhC	>5	>5	0–10	Sandy loam	SM or SC	A-2 or A-4	0–2
			10–36	Sandy loam	SM or SC	A-2 or A-4	0–2
			36–60	Fine sand	SM or SC	A-4, A-2 or A-3	0–5
Rowland: Ro	>4	1–3	0–10	Silt loam	ML or CL	A-4 or A-6	0–2
			10–40	Silt loam	ML or CL	A-4 or A-6	0–2
			40–65	Sand, gravel	SM or SC	A-2	0–5
Royce: RyB	3½–6	>5	0–8	Silt loam	ML or CL	A-4 or A-6	0–2
			8–30	Silt loam, clay loam	ML or CL	A-6	0–2
			30–48	Shaly loam	ML or CL	A-6 or A-7	0–2
			48	Red shale bedrock.			
Udifluvents and Ochrepts: UD. Most properties too variable to be estimated.	>6	1–5					

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit[1]	Plasticity index[2]	Permeability	Available water capacity	Reaction[3]	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)			*Inches per hour*	*Inches per inch of soil*	*pH*	
95–100	95–100	70–85	65–80	35–45	8–16	0.2–0.6	0.22–0.26	5.1–6.0	Low.
95–100	95–100	85–95	70–85	35–45	12–20	<0.2	0.14–0.18	5.1–6.5	Moderate.
95–100	95–100	80–95	65–80	25–45	10–15	<0.2–0.6	0.14–0.18	6.1–7.3	Moderate.
70–95	65–85	45–80	40–50	20–30	5–10	0.6–2.0	0.14–0.18	5.1–5.5	Low.
60–85	40–75	35–60	30–45	25–35	5–10	0.6–2.0	0.12–0.16	5.1–5.5	Low.
50–80	40–65	20–55	10–45	20–30	5–10	2.0–6.0	0.05–0.15	5.1–5.5	Low.
75–100	70–95	55–95	50–90	20–40	5–10	0.6–2.0	0.14–0.26	5.1–5.5	Low.
70–100	70–90	60–90	50–90	25–40	4–12	0.6–2.0	0.12–0.24	5.1–5.5	Low.
50–85	40–60	15–55	15–50	20–45	2–15	2.0–6.0	0.05–0.12	5.1–6.5	Low.
90–100	90–100	80–95	70–95	20–40	8–12	0.6–2.0	0.18–0.25	5.1–5.5	Low.
85–100	85–100	80–90	70–90	25–35	8–12	0.2–0.6	0.14–0.22	5.1–5.5	Low.
50–90	50–80	45–75	40–70	25–35	8–12	0.2–0.6	0.10–0.18	5.1–5.5	Low.
90–100	85–100	80–90	75–90	20–30	4–8	0.6–6.0	0.20–0.28	4.5–5.5	Low.
90–100	85–100	80–90	70–80	25–35	5–12	0.2–0.6	0.20–0.25	4.5–5.5	Moderate.
95–100	85–100	85–100	70–80	25–35	5–12	0.2–0.6	0.08–0.12	4.5–6.0	Moderate.
50–95	30–90	30–60	10–40	20–30	5–10	0.6–6.0	0.05–0.20	4.5–6.0	Low.
90–100	90–100	70–100	70–85	20–35	5–10	0.6–2.0	0.20–0.26	4.5–5.0	Low.
90–100	80–90	70–90	70–90	25–40	10–20	0.6–2.0	0.20–0.24	4.5–5.5	Low.
90–100	80–90	70–90	65–85	20–30	5–15	0.2–0.6	0.10–0.14	4.5–5.5	Low.
90–100	85–100	85–95	70–90	20–50	5–15	0.6–2.0	0.18–0.24	5.1–5.5	Low.
90–100	90–100	80–95	75–90	20–35	5–15	0.2–0.6	0.12–0.20	5.1–5.5	Moderate.
50–75	35–70	30–60	25–50	20–35	5–15	0.6–2.0	0.08–0.12	5.1–6.0	Low.
90–100	90–100	75–85	30–40	20–30	5–10	2.0–6.0	0.10–0.14	4.5–5.5	Low.
90–100	90–100	70–85	30–50	20–30	5–10	2.0–6.0	0.10–0.14	4.5–5.5	Low.
85–100	85–95	60–70	10–40	NL–10	NP–5	>6.0	0.05–0.10	4.5–5.5	Low.
95–100	90–100	90–100	70–90	20–30	2–12	0.2–2.0	0.20–0.26	4.5–5.5	Low.
95–100	90–100	90–100	60–80	20–30	5–12	0.2–2.0	0.20–0.24	4.5–5.5	Low.
70–100	50–80	40–70	15–30	5–30	NP–10	2.0–6.0	0.05–0.10	4.5–6.0	Low.
90–100	85–95	70–90	60–80	20–40	8–15	0.6–2.0	0.18–0.22	4.5–5.5	Low.
85–95	80–95	70–90	55–85	20–40	12–16	0.2–0.6	0.18–0.22	4.5–5.5	Low.
60–95	60–95	60–85	55–75	30–45	12–20	0.6–2.0	0.18–0.22	4.5–5.5	Moderate.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Urban land: Um. Properties too variable to be estimated.							
Watchung: Wc	>5	0–1	0–13	Silt loam	ML or CL	A-5, A-7, A-4, or A-6	0–10
			13–36	Silty clay loam	ML or CL	A-6 or A-7	0–5
			36–60	Gravelly loam	ML or CL	A-4 or A-6	0–5
Whippany: WhA	>5	½–1½	0–10	Silt loam	ML or CL	A-4 or A-6	0–1
			10–45	Silty clay loam, silty clay	ML or CL	A-6 or A-7	0–1
			45–60	Silty clay loam	ML or CL	A-6 or A-4	0–1

[1] NL means nonliquid.
[2] NP means nonplastic.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such other series that appear in

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Reservoirs
					Pond reservoir areas
Abbottstown: AbA, AbB.	Good: seasonal high water table at a depth of ½ foot to 1½ feet.	Unsuitable: none present.	Poor: ML or CL material; seasonal high water table at a depth of ½ foot to 1½ feet limits excavation.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; high potential frost action.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; shattered bedrock may permit seepage losses.
Amwell: AmB, AmC, AnB, AnC.	Poor: excessive gravel.	Unsuitable: excessive fines.	Fair: ML or CL material.	Seasonal high water table perched at a depth of 1 foot to 4 feet; high potential frost action.	Seasonal high water table perched at a depth of 1 foot to 4 feet; fractured bedrock may permit seepage losses.
Arendtsville: ArB, ArC	Poor: excessive gravel.	Unsuitable: excessive fines.	Fair for ML or CL material. Good for GM or SM material.	Moderate potential frost action.	Permeable substratum may permit seepage losses.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit[1]	Plasticity index[2]	Permeability	Available water capacity	Reaction[3]	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
						Inches per hour	*Inches per inch of soil*	*pH*	
95–100	90–100	70–100	70–90	30–45	5–15	0.2–2.0	0.14–0.26	4.5–6.0	Low.
95–100	90–100	80–95	70–90	30–55	12–25	<0.2	0.10–0.15	5.1–6.5	Moderate.
90–100	80–90	65–85	50–80	25–40	8–15	0.2–2.0	0.12–0.24	6.1–7.3	Low.
95–100	95–100	75–90	70–80	30–40	10–15	0.6–2.0	0.18–0.26	5.1–6.0	Low.
95–100	95–100	90–100	65–90	35–45	15–20	<0.2	0.14–0.24	5.1–6.0	Moderate.
95–100	95–100	90–100	70–90	30–40	10–15	<0.2–0.6	0.14–0.20	5.6–7.3	Moderate.

[3] Unlimed soil.
[4] Additional water is available from the seasonal high water table.

interpretations of the soils

mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to the first column of this table]

Soil features affecting—Continued						
Reservoirs—Continued	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Embankments and dikes						
Fair stability and compaction characteristics; hazard of piping; limited material; bedrock at a depth of 3½ to 4½ feet.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; depth to fragipan is 15 to 25 inches.	Moderate intake rate; moderate available water capacity; drainage needed.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; depth to fragipan is 15 to 25 inches.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; water flows laterally above fragipan.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; poor trafficability.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; rippable bedrock at a depth of 3½ to 4½ feet.
Fair to poor stability and compaction characteristics; hazard of piping; bedrock at a depth of 3½ to more than 5 feet.	Seasonal high water table perched at a depth of 1 foot to 4 feet; depth to fragipan is 18 to 30 inches.	Moderately slow or moderate intake rate; moderate available water capacity; drainage needed.	Seasonal high water table perched at a depth of 1 foot to 4 feet; depth to fragipan is 18 to 30 inches.	Seasonal high water table perched at a depth of 1 foot to 4 feet; water flows laterally above fragipan.	Seasonal high water table perched at a depth of 1 foot to 4 feet; poor trafficability.	Seasonal high water table perched at a depth of 1 foot to 4 feet; hard bedrock at a depth of 3½ to more than 5 feet.
Fair stability and compaction characteristics; hazard of piping.	Not needed	Moderately rapid intake rate; moderate available water capacity; erosion hazard on ArC.	(1)	(1)	(1)	Bedrock at a depth of more than 5 feet; strong slopes in ArC.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Reservoirs: Pond reservoir areas
Bartley: BaC	Fair: moderate gravel.	Unsuitable: excessive fines.	Fair: seasonal high water table perched at a depth of 2 to 4 feet.	Seasonal high water table perched at a depth of 2 to 4 feet; moderate potential frost action.	Moderately slow permeability in fragipan; limestone bedrock may permit seepage losses.
Birdsboro: BdA, BdB, BdC.	Good	Fair: sand and gravel beds normally at a depth of 4 to 5 feet; occurrence and thickness variable.	Fair: ML, CL, or SM material to a depth of 4½ feet.	Moderate potential frost action.	Pervious substratum.
Bowmansville: Bt	Poor: poorly drained; frequent flooding.	Unsuitable: excessive fines.	Poor to fair: ML or CL material; seasonal high water table at a depth of 0 to 1 foot limits excavation; hazard of stream overflow.	Frequent flooding; seasonal high water table at a depth of 0 to 1 foot; high potential frost action.	Pervious substratum; seasonal high water table at a depth of 0 to 1 foot; frequent flooding.
Bucks: BuB, BuC2	Good	Unsuitable: none present.	Fair: ML or CL material.	Moderate potential frost action; rippable shale bedrock at a depth of 3½ to 5 feet.	Pervious bedrock may permit seepage losses.
Califon: CaB, CcB	Poor: high gravel and stone content.	Unsuitable: excessive fines.	Fair for CaB: ML or CL material. Poor for CcB: high stone content.	Moderate potential frost action; seasonal high water table perched at a depth of ½ foot to 2½ feet; CcB has high stone content.	Seasonal high water table perched at a depth of ½ foot to 2½ feet; pervious substratum may permit seepage losses; CcB has high stone content.
Chalfont: CdB, CdC, CeB, CeC, CeE.	Good for CdB or CdC. Poor for CeB, CeC, or CeE: high stone content.	Unsuitable: excessive fines.	Poor to fair for CdB or CdC: ML or CL material. Poor for CeB, CeC, or CeE: high stone content.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; bedrock at a depth of 3½ to more than 5 feet; high potential frost action.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; pervious shale bedrock at a depth of 3½ to more than 5 feet.
Cokesbury: CpB	Poor: high stone content; poorly drained.	Unsuitable: excessive fines.	Fair to poor: ML or CL material; high stone content.	Seasonal high water table perched at a depth of 0 to 1 foot; high potential frost action; high stone content.	Seasonal high water table perched at a depth of 0 to 1 foot.

of the soils—Continued

Soil features affecting—Continued						
Reservoirs—Continued Embankments and dikes	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Good stability and compaction characteristics; seasonal high water table perched at a depth of 2 to 4 feet.	Lateral seepage over fragipan; moderately slow permeability.	Moderate intake rate; moderate available water capacity.	Depth to fragipan is 24 to 36 inches.	Seasonal high water table perched at a depth of 2 to 4 feet.	Seasonal high water table perched at a depth of 2 to 4 feet.	Seasonal high water table perched at a depth of 2 to 4 feet; limestone bedrock at a depth of more than 5 feet.
Fair to poor stability and compaction characteristics; medium to low resistance to piping.	Not needed	Moderate intake rate; moderate permeability; high available water capacity.	(1)	(1)	Fair trafficability.	(1)
Fair to poor stability and compaction characteristics; low resistance to piping.	Seasonal high water table at a depth of 0 to 1 foot; moderately slow permeability; frequent flooding.	Seasonal high water table at a depth of 0 to 1 foot; moderate intake rate; drainage needed.	Not needed	Not needed	Seasonal high water table at a depth of 0 to 1 foot; frequent flooding.	Seasonal high water table at a depth of 0 to 1 foot; frequent flooding; bedrock at a depth of 3½ to more than 7 feet.
Fair to poor stability and compaction characteristics; medium resistance to piping.	Not needed	High available water capacity; moderate or moderately slow intake rate.	(1)	(1)	Fair trafficability; clods severely.	Rippable shale bedrock at a depth of 3½ to more than 5 feet.
Fair to good stability and compaction characteristics; CcB has high stone content.	Seasonal high water table perched at a depth of ½ foot to 2½ feet; slow permeability in pan; depth to fragipan is 20 to 30 inches.	High available water capacity; moderate intake rate above pan.	Seasonal high water table perched at a depth of ½ foot to 2½ feet; depth to root-restricting pan is 20 to 30 inches.	Seasonal high water table perched at a depth of ½ foot to 2½ feet; depth to root-restricting pan is 20 to 30 inches.	Seasonal high water table perched at a depth of ½ foot to 2½ feet; poor trafficability.	Seasonal high water table perched at a depth of ½ foot to 2½ feet; hard bedrock at a depth of more than 6 feet.
Fair to poor stability and compaction characteristics; CeB, CeC, and CeE have high stone content.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; slow permeability in fragipan; depth to pan is 15 to 22 inches; CeB, CeC, and CeE have high stone content.	Moderate to moderately slow intake rate; moderate available water capacity; CeB, CeC, and CeE have high stone content.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; CeB, CeC, and CeE have high stone content.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; CeB, CeC, and CeE have high stone content.	Seasonal high water table perched at a depth of ½ foot to 1½ feet; poor trafficability.	Seasonal high water table perched at depth of ½ foot to 1½ feet; bedrock at a depth of 3½ to more than 5 feet.
Fair to good stability and compaction characteristics; high stone content.	Seasonal high water table perched at a depth of 0 to 1 foot; depth to pan is 20 to 25 inches; slow permeability in fragipan; high stone content.	High available water capacity; seasonal high water table perched at a depth of 0 to 1 foot; needs drainage; high stone content.	Not needed	Not needed	Seasonal high water table perched at a depth of 0 to 1 foot.	Seasonal high water table perched at a depth of 0 to 1 foot.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Reservoirs: Pond reservoir areas
Croton: CrA, CrB	Poor: poorly drained.	Unsuitable: none present.	Fair to poor: ML or CL material; seasonal high water table perched at a depth of 0 to 1 foot.	Seasonal high water table perched at a depth of 0 to 1 foot; high potential frost action.	Seasonal high water table perched at a depth of 0 to 1 foot; shale bedrock at a depth of 3½ to 5 feet; slow permeability.
Dunellen: DnA, DnB, DnC.	Good	Fair for sand below a depth of 3½ feet; gravel occurrence unpredictable.	Fair: SM, SC, ML, or CL material to a depth of 3 feet. Good below a depth of 3 feet.	Moderate potential frost action.	Pervious substratum permits excessive seepage; seasonal high water table at a depth of 4 feet or more.
Dunellen variant: Dw	Good	Poor for sand and gravel: thickness and occurrence unpredictable.	Fair: SM or ML material; seasonal high water table at a depth of ½ foot to 4 feet.	Seasonal high water table at a depth of ½ foot to 4 feet; moderate potential frost action.	Pervious substratum permits excessive seepage; seasonal high water table at a depth of ½ foot to 4 feet.
Edneyville: EdB, EdC, EdD.	Poor: high gravel content.	Unsuitable: excessive fines.	Good: SM, SC, ML, or CL material.	Moderate potential frost action.	Pervious substratum permits seepage losses.
Elkton: Ek	Poor: poorly drained.	Unsuitable: none present.	Poor: ML, CL, or CH material.	Seasonal high water table at a depth of 0 to 1 foot; high potential frost action.	Impervious material; seasonal high water table at a depth of 0 to 1 foot.
Fluvaquents: FL	Poor: poorly drained; hazard of flooding.	Unsuitable: loamy material; excessive fines.	Fair: ML or CL material; seasonal high water table at a depth of 1 foot to 3 feet.	Seasonal high water table at a depth of 0 to 1 foot; hazard of flooding; high potential frost action.	Seasonal high water table at a depth of 0 to 1 foot; hazard of flooding.
Keyport: KfA, KfB	Good: seasonal high water table may prevent accessibility.	Unsuitable: none present.	Poor: ML, CL, or CH material.	Seasonal high water table at a depth of 1½ to 4 feet; high potential frost action.	Impervious material; seasonal high water table at a depth of 1½ to 4 feet.
Klinesville: KlC, KlD, KlE.	Poor: high shale content; limited material; bedrock at a depth of 1 foot to 1½ feet.	Unsuitable: none present.	Poor: limited material; bedrock at a depth of 1 foot to 1½ feet.	Rippable shale bedrock at a depth of 1 foot to 1½ feet; moderate potential frost action; KlE has steep slopes.	Pervious shale bedrock at a depth of 1 foot to 1½ feet.
Lamington: La	Poor: poorly drained.	Fair for sand below a depth of 4 feet: excessive fines in in places. Unsuitable for gravel.	Poor: ML or CL material; seasonal high water table perched at a depth of 0 to 1 foot.	Seasonal high water table perched at a depth of 0 to 1 foot; high potential frost action.	Slow permeability in subsoil; seasonal high water perched at a depth of 0 to 1 foot.

of the soils—Continued

Soil features affecting—Continued						
Reservoirs—Continued Embankments and dikes	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Fair to poor stability and compaction characteristics.	Seasonal high water table perched at a depth of 0 to 1 foot; slow permeability in fragipan at a depth of 15 to 23 inches.	Moderate available water capacity; moderately slow intake rate; slow permeability in fragipan; needs drainage.	Not needed	Not needed	Seasonal high water table perched at a depth of 0 to 1 foot.	Seasonal high water table perched at a depth of 0 to 1 foot; rippable bedrock at a depth of 3½ to 5 feet.
Fair stability and compaction characteristics; medium to high resistance to piping.	Not needed	Moderately rapid intake rate; moderate available water capacity.	(1)	(1)	(1)	(1)
Fair stability and compaction characteristics; low resistance to piping.	Seasonal high water table at a depth of ½ foot to 4 feet.	Moderate intake rate; moderate available water capacity.	Not needed	Not needed	Seasonal high water table at a depth of ½ foot to 4 feet.	Seasonal high water table at a depth of ½ foot to 4 feet; sidewalls collapse readily.
Fair stability and compaction characteristics.	Not needed	Moderate intake rate; moderate available water capacity.	(1)	(1)	(1)	Bedrock at a depth of 3½ to 5 feet.
Fair to poor stability and compaction characteristics; high resistance to piping.	Seasonal high water table at a depth of 0 to 1 foot; slow permeability in subsoil and substratum.	Moderately slow to moderate intake rate; high available water capacity; drainage needed.	Not needed	Not needed	Seasonal high water table at a depth of 0 to 1 foot; poor trafficability.	Seasonal high water table at a depth of 0 to 1 foot.
Fair stability and compaction characteristics.	Moderate permeability to a depth of 30 inches; hazard of flooding.	Seasonal high water table at a depth of 0 to 1 foot; hazard of flooding.	Not needed	Not needed	Seasonal high water table at a depth of 0 to 1 foot; hazard of flooding.	Seasonal high water table at a depth of 0 to 1 foot; hazard of flooding.
Fair to poor stability and compaction characteristics; high resistance to piping.	Seasonal high water table at a depth of 1½ to 4 feet; slow permeability in subsoil.	Moderately slow to moderate intake rate; high available water capacity.	Fair to poor stability; seepage in places; difficult to vegetate.	(1)	Seasonal high water table at a depth of 1½ to 4 feet; poor trafficability.	Seasonal high water table at a depth of 1½ to 4 feet.
Fair stability; fair to good compaction characteristics; limited material over bedrock; high shale content.	Not needed	Moderately rapid intake rate; low available water capacity.	High shale content; shale bedrock at a depth of 1 foot to 1½ feet.	High shale content; shale bedrock at a depth of 1 foot to 1½ feet.	Shale bedrock at a depth of 1 foot to 1½ feet; fair trafficability.	Rippable shale bedrock at a depth of 1 foot to 1½ feet.
Fair to poor stability and compaction characteristics; high resistance to piping.	Seasonal high water table perched at a depth of 0 to 1 foot; slow permeability in fragipan.	Moderate intake rate; seasonal high water table perched at a depth of 0 to 1 foot.	Not needed	Not needed	Seasonal high water table perched at a depth of 0 to 1 foot; poor trafficability.	Seasonal high water table perched at a depth of 0 to 1 foot.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Reservoirs: Pond reservoir areas
Lansdowne: LbA, LbB	Good	Unsuitable: none present.	Poor: ML or CL material.	Seasonal high water table perched at a depth of 1 foot to 2½ feet; shale bedrock at a depth of 3½ to 5 feet; high potential frost action.	Pervious substratum and bedrock may permit seepage losses.
Lawrenceville: LeB, LeC.	Good	Unsuitable: none present.	Fair: ML or CL material.	Seasonal high water table at a depth of 1½ to 4 feet; high potential frost action.	Pervious substratum and bedrock may permit seepage losses.
Lehigh: LhB, LhC	Fair: shale fragments.	Unsuitable: none present.	Fair: ML, CL, or GC material.	Seasonal high water table at a depth of ½ foot to 4 feet; high potential frost action.	Seasonal high water table at a depth of ½ foot to 4 feet; fractured bedrock may permit seepage losses.
Meckesville: MeB, MeC.	Poor: high gravel content.	Unsuitable: excessive fines.	Fair: ML or CL material.	Moderate potential frost action; bedrock at a depth of 4 to more than 5 feet.	Pervious substratum and bedrock may permit seepage losses.
*Mount Lucas: MoB, MpC, MuB. For Watchung part of MuB, see Watchung series.	Good for MoB. Poor for MpC and MuB: high gravel and stone content.	Unsuitable: excessive fines.	Fair: ML or CL material.	Seasonal high water table at a depth of 1 foot to 4 feet; high potential frost action.	Pervious substratum may permit seepage losses.
*Neshaminy: NeB, NeC, NhE, NkC, NkD. For Mount Lucas part of NkC and NkD, see Mount Lucas series.	Good for NeB and NeC. Poor for NhE, NkC, and NkD: high stone content.	Unsuitable: excessive fines.	Fair: ML or CL material.	Hard bedrock at a depth of 4 to more than 5 feet; moderate potential frost action; NhE, NkC, and NkD have high stone content.	Hard bedrock at a depth of 4 to more than 5 feet; pervious substratum permits seepage losses in places.
Neshaminy variant: NmB, NmC.	Fair: moderate gravel content.	Unsuitable: excessive fines.	Fair: ML or CL material.	Bedrock at a depth of 3½ to 4½ feet; moderate potential frost action.	Bedrock at a depth of 3½ to 4½ feet; fractured bedrock may permit seepage losses.

of the soils—Continued

Soil features affecting—Continued						
Reservoirs—Continued Embankments and dikes	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Fair to poor stability and compaction characteristics; high resistance to piping.	Slow permeability; seasonal high water table perched at a depth of 1 foot to 2½ feet.	Moderate available water capacity; moderate intake rate; slow permeability; seasonal high water table perched at a depth of 1 foot to 2½ feet.	Fair to poor stability; dense subsoil.	Seasonal high water table perched at a depth of 1 foot to 2½ feet; high available water capacity.	Seasonal high water table perched at depth of 1 foot to 2½ feet; poor trafficability; dense clay subsoil.	Seasonal high water table perched at a depth of 1 foot to 2½ feet; rippable bedrock at a depth of 3½ to 5 feet.
Fair to poor stability and compaction characteristics; medium resistance to piping.	Moderately slow permeability in fragipan at a depth of 25 to 35 inches; seasonal high water table at a depth of 1½ to 4 feet.	Moderate intake rate; seasonal high water table at a depth of 1½ to 4 feet; moderate available water capacity.	Poor to fair stability; erodibility.	Seasonal high water table at a depth of 1½ to 4 feet; moderate available water capacity.	Seasonal high water table at a depth of 1½ to 4 feet; poor trafficability.	Seasonal high water table at a depth of 1½ to 4 feet; rippable bedrock at a depth of 4 to more than 5 feet.
Fair stability and compaction characteristics; high shale content in places.	Seasonal high water table at a depth of ½ foot to 4 feet; slow permeability.	Moderately slow or moderate intake rate; moderate available water capacity.	Seasonal high water table at a depth of ½ foot to 4 feet; shale bedrock at a depth of 3½ to 5 feet.	Seasonal high water table at a depth of ½ foot to 4 feet; shale bedrock at a depth of 3½ to 5 feet.	Seasonal high water table at a depth of ½ foot to 4 feet; poor trafficability.	Seasonal high water table at a depth of ½ foot to 4 feet; rippable bedrock at a depth of 3½ to 5 feet.
Fair to good stability and compaction characteristics; low to medium permeability when compacted.	Not needed	Moderate intake rate; moderate available water capacity; slow permeability in fragipan.	(1)	(1)	Slow permeability in lower part of subsoil.	Bedrock at a depth of 4 to more than 5 feet.
Fair to poor stability and compaction characteristics; seasonal high water table may limit accessibility.	Seasonal high water table at a depth of 1 foot to 4 feet; moderately slow permeability.	Moderately slow to moderate intake rate; moderately slow permeability; seasonal high water table at a depth of 1 foot to 4 feet.	Seasonal high water table at a depth of 1 foot to 4 feet; fair to poor stability.	Seasonal high water table at a depth of 1 foot to 4 feet; high available water capacity.	Seasonal high water table at a depth of 1 foot to 4 feet; poor trafficability.	Seasonal high water table at a depth of 1 foot to 4 feet; hard bedrock at a depth of 4 to 6 feet.
Fair stability and compaction characteristics; NhE, NkC, and NkD have high stone content.	Not needed	Moderate intake rate; moderately slow to moderate permeability; high available water capacity; NhE, NkC, and NkD have high stone content.	Fair stability; NhE, NkC, and NkD have high stone content.	High available water capacity; NhE, NkC, and NkD have high stone content.	Fair trafficability for NeB and NeC; NhE, NkC, and NkD have high stone content.	Hard bedrock at a depth of 4 to more than 5 feet; NhE, NkC, and NkD have high stone content.
Fair stability and compaction characteristics; medium to low resistance to piping.	Not needed	Moderate intake rate; slow permeability in fragipan.	Fair stability; coarse fragments in places.	Fair stability; coarse fragments in places.	Fair trafficability	Hard bedrock at a depth of 3½ to 4½ feet.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Reservoirs: Pond reservoir areas
Norton: NoA, NoB, NoC, NoC2.	Good	Unsuitable: none present.	Fair: ML or CL material.	Moderate potential frost action; rippable shale bedrock at a depth of 3½ to more than 5 feet.	Bedrock at a depth of 3½ to more than 5 feet; fractured bedrock may permit seepage losses.
*Parker: PbC, PcE, PeD. For Edneyville part of PeD, see Edneyville series.	Poor: excessive stones, cobbles, or gravel.	Poor for sand and gravel: PcE and PeD have moderate or high stone content.	Good to poor for GM or SM material depending on proportion of stones; stone-free material is stable and compacts well.	Bedrock at a depth of 4 to more than 5 feet; PcE and PeD have moderate or high stone content.	Rapid permeability in substratum; PcE and PeD have moderate or high stone content.
Parsippany: Ph	Poor: poorly drained.	Unsuitable: none present.	Poor: ML or CL material; high proportion of fines.	Frequent flooding; seasonal high water table at a depth of 0 to 1 foot; high potential frost action.	Seasonal high water table at a depth of 0 to 1 foot; slow permeability in subsoil; broad, unconfined areas.
Parsippany variant: Pk	Poor: very poorly drained.	Unsuitable: none present.	Poor: ML or CL material; high proportion of fines.	Frequent flooding; seasonal high water table at the surface most of the year; high potential frost action.	Seasonal high water table at the surface most of the year; slow permeability in subsoil; broad, unconfined areas.
Pattenburg: PIC, PID	Poor: excessive gravel content.	Unsuitable: excessive fines; small amount of gravel.	Good: GM, GC, SM, or SC material; coarse-fragment content increases with depth.	Bedrock at a depth of 3½ to 5 feet; moderate potential frost action.	Pervious substratum may permit seepage losses.
Penn: PmA, PmB, PmC, PnB, PnC.	Good for PmA, PmB, and PmC. Poor for PnB and PnC: excessive shale content.	Unsuitable: none present.	Poor: dominantly ML or CL material; supply limited; bedrock at a depth of 1½ to 3½ feet.	Bedrock at a depth of 3½ to 5 feet; moderate potential frost action.	Pervious soil and bedrock permit seepage losses.
Quakertown: QkC, QkD.	Good	Unsuitable: none present.	Fair: ML or CL material; high potential frost action.	Bedrock at a depth of 3½ to 5 feet; moderate potential frost action.	Pervious bedrock may permit seepage losses.
Raritan: RbA	Good	Fair for sand and gravel below a depth of 4 feet; occurrence and thickness variable.	Fair: ML or CL material.	Moderate potential frost action; seasonal high water table at a depth of ½ foot to 3 feet.	Seasonal high water table at a depth of ½ foot to 3 feet; pervious substratum permits seepage losses.

of the soils—Continued

Soil features affecting—Continued						
Reservoirs—Continued Embankments and dikes	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Fair stability and compaction characteristics; moderate shrink-swell potential.	Not needed	Moderate or moderately slow intake rate; slow permeability; high available water capacity.	Fair stability; hazard of erosion.	High available water capacity.	Fair trafficability; plastic subsoil.	Bedrock at a depth of 3½ to more than 5 feet.
PcE and PeD have moderate or high stone content; stone-free material is stable and compacts well; low compressibility.	Not needed	Moderately rapid intake rate; low available water capacity.	PcE and PeD have moderate or high stone content; hazard of erosion.	Low available water capacity; PcE and PeD have moderate or high stone content.	PcE and PeD have moderate or high stone content.	PcE and PeD have moderate or high stone content; bedrock at a depth of 4 to more than 5 feet.
Poor stability and compaction characteristics; moderate shrink-swell potential; high proportion of plastic fines.	Seasonal high water table at a depth of 0 to 1 foot; subject to frequent flooding; slow permeability.	Moderately slow intake rate; slow permeability; high available water capacity.	Not needed	Not needed	Seasonal high water table at a depth of 0 to 1 foot; frequent flooding; poor trafficability.	Seasonal high water table at a depth of 0 to 1 foot; frequent flooding; bedrock at a depth of 4 to more than 5 feet.
Poor stability and compaction characteristics; moderate shrink-swell potential; high proportion of plastic fines.	Seasonal high water table at a depth of 0 to 1 foot; subject to frequent flooding; slow permeability.	Moderately slow intake rate; slow permeability; high available water capacity.	Not needed	Not needed	Seasonal high water table at the surface most of the year.	Seasonal high water table at the surface most of the year.
Fair stability and compaction characteristics; excessive coarse fragments in places.	Not needed	Moderately rapid intake rate; moderate available water capacity; hazard or erosion.	Moderate gravel content; irregular slopes.	Moderate available water capacity; moderate gravel content.	(1)	Bedrock at a depth of 3½ to 5 feet; PID has moderately steep slopes.
Fair stability and compaction characteristics; high shale fragment content.	Not needed	Moderate intake rate; moderate permeability.	Fair stability; erodible; moderate shale fragment content; bedrock at a depth of 1½ to 3½ feet.	Moderate available water capacity; moderate shale content in subsoil.	Fair to good trafficability.	Rippable bedrock at a depth of 1½ to 3½ feet.
Fair to good stability and compaction characteristics; hazard of piping.	Not needed	Moderate intake rate; moderately slow permeability; high available water capacity.	Fair stability; erodible.	High available water capacity.	Fair to good trafficability.	Rippable bedrock at a depth of 3½ to 5 feet; QkD has moderately steep slopes.
Fair stability; fair to good compaction characteristics; hazard of piping.	Seasonal high water table perched at a depth of ½ foot to 3 feet; moderately slow permeability.	Moderate intake rate; moderately slow permeability; rooting restricted at a depth of 20 to 30 inches.	Root-restricting fragipan at a depth of 20 to 30 inches; seasonal high water table perched at a depth of ½ foot to 3 feet.	Moderate available water capacity; rooting restricted at a depth of 20 to 30 inches.	Poor trafficability; seasonal high water table perched at a depth of ½ foot to 3 feet.	Seasonal high water table perched at a depth of ½ foot to 3 feet.

TABLE 8.—*Engineering interpretations*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Road location	Reservoirs: Pond reservoir areas
Readington: RcB	Good	Unsuitable: none present.	Fair: ML or CL material.	Seasonal high water table perched at a depth of 1½ to 3 feet; moderate potential frost action.	Seasonal high water table perched at a depth of 1½ to 3 feet; pervious shale bedrock at a depth of 3½ to more than 5 feet.
Reaville: ReA, ReB	Good: seasonal high water table may limit accessibility.	Unsuitable: none present.	Poor: ML or CL material; bedrock at a depth of 1½ to 3½ feet.	Seasonal high water table at a depth of ½ foot to 3 feet; shale bedrock at a depth of 1½ to 3½ feet; high potential frost action.	Seasonal high water table at a depth of ½ foot to 3 feet; pervious shale bedrock at a depth of 1½ to 3½ feet.
Riverhead: RhC	Good	Fair for sand below a depth of 3 feet.	Good: SM or SC material.	Moderate potential frost action; low shrink-swell potential.	Pervious material permits seepage losses.
Rowland: Ro	Good: seasonal high water table may limit accessibility.	Fair below a depth of 40 inches; occurrence and thickness unpredictable; hazard of flooding.	Fair: ML or CL material to a depth of 40 inches; hazard of flooding.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 3 feet.
Royce: RyB	Fair: moderate gravel content.	Unsuitable: excessive fines.	Poor: ML or CL material; poor stability.	Moderate potential frost action; bedrock at a depth of 3½ to 6 feet.	Bedrock at a depth of 3½ to 6 feet; moderately slow permeability in subsoil.
Udifluvents and Ochrepts: UD.	Good: seasonal high water table may limit accessibility.	Fair below a depth of 2½ feet; occurrence and thickness unpredictable; hazard of flooding.	Fair: ML and CL material to a depth of 2½ feet: hazard of flooding.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 5 feet; moderate potential frost action.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 5 feet.
Urban land: Um. Properties too variable to be estimated.					
Watchung: Wc	Poor: poorly drained.	Unsuitable: none present.	Poor: ML or CL material.	Seasonal high water table at a depth of 0 to 1 foot; high potential frost action.	Seasonal high water table at a depth of 0 to 1 foot.
Whippany: WhA	Good: seasonal high water table at a depth of ½ foot to 1½ feet may hinder excavating and hauling.	Unsuitable: none present.	Poor: ML or CL material; moderate shrink-swell potential.	Seasonal high water table at a depth of ½ foot to 1½ feet; high potential frost action.	Seasonal high water table at a depth of ½ foot to 1½ feet; slow permeability in subsoil.

[1] No unfavorable features.

of the soils—Continued

Soil features affecting—Continued						
Reservoirs—Continued Embankments and dikes	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Fair stability and compaction characteristics; hazard of piping.	Seasonal high water table perched at a depth of 1½ to 3 feet; slow permeability.	Moderate intake rate; slow permeability in fragipan.	Seasonal high water table perched over fragipan at a depth of 1½ to 3 feet; lateral movement of water above fragipan.	Moderate available water capacity; seasonal high water table perched at a depth of 1½ to 3 feet.	Poor trafficability; seasonal high water table perched at a depth of 1½ to 3 feet.	Seasonal high water table perched at a depth of 1½ to 3 feet; bedrock at a depth of 3½ to more than 5 feet.
Fair stability and compaction characteristics; variable shale content.	Seasonal high water table at a depth of ½ foot to 3 feet; moderately slow permeability.	Seasonal high water table at a depth of ½ foot to 3 feet; moderately slow permeability.	Fair to poor stability; shale bedrock at a depth of 1½ to 3½ feet.	Seasonal high water table at a depth of ½ foot to 3 feet; shale bedrock at a depth of 1½ to 3½ feet.	Seasonal high water table at a depth of ½ foot to 3 feet; poor trafficability.	Rippable bedrock at a depth of 1½ to 3½ feet; seasonal high water table at a depth of ½ foot to 3 feet.
Good stability; fair to good compaction characteristics; hazard of piping.	Not needed	Moderate intake rate; moderate permeability; moderate available water capacity.	(1)	Moderate available water capacity.	(1)	Unstable trench walls.
Fair stability and compaction characteristics.	Seasonal high water table at a depth of 1 foot to 3 feet; hazard of flooding; moderate or moderately slow permeability.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 3 feet.	Not needed	Not needed	Seasonal high water table at a depth of 1 foot to 3 feet; poor trafficability; hazard of flooding.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 3 feet; rippable bedrock at a depth of 4 to 8 feet.
Fair to good stability and compaction characteristics; hazard of piping.	Not needed	Moderate intake rate; moderately slow permeability; high available water capacity.	(1)	High available water capacity.	Fair trafficability; poor stability.	Rippable bedrock at a depth of 3½ to 6 feet.
Fair stability and compaction characteristics.	Seasonal high water table at a depth of 1 foot to 5 feet; hazard of flooding.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 5 feet.	Not needed	Not needed	Seasonal high water table at a depth of 1 foot to 5 feet; poor trafficability; hazard of flooding.	Hazard of flooding; seasonal high water table at a depth of 1 foot to 5 feet.
Fair stability and compaction characteristics; moderate shrink-swell potential.	Seasonal high water table at a depth of 0 to 1 foot; slow permeability.	Seasonal high water table at a depth of 0 to 1 foot; high available water capacity.	Not needed	Not needed	Seasonal high water table at a depth of 0 to 1 foot; poor trafficability.	Seasonal high water table at a depth of 0 to 1 foot; hard bedrock at a depth of 5 to 10 feet.
Poor to fair stability and compaction characteristics; hazard of piping.	Seasonal high water table at a depth of ½ foot to 1½ feet; slow permeability in subsoil.	Moderate intake rate; high available water capacity; drainage needed.	Not needed	Not needed	Seasonal high water table at a depth of ½ foot to 1½ feet; poor trafficability.	Seasonal high water table at a depth of ½ foot to 1½ feet; bedrock at a depth of 5 to 10 feet.

TABLE 9.—*Engineering*

[Tests performed by the College of Engineering, Rutgers University.

Soil	Sampling site			Depth	Test results		
					Sieve analysis		
					Cumulative percentage passing—		
	Site number	Latitude	Longitude		¾ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)
				Inches			
Amwell gravelly loam:							
Less gravel than in modal profile.	7	74°37′14″	40°36′04″	0–8	96	88	85
				8–19	98	95	93
				19–30	72	65	53
Amwell gravelly silt loam:							
Less gravel than in modal profile.	21	74°36′03″	40°37′27″	0–9	94	90	89
				9–23	97	92	92
				23–42	70	67	67
Arendtsville gravelly loam:							
Less gravel in subsoil and substratum than in modal profile; more sand than in modal profile.	33	74°42′05″	40°42′48″	0–6	85	75	71
				6–13	97	92	88
				13–28	97	89	81
Birdsboro silt loam:							
Thinner solum than in modal profile.	47	74°39′16″	40°32′32″	0–7	100	100	96
				7–26	100	100	89
				26–36	100	92	90
Chalfont silt loam:							
Modal.	30	74°42′52″	40°28′47″	0–6	100	100	100
				6–12	100	100	100
				12–33	100	100	100
Dunellen sandy loam:							
Modal.	13	74°36′23″	40°32′50″	0–9	99	88	85
				9–16	99	94	91
				16–24	99	94	91
Edneyville gravelly loam:							
Modal.	27	74°38′07″	40°44′08″	0–11	77	63	54
				11–42	98	92	72
More gravel than in modal profile.	28	74°36′25″	40°43′44″	0–8	56	48	44
				8–30	84	75	62
Klinesville shaly loam:							
Modal.	45	74°40′37″	40°32′40″	0–8	95	83	75
				8–16	97	86	85
				16–22	93	78	65
Lamington silt loam:							
Modal.	11	74°36′36″	40°32′36″	0–8	100	100	100
				8–15	100	99	99
				15–24	100	98	92
Lansdowne silt loam:							
Modal.	40	74°36′41″	40°35′25″	0–5	98	96	95
				5–16	96	95	93
				16–32	100	92	91
Meckesville gravelly loam:							
Modal.	10	74°41′20″	40°41′23″	0–6	93	88	85
				6–20	93	88	84
				20–27	98	94	90
Mount Lucas silt loam:							
Surface texture finer than in modal profile.	17	74°32′43″	40°37′00″	0–10	100	99	99
				10–24	89	84	80

test data

Absence of data indicates the determination was not made]

Test results—Continued								Classification	
Sieve analysis—Continued		Hydrometer analysis		Liquid limit [1]	Plasticity index [2]	Maximum dry density [3]	Optimum moisture content	AASHTO	Unified
Cumulative percentage passing—Continued		0.05–0.005 mm	Less than 0.005 mm						
No. 40 (0.42 mm)	No. 200 (0.074 mm)								
		Percent	*Percent*	*Percent*		*Lb per cu ft*	*Percent*		
72	57			33	9			A-4(4)	ML-CL
86	77	45	29	29	11			A-6(8)	CL
44	33	19	12	24	6			A-2-4(0)	GM-GC
84	78			31	7			A-4(8)	ML-CL
90	86	54	26	33	11	106	20	A-6(8)	ML-CL
65	60	36	19	36	15	106	19	A-6(6)	ML-CL
58	46			33	10			A-4(2)	SM-SC
79	71	33	37	35	13	111	17	A-6(8)	ML-CL
67	58	34	37	50	23	104	21	A-7-6(11)	CH
92	85			34	11			A-6(8)	ML-CL
87	77	41	36	31	13			A-6(9)	CL
58	31	14	16	21	7			A-2-4(0)	SC-SM
95	93			36	11			A-6(8)	ML-CL
97	94	53	39	36	13	104	21	A-6(9)	ML-CL
97	92	43	42	32	12	107	15	A-6(9)	CL
66	32			30	9			A-2-4(0)	SM-SC
74	49			24	5	116	14	A-4(3)	SM-SC
75	54			25	7	119	13	A-4(4)	ML-CL
43	29			38	11			A-2-6(0)	GM
58	39	19	20	38	10			A-4(1)	SM
36	30			40	9			A-2-4(0)	GM
52	44	28	14	32	8	108	18	A-4(3)	SM-SC
63	54			37	8			A-4(4)	ML
68	55			26	5	110	15	A-4(4)	ML-CL
60	54	30	18	26	5	114	15	A-4(4)	ML-CL
94	86			36	12			A-6(9)	ML-CL
96	90			35	15			A-6(10)	CL
79	72			41	19			A-7-6(11)	CL
83	73			32	10			A-4(8)	ML-CL
87	82	41	37	31	13	107	18	A-6(9)	CL
87	83	39	37	33	14	105	19	A-6(10)	CL
71	55			31	9			A-4(4)	ML-CL
76	67	35	28	30	11			A-6(7)	CL
81	69	30	36	32	13			A-6(8)	CL
97	93			56	23			A-7-5(13)	MH
72	65	43	17	35	13			A-6(7)	ML-CL

TABLE 9.—*Engineering*

Soil	Sampling site			Depth	Test results		
					Sieve analysis		
	Site number	Latitude	Longitude		Cumulative percentage passing—		
					¾ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)
				Inches			
Mount Lucas gravelly silt loam:							
More gravel and less silt than in modal profile.	14	74°32′25″	40°34′55″	0–6	75	66	65
				6–36	42	36	36
More gravel below a depth of 28 inches than in modal profile.	22	74°43′54″	40°27′45″	0–11	79	74	73
				11–28	95	93	91
				28–30	95	68	41
Neshaminy silt loam:							
Modal.	23	74°36′25″	40°25′25″	0–7	99	98	98
				7–24	100	99	99
				24–27	99	98	98
More gravel than in modal profile.	20	74°33′33″	40°41′35″	0–9	73	70	70
				9–21	87	84	84
				21–30	87	81	79
Norton loam:							
Modal.	6	74°32′29″	40°42′11″	0–9	100	98	94
				9–16	100	99	97
				16–27	100	100	99
Parsippany silt loam:							
Modal.	1	74°39′52″	40°39′37″	0–7	100	100	98
				7–20	100	99	93
				20–25	100	100	91
Penn shaly silt loam:							
Modal.	41	74°34′34″	40°40′18″	0–10	92	79	72
				10–22	90	76	73
				22–30	89	64	53
Quakertown silt loam:							
Modal.	55	74°44′15″	40°25′09″	0–9	95	91	90
				9–24	90	88	87
Reaville silt loam:							
More gravel in subsoil than in modal profile.	46	74°38′55″	40°36′18″	0–9	100	95	88
				9–18	99	77	59
				18–30	97	51	40
Royce silt loam:							
Modal.	52	74°33′30″	40°26′40″	0–10	96	89	88
				10–22	94	87	84
				22–37	100	91	85

[1] Based on AASHTO Designation T 89-49.
[2] Based on AASHTO Designation T 90-49.

roads. The suitability ratings reflect the predicted performance of the soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage. They also reflect the relative ease of excavating the material at borrow areas.

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

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

Embankments and dikes require soil material that is resistant to seepage and piping and of favorable stability,

test data—Continued

Test results—Continued								Classification	
Sieve analysis—Continued		Hydrometer analysis		Liquid limit [1]	Plasticity index [2]	Maximum dry density [3]	Optimum moisture content	AASHTO	Unified
Cumulative percentage passing—Continued		0.05–0.005 mm	Less than 0.005 mm						
No. 40 (0.42 mm)	No. 200 (0.074 mm)								
		Percent	*Percent*	*Percent*		*Lb per cu ft*	*Percent*		
58	42			34	9			A-4(1)	GM-GC
35	33	16	14	38	14			A-2-6(1)	GM-GC
64	56			35	11			A-6(5)	ML
84	75	44	27	29	8	110	17	A-4(8)	ML-CL
18	12			25	5			A-1-a(0)	SP-SM
96	90			35	10			A-4(8)	ML-CL
97	92	56	33	33	11			A-6(8)	ML-CL
93	86	54	28	33	11			A-6(8)	ML-CL
67	64			37	10			A-4(6)	ML
82	78	44	28	31	10			A-4(8)	ML-CL
76	73	44	25	33	12			A-6(8)	CL
82	71			37	10			A-4(7)	ML
91	83	45	35	37	15			A-6(10)	CL
96	89	43	40	44	18			A-7-6(11)	ML-CL
89	79			43	8			A-5(9)	ML
90	86	52	27	29	6			A-4(8)	ML-CL
87	81	38	42	42	22			A-7-6(13)	CL
69	69			41	10			A-5(7)	ML
63	58	29	24	34	8			A-4(5)	ML
47	40	20	17	45	12			A-2-7(1)	GM
88	86			37	11			A-6(8)	ML-CL
86	85	39	31	34	10			A-4(8)	ML-CL
85	84			49	16			A-7-5(12)	ML
53	50	21	23	36	12			A-6(4)	SM-SC
32	28	11	16	34	12			A-2-6(0)	GM-GC
74	60			38	13			A-6(6)	ML-CL
70	56	21	35	40	14			A-6(6)	ML-CL
71	56	18	38	45	17			A-7-6(7)	ML-CL

[3] Based on AASHTO Designation T 99-49.

shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil is among the factors that are unfavorable.

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

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to the water table or bedrock (*5*).

Terraces and diversions are embankments or ridges constructed across the slope to intercept runoff and seepage so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil

for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

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

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

Shallow excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries are those that generally require digging or trenching to a depth of less than 6 feet. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding.

Town and Country Planning

This section is mainly for land planners, municipal officials, developers, and owners or users of land who are responsible for the preparation or evaluation of land-use plans or for community development. The limitations of the soils for several uses in community developments are shown in table 10. For each mapping unit, the table lists the degree and kind of limitations for each use named.

A rating of *slight* means soil properties are generally favorable for the rated use, or in other words, limitations are minor and easily overcome. A rating of *moderate* means that some soil properties are unfavorable but can be overcome by careful planning and design and good management. A rating of *severe* means soil properties are so unfavorable and so difficult to correct or overcome as to require soil reclamation, special design, or intensive maintenance. Some properties are so unfavorable for a particular use that overcoming the limitations is most difficult and costly and commonly is not practical for the rated use.

Planning and zoning officials need to consider the merits of competing uses for soils. Those soils best suited to community development are also among the best for farming. Capability of the soils for farm crops is given at the end of the description for each mapping unit, and the capability units are explained in the section "Capability Grouping."

In the following paragraphs are explanations of some of the assumptions made for the ratings in table 11.

Foundations for dwellings ratings are based on the properties of an undisturbed soil and are for dwellings of three stories or less.

Septic tank absorption fields ratings are for residences on normal lot sizes but not for public buildings or trailer parks. Requirements of the New Jersey Department of Health were followed. Where seasonal water table is listed as a limitation, the ratings may be more severe than percolation tests indicate if tests are made in dry seasons.

Sewage lagoons are shallow ponds constructed to hold animal manure within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor, and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and slope, and if the floor needs to be leveled, depth to bedrock becomes important.

Sanitary landfills ratings are based on soil properties above a depth of 5 feet. Onsite investigations are needed to determine soil and water conditions below that depth. The ratings are an indication as to where onsite investigation would be most profitable. Sanitary landfill ratings are based on the trench method. All soils that have a seasonal high water table within 5 feet of the surface were rated severe because of the hazard of ground-water pollution. Soils that have a small amount of water perched over a fragipan were rated slight or moderate, depending on the amount of water. Soils that have rapid permeability in the substratum were rated severe because of the hazard of ground-water pollution.

Local roads and streets ratings are based on the assumption the roads and streets will be paved. The ratings also apply in general to parking lots. Slope, depth to bedrock, and content of stones and boulders are somewhat more critical for parking lots than for roads and streets, however, because of the more extensive grading required.

Lawns, landscaping, and golf fairways ratings are based on those properties that affect plant production.

Athletic-field use was assumed to be year round. If only summer use is planned, limitations caused by a seasonal high water table are not as severe as indicated in the table. Intensive use and a grass turf are assumed.

Picnic and play area ratings assume about 7 months of use, from April through October. No major land shaping was assumed in the ratings.

Campsites for trailers and tents ratings assume about 7 months of use, from April through October. If all-season camping is anticipated, limitations caused by a seasonal high water table are more severe than indicated in the table. Areas that have a seasonal high water table should be avoided, where possible, in laying out access roads.

Landscaping

This section contains information about some of the trees and shrubs used in landscaping sites for homes, schools, industry, and recreation areas. In planning, consideration should be given to protection from wind, screening of unsightly areas, and the general beauty of neighborhoods.

Trees and shrubs of different species vary widely in suitability for different soils and site conditions. The soils in the county are placed in three landscape planting groups, mainly on the basis of the amount of wetness from seasonal high water table and from the available water capacity.

Each of the soils in a specific group has similar suitability for tree and shrub plantings. Trees and shrubs suited to those groups and important characteristics of those trees and shrubs are presented in tables 11 through 14. Tables 11 and 12 provide, respectively, guidance for landscape planting of deciduous trees and deciduous shrubs. Tables 13 and 14, on the other hand, provide, respectively, guidance for landscape planting of evergreen

trees and evergreen shrubs. The soils in a landscape planting group can be identified by referring to the "Guide to Mapping Units" at the back of this survey. No landscape planting group has been assigned to gravel pits, quarries, or Urban land.

The lists of plants in tables 11 through 14 are only partial ones, and the soils in the county are suited to many other plants as well. Many of the plants serve the dual purpose of landscaping and of providing food and cover for wildlife. If more detail is needed and pertinent landscaping plans are desired, landowners and others should communicate with local landscape specialists.

Named in the following paragraphs are properties of the soils in each landscape group that are important to the growth of plants.

LANDSCAPE PLANTING GROUP 1

All the soils in this group are poorly drained or very poorly drained. These soils have a high water table and may be ponded at some time during the year. They are nearly level and depressional.

LANDSCAPE PLANTING GROUP 2

All the soils in this group are somewhat poorly drained. These soils have a perched or seasonal high water table.

LANDSCAPE PLANTING GROUP 3

In this group are moderately well drained and well drained soils that have moderate or high available water capacity. The water table normally is below a depth of 4 feet. These soils are nearly level to steep.

Formation and Classification of the Soils

This section describes the factors of soil formation as they exist in Somerset County, the processes through which soil horizons develop, the nature of the major horizons in mature soils, and the classification of the soils of the county according to the current classification system.

Factors of Soil Formation

Soils form through the interaction of five major factors: climate, plant and animal life, parent material, topography, and time. The relative influence of each factor varies from place to place. Local variations in soils are caused by differences in kind of parent material and differences in topography and drainage. In places one factor dominates in the formation of a soil and determines most of its properties. Table 15 shows the parent material, the topographic position, and the drainage class of the soils of this county, by series.

Climate

Somerset County has a humid, continental climate that is marked by extreme seasonal changes in temperature. The annual precipitation is about 45 inches, and the average annual air temperature is about 53° F. Rainfall is fairly uniform during the growing season of May to September and averages about 21 inches. The cool temperature has promoted the accumulation of organic matter in the surface layer of the soils. More detailed information on climate is in the section "Physiography and Relief."

Plant and animal life

Plants, micro-organisms, earthworms, and other forms of life on and in the soil are active factors in soil formation. The kinds of plants and animals depend on the climate, the parent material, the age of the soil, and the presence of other organisms.

All the soils in Somerset County formed under forests, mostly of hardwood trees. Organic matter was added to the soil in the form of decayed leaves, twigs, roots, and dead micro-organisms. Most of this material accumulated near the surface, where it was acted upon by micro-organisms, earthworms, termites, and other forms of life and by direct chemical reaction.

Man's activities, including land clearing, stone removal, cultivation, the introduction of new plants, and artificial drainage, have also affected soil development. The most apparent widespread results of these activities are accelerated erosion of the steeper soils and the resulting deposition on lower slopes, the alteration of the surface layer by tillage, the reduction of acidity by the addition of lime, and the raising of the fertility level by the addition of fertilizer.

In addition, man has made some drastic changes locally. He has removed the original soil or so mixed it during recent construction projects that soil formation has started anew.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It determines the mineralogical and chemical composition of the soil and, to a large extent, the rate of the soil-forming processes.

The soils of Somerset County formed in either residual material weathered from underlying rocks or transported material deposited by water, glacial ice, wind, or gravity.

Penn and Klinesville soils, which are in the southern two-thirds of the county, are examples of soils that formed in residuum weathered from red Triassic shale. These soils commonly contain numerous flat fragments of shale.

Neshaminy and Mount Lucas soils are examples of soils that formed in residuum weathered from igneous diabase or basalt rocks (fig. 12), which are the relatively hard rocks that form the Sourland and Watchung Mountains. These soils are typically sloping and contain many stones and boulders.

Edneyville and Parker soils, which are in the northern part of the county, formed in residuum weathered from granitic gneiss.

The soils that formed in transported material have a great variety of composition, texture, and landform. Norton soils formed in glacial deposits that contained a high proportion of soft red shale. Rowland and Bowmansville soils formed on flood plains in recent loamy alluvium. These soils have weakly developed profiles. Birdsboro and Riverhead soils occur on terraces and formed in older alluvium. They have better differentiated soil horizons than the Rowland and Bowmansville soils. Bucks soils formed partly in silty windblown deposits and partly in the underlying material weathered from shale, siltstone, or sandstone.

TABLE 10.—*Degree and kind of limitations*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Abbottstown: AbA, AbB.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; slow permeability in subsoil; bedrock at a depth of 3½ to 4½ feet.	Moderate: bedrock at a depth of 3½ to 4½ feet; AbB is gently sloping.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; rippable bedrock at a depth of 3½ to 4½ feet.
Amwell: AmB, AnB	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet; slow permeability in fragipan; hard bedrock at a depth of 3½ to more than 5 feet in places.	Moderate: gently sloping; hard bedrock at a depth of 3½ to more than 5 feet in places.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet; hard bedrock at a depth of 3½ to more than 5 feet in places.
AmC, AnC	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet; slow permeability in fragipan; hard bedrock at a depth of 3½ to more than 5 feet in places.	Severe: strongly sloping.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet; hard bedrock at a depth of 3½ to more than 5 feet in places.
Arendtsville: ArB, ArC	Slight	Moderate: frost action potential.	Slight: hazard of ground-water pollution.	Severe: moderately rapid permeability in substratum.	Severe: moderately rapid permeability in substratum creates hazard of ground-water pollution.
Bartley: BaC	Moderate: seasonal high water table perched over fragipan at a depth of 2 to 4 feet.	Moderate: seasonal high water table perched at a depth of 2 to 4 feet.	Severe: seasonal high water table perched over fragipan at a depth of 2 to 4 feet; moderately slow permeability.	Severe: strongly sloping.	Severe: seasonal high water table perched at a depth of 2 to 4 feet; hazard of ground-water pollution in fractured limestone bedrock.
Birdsboro: BdA	Slight	Moderate: frost action potential.	Slight: hazard of ground-water pollution.	Severe: moderate to rapid permeability.	Severe: rapid permeability in substratum creates hazard of ground-water pollution.
BdB	Slight	Moderate: frost action potential.	Slight: hazard of ground-water pollution.	Severe: moderate to rapid permeability.	Severe: rapid permeability in substratum creates hazard of ground-water pollution.
BdC	Moderate: strongly sloping.	Moderate: strongly sloping; frost action potential.	Moderate: strongly sloping; hazard of ground-water pollution.	Severe: moderate to rapid permeability; strongly sloping.	Severe: rapid permeability in substratum creates hazard of ground-water pollution.

of soils used for community development

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; high potential frost action.	Moderate: seasonal high water table at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table at a depth of ½ foot to 1½ feet.	Moderate: water table above a depth of 20 inches for short period during season of use.	Moderate: water table below a depth of 20 inches during season of use.	Moderate: water table below a depth of 20 inches during season of use.
Severe: seasonal high water table perched at a depth of 1 foot to 4 feet; high potential frost action.	Moderate: seasonal high water table perched at a depth of 1 foot to 4 feet.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet.	Slight: water table below a depth of 20 inches during season of use.	Moderate: water table below a depth of 20 inches during season of use.	Slight: water table below a depth of 20 inches during season of use.
Severe: seasonal high water table perched at a depth of 1 foot to 4 feet; high potential frost action.	Moderate: seasonal high water table perched at a depth of 1 foot to 4 feet.	Severe: seasonal high water table perched at a depth of 1 foot to 4 feet; strongly sloping.	Moderate: strongly sloping.	Moderate: water table below a depth of 20 inches during season of use.	Slight: water table below a depth of 20 inches during season of use.
Moderate: potential frost action.	Moderate: high gravel content.	Severe: high gravel content.	Moderate: moderate gravel content on surface.	Moderate: moderate gravel content on surface.	Moderate: moderate gravel content on surface.
Severe: seasonal high water table perched at a depth of 2 to 4 feet; high potential frost action.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Moderate: high potential frost action.	Slight	Slight	Slight	Slight	Slight.
Moderate: high potential frost action.	Slight	Moderate: gently sloping.	Slight	Slight	Slight.
Moderate: potential frost action.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.

TABLE 10.—*Degree and kind of limitations of*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Bowmansville: Bt	Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.	Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.	Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.	Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.	Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.
Bucks:					
BuB	Slight: rippable bedrock at a depth of 3½ to more than 5 feet.	Moderate: frost action potential.	Moderate: bedrock at a depth of 3½ to more than 5 feet.	Moderate: gently sloping; bedrock at a depth of 3½ to more than 5 feet.	Severe: rippable bedrock at a depth of 3½ to more than 5 feet.
BuC2	Moderate: strongly sloping; rippable bedrock at a depth of 3½ to more than 5 feet.	Moderate: strongly sloping.	Moderate: strongly sloping; bedrock at a depth of 3½ to more than 5 feet.	Severe: strongly sloping.	Severe: rippable bedrock at a depth of 3½ to more than 5 feet.
Califon:					
CaB	Severe: seasonal high water table perched at a depth of ½ foot to 2½ feet; lateral seepage over fragipan; foundation and interceptor drains generally needed.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Severe: slow permeability; seasonal high water table perched at a depth of ½ foot to 2½ feet.	Moderate: gently sloping.	Moderate: seasonal high water table perched at a depth of ½ foot to 2½ feet.
CcB	Severe: seasonal high water table perched at a depth of ½ foot to 2½ feet; lateral seepage over fragipan; strongly sloping; very stony.	Severe: seasonal high water table perched at a depth of ½ foot to 2½ feet; lateral seepage over fragipan; very stony.	Severe: slow permeability; seasonal high water table perched at a depth of ½ foot to 2½ feet; very stony.	Moderate: gently sloping.	Moderate: seasonal high water table perched at a depth of ½ foot to 2½ feet; very stony.
Chalfont:					
CdB, CeB	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; high frost action potential.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; slow permeability.	Moderate: gently sloping.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; bedrock at a depth of 3½ to more than 5 feet.
CdC, CeC	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; high frost action potential.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; slow permeability.	Severe: strongly sloping.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; bedrock at a depth of 3½ to more than 5 feet.
CeE	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; steep.	Severe: steep	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; slow permeability; steep.	Severe: steep	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; bedrock at a depth of 3½ to more than 5 feet; steep.

soils used for community development—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.	Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.	Severe: hazard of stream overflow; seasonal water table at a depth of 0 to 1 foot.	Severe: hazard of stream overflow; water table above a depth of 20 inches during season of use.	Severe: hazard of stream overflow.	Severe: water table above a depth of 20 inches during season of use.
Moderate: potential frost action.	Slight	Moderate: gently sloping.	Slight	Slight	Slight.
Moderate: potential frost action.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Severe: high potential frost action; seasonal high water table perched over fragipan.	Moderate: seasonal high water table at a depth of ½ foot to 2½ feet.	Severe: seasonal high water table at a depth of ½ foot to 2½ feet; moderate gravel content.	Slight: water table below a depth of 20 inches during season of use.	Moderate: water table below a depth of 20 inches during season of use.	Moderate: water table below a depth of 20 inches during season of use.
Severe: high potential frost action; seasonal high water table perched over fragipan.	Moderate: very stony.	Severe: seasonal high water table perched at a depth of ½ foot to 2½ feet; very stony.	Moderate: very stony.	Moderate: very stony.	Moderate: water table above a depth of 20 inches for short periods during season of use; very stony.
Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; high potential frost action.	Moderate: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Moderate: water table below a depth of 20 inches during season of use.	Severe: water table above a depth of 20 inches during season of use.	Moderate: seasonal high water table perched at a depth of ½ foot to 1½ feet.
Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; high potential frost action.	Moderate: seasonal high water table perched at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; strongly sloping.	Moderate: water table below a depth of 20 inches during season of use.	Severe: water table above a depth of 20 inches during season of use.	Moderate: seasonal high water table perched at a depth of ½ foot to 1½ feet.
Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; high potential frost action; steep.	Severe: steep	Severe: seasonal high water table perched at a depth of ½ foot to 1½ feet; steep.	Severe: steep	Severe: water table above a depth of 20 inches during season of use; steep.	Moderate: seasonal high water table perched at a depth of ½ foot to 1½ feet; steep.

TABLE 10.—*Degree and kind of limitations of*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Cokesbury: CpB	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.
Croton: CrA, CrB	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.
Dunellen: DnA, DnB, DnC.	Slight	Moderate: frost action potential.	Slight	Severe: rapid permeability in substratum.	Severe: rapid permeability in substratum creates hazard of groundwater pollution.
Dunellen variant: Dw	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: seasonal high water table at a depth of ½ foot to 4 feet.
Edneyville: EdB	Slight	Moderate: frost action potential.	Moderate: bedrock at a depth of 3½ to more than 5 feet.	Severe: moderately rapid permeability in substratum.	Severe: moderately rapid permeability in substratum creates hazard of ground-water pollution.
EdC	Moderate: strongly sloping.	Moderate: strongly sloping.	Moderate: bedrock at a depth of 3½ to more than 5 feet; strongly sloping.	Severe: moderately rapid or rapid permeability in substratum; strongly sloping.	Severe: moderately rapid permeability in substratum creates hazard of groundwater pollution.
EdD	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately rapid permeability in substratum creates hazard of groundwater pollution.
Elkton: Ek	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.
Fluvaquents: FL	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.
Keyport: KfA, KfB	Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Severe: slow permeability; seasonal high water table at a depth of 1½ to 4 feet.	Slight	Severe: seasonal high water table at a depth of 1½ to 4 feet.
Klinesville: KlC, KlD	Moderate: rippable shale bedrock at a depth of 1 foot to 1½ feet.	Moderate: rippable shale bedrock at a depth of 1 foot to 1½ feet.	Severe: pervious shale bedrock at a depth of 1 foot to 1½ feet; KlD is moderately steep.	Severe: strongly sloping or moderately steep.	Severe: rippable bedrock at a depth of 1 foot to 1½ feet; KlD is moderately steep.
KlE	Severe: steep	Severe: steep	Severe: steep; shallow over shale bedrock.	Severe: steep	Severe: steep; shallow over shale bedrock.

soils used for community development—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot; very stony.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot; very stony.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.
Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.	Severe: seasonal high water table perched at a depth of 0 to 1 foot.
Moderate: potential frost action.	Slight	Slight for DnA. Moderate for DnB: gently sloping.	Slight	Slight	Slight.
Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Moderate: seasonal high water table at a depth of ½ foot to 4 feet.	Moderate: seasonal high water table at a depth of ½ foot to 4 feet.	Slight: seasonal high water table below a depth of 20 inches during season of use.	Moderate: seasonal high water table below a depth of 20 inches during season of use.	Slight: seasonal high water table below a depth of 20 inches during season of use.
Moderate: moderate potential frost action.	Moderate: moderate gravel content.	Severe: excessive gravel content.	Slight	Slight	Slight.
Moderate: strongly sloping; moderate potential frost action.	Severe: strongly sloping.	Severe: high gravel content; strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Severe: steep	Severe: steep	Severe: steep	Severe: steep	Severe: steep	Moderate: steep.
Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: water table above a depth of 20 inches during season of use.	Severe: water table above a depth of 20 inches during season of use.	Severe: water table above a depth of 20 inches during season of use.
Severe: hazard of stream overflow.	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.	Severe: hazard of stream overflow.
Severe: high potential frost action; seasonal high water table at a depth of 1½ to 4 feet.	Slight	Moderate: slow permeability; seasonal high water table at a depth of 1½ to 4 feet.	Slight	Moderate: water table below a depth of 20 inches during season of use.	Slight.
Severe: rippable bedrock at a depth of 1 foot to 1½ feet; KID is moderately steep.	Severe: shale bedrock at a depth of 1 foot to 1½ feet; KID is moderately steep.	Severe: shale bedrock at a depth of 1 foot to 1½ feet; strongly sloping and moderately steep.	Moderate for KIC: moderate shale content; strongly sloping. Severe for KID: moderately steep.	Moderate for KIC: moderate shale content; strongly sloping. Severe for KID: moderately steep.	Slight for KIC. Moderate for KID: slope.
Severe: steep; shallow over shale bedrock.	Severe: steep; shallow over shale bedrock.	Severe: steep; shallow over shale bedrock.	Severe: steep	Severe: steep	Severe: steep.

TABLE 10.—*Degree and kind of limitations of*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Lamington: La	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Slight	Severe: seasonal high water table at a depth of 0 to 1 foot.
Lansdowne: LbA, LbB	Severe: seasonal high water table at a depth of 1 foot to 2½ feet.	Severe: seasonal high water table at a depth of 1 foot to 2½ feet.	Severe: seasonal high water table at a depth of 1 foot to 2½ feet.	Slight for LbA Moderate for LbB: gently sloping.	Severe: rippable shale bedrock at a depth of 3½ to 5 feet.
Lawrenceville:					
LeB	Severe: seasonal high water table at a depth of 1½ to 4 feet.	Severe: high frost action potential.	Severe: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: gently sloping.	Severe: rippable bedrock at a depth of 4 to more than 5 feet; hard in places.
LeC	Severe: seasonal high water table at a depth of 1½ to 4 feet.	Severe: high frost action potential.	Severe: seasonal high water table at a depth of 1½ to 4 feet.	Severe: strongly sloping.	Severe: rippable bedrock at a depth of 4½ to more than 5 feet; hard in places.
Lehigh:					
LhB	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: frost action potential.	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Moderate: gently sloping; rippable bedrock at a depth of 3½ to 5 feet.	Severe: rippable bedrock at a depth of 3½ to 5 feet.
LhC	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: frost action potential.	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: strongly sloping.	Severe: rippable bedrock at a depth of 3½ to 5 feet.
Meckesville:					
MeB	Severe: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Severe: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: gently sloping.	Severe: bedrock at a depth of 4 to more than 5 feet.
MeC	Severe: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: strongly sloping.	Severe: seasonal high water table at a depth of 1½ to 4 feet; strongly sloping.	Severe: strongly sloping.	Severe: bedrock at a depth of 4 to more than 5 feet.
Mount Lucas:					
MoB	Severe: seasonal high water table at a depth of 1 foot to 4 feet.	Severe: seasonal high water table at a depth of 1 foot to 4 feet.	Severe: seasonal high water table at a depth of 1 foot to 4 feet; hard bedrock at a depth of 4 to 6 feet.	Moderate: hard bedrock at a depth of 4 to 6 feet.	Severe: hard bedrock at a depth of 4 to 6 feet; seasonal high water table at a depth of 1 foot to 4 feet.
MpC	Severe: seasonal high water table at a depth of 1 foot to 4 feet; strongly sloping.	Severe: seasonal high water table at a depth of 1 foot to 4 feet; strongly sloping.	Severe: seasonal high water table at a depth of 1 foot to 4 feet; hard bedrock at a depth of 4 to 6 feet.	Severe: strongly sloping.	Severe: hard bedrock at a depth of 4 to 6 feet; seasonal high water table at a depth of 1 foot to 4 feet.

soils used for community development—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: water table above a depth of 20 inches during season of use.	Severe: water table above a depth of 20 inches during season of use.	Severe: water table above a depth of 20 inches during season of use.
Severe: seasonal high water table at a depth of 1 foot to 2½ feet; high potential frost action.	Moderate: seasonal high water table at a depth of 1 foot to 2½ feet.	Severe: seasonal high water table at a depth of 1 foot to 2½ feet.	Moderate: water table above a depth of 20 inches for short periods during season of use.	Severe: water table above a depth of 20 inches during season of use.	Moderate: water table above a depth of 20 inches during season of use.
Severe: seasonal high water table at a depth of 1½ to 4 feet; high potential frost action.	Slight	Moderate: seasonal high water table at a depth of 1½ to 4 feet; gently sloping.	Slight	Moderate: moderately slow permeability.	Slight.
Severe: seasonal high water table at a depth of 1½ to 4 feet; high potential frost action.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Severe: seasonal high water table at a depth of ½ foot to 4 feet; high potential frost action.	Moderate: seasonal high water table at a depth of ½ foot to 4 feet.	Severe: seasonal high water table at a depth of ½ foot to 4 feet.	Moderate: water table above a depth of 20 inches for short periods during season of use.	Moderate: water table below a depth of 20 inches during season of use.	Moderate: water table above a depth of 20 inches for short periods during season of use.
Severe: seasonal high water table at a depth of ½ foot to 4 feet; high potential frost action.	Moderate: seasonal high water table at a depth of ½ foot to 4 feet; strongly sloping.	Severe: seasonal high water table at a depth of ½ foot to 4 feet; strongly sloping.	Moderate: water table above a depth of 20 inches for short periods during season of use; strongly sloping.	Moderate: strongly sloping.	Moderate: water table above a depth of 20 inches for short periods during season of use.
Moderate: moderate potential frost action.	Slight	Severe: moderate gravel content on surface.	Slight	Moderate: moderately slow permeability.	Slight.
Moderate: moderate potential frost action; strongly sloping.	Moderate: strongly sloping.	Severe: high gravel content; strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Severe: seasonal high water table at a depth of 1 foot to 4 feet; high potential frost action.	Slight	Moderate: seasonal high water table at a depth of 1 foot to 4 feet; gently sloping.	Slight	Slight	Slight.
Severe: seasonal high water table at a depth of 1 foot to 4 feet; high potential frost action.	Moderate: strongly sloping; moderate gravel content.	Severe: strongly sloping; excessive gravel content on surface.	Moderate: strongly sloping; moderate gravel content.	Moderate: strongly sloping.	Slight

TABLE 10.—*Degree and kind of limitations of*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Mount Lucas—Continued MuB	Severe: seasonal high water table at a depth of 0 to 2½ feet; hard bedrock at a depth of 3½ to more than 5 feet; high stone content.	Severe: seasonal high water table at a depth of 0 to 2½ feet; high stone content.	Severe: seasonal high water table at a depth of 0 to 2½ feet; hard bedrock at a depth of 3½ to more than 5 feet.	Severe: hard bedrock at a depth of 3½ to more than 5 feet; seasonal high water table at a depth of 0 to 2½ feet.	Severe: hard bedrock at a depth of 3½ to more than 5 feet; seasonal high water table at a depth of 0 to 2½ feet.
Neshaminy: NeB	Moderate: hard bedrock at a depth of 4 to more than 5 feet.	Moderate: frost action potential.	Moderate: hard bedrock at a depth of 4 to more than 5 feet.	Moderate: gently sloping.	Moderate: hard bedrock at a depth of 4 to more than 5 feet.
NeC	Moderate: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: hard bedrock at a depth of 4 to more than 5 feet.
NhE	Severe: steep	Severe: steep	Severe: steep	Severe: steep	Severe: steep
NkC: Neshaminy part	Moderate: gently sloping and strongly sloping; very stony.	Moderate: gently sloping and strongly sloping; very stony.	Moderate: gently sloping and strongly sloping; very stony.	Moderate where slopes are 0 to 6 percent. Severe where slopes are 6 to 12 percent.	Moderate: hard bedrock at a depth of 4 to more than 5 feet.
Mount Lucas part	Severe: seasonal high water table at a depth of 1 foot to 4 feet.	Severe: seasonal high water table at a depth of 1 foot to 4 feet.	Severe: seasonal high water table at a depth of 1 foot to 4 feet.	Moderate where slopes are 0 to 6 percent. Severe where slopes are 6 to 12 percent.	Severe: hard bedrock at a depth of 4 to more than 5 feet; seasonal high water table at a depth of 1 foot to 4 feet.
NkD	Severe: moderately steep; Mount Lucas part has seasonal high water table at a depth of 1 foot to 4 feet.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.
Neshaminy variant: NmB	Severe: seasonal high water table at a depth of 2 to more than 5 feet.	Moderate: seasonal high water table at a depth of 2 to more than 5 feet.	Severe: hard bedrock at a depth of 3½ to 4½ feet; seasonal high water table at a depth of 2 to more than 5 feet.	Moderate: gently sloping.	Severe: hard bedrock at a depth of 3½ to 4½ feet; seasonal high water table at a depth of 2 to more than 5 feet.
NmC	Moderate: seasonal high water table at a depth of 2 to more than 5 feet; strongly sloping.	Moderate: strongly sloping.	Severe: hard bedrock at a depth of 3½ to 4½ feet; seasonal high water table at a depth of 2 to more than 5 feet.	Severe: strongly sloping.	Severe: hard bedrock at a depth of 3½ to 4½ feet; seasonal high water table at a depth of 2 to more than 5 feet.

soils used for community development—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Severe: seasonal high water table at a depth of 0 to 2½ feet.	Severe: high stone content.	Severe: seasonal high water table at a depth of 0 to 2½ feet; high stone content.	Severe: seasonal high water table at a depth of 0 to 2½ feet.	Severe: seasonal high water table at a depth of 0 to 2½ feet.	Severe: water table above a depth of 20 inches during season of use.
Moderate: moderate potential frost action.	Slight	Moderate: gently sloping.	Slight	Slight	Slight.
Moderate: moderate potential frost action; strongly sloping.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Severe: steep	Severe: steep; very stony.	Severe: steep; very stony.	Severe: steep	Severe: steep	Severe: steep.
Moderate: moderate potential frost action; gently sloping and strongly sloping.	Moderate: gently sloping and strongly sloping; very stony.	Severe: gently sloping and strongly sloping; very stony.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent.	Moderate: gently sloping and strongly sloping; very stony.	Moderate: very stony.
Severe: high potential frost action; seasonal high water table at a depth of 1 foot to 4 feet.	Moderate: seasonal high water table at a depth of 1 foot to 4 feet; strongly sloping; very stony.	Severe: strongly sloping; very stony.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent.	Moderate: gently sloping and strongly sloping; very stony.	Moderate: very stony.
Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.
Moderate: moderate potential frost action.	Slight	Moderate: gently sloping.	Slight	Slight	Slight.
Moderate: moderate potential frost action.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.

TABLE 10.—*Degree and kind of limitations of*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Norton: NoA	Slight	Moderate: frost action potential.	Severe: slow permeability in subsoil.	Slight: rippable bedrock at a depth of 3½ to more than 5 feet.	Moderate where bedrock is at a depth of more than 6 feet: moderately fine texture. Severe where bedrock is at a depth of less than 6 feet.
NoB	Slight	Moderate: frost action potential.	Severe: slow permeability in subsoil.	Moderate: gently sloping.	Moderate where bedrock is at a depth of more than 6 feet: moderately fine texture. Severe where bedrock is at a depth of less than 6 feet.
NoC, NoC2	Moderate: strongly sloping.	Moderate: strongly sloping.	Severe: slow permeability in subsoil.	Severe: strongly sloping.	Moderate where bedrock is at a depth of more than 6 feet: moderately fine texture. Severe where bedrock is at a depth of less than 6 feet.
Parker: PbC	Moderate: bedrock at a depth of 4 to 10 feet; gently sloping and strongly sloping.	Moderate: strongly sloping.	Moderate: bedrock at a depth of 4 to 10 feet; strongly sloping; hazard of ground-water pollution.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability creates hazard of ground-water pollution.
PcE	Severe: steep	Severe: steep	Severe: steep	Severe: steep	Severe: steep
PeD	Severe: steep	Severe: steep	Severe: steep	Severe: steep	Severe: steep
Parsippany: Ph	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.
Parsippany variant: Pk	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.
Pattenburg: PlC	Moderate: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping; moderately rapid permeability creates hazard of ground-water pollution.	Severe: strongly sloping; moderately rapid permeability.	Severe: rippable bedrock at a depth of 3½ to 5 feet; moderately rapid permeability creates hazard of ground-water pollution.
PlD	Moderate: moderately steep; bedrock at a depth of 3½ to 5 feet.	Moderate: moderately steep.	Severe: moderately steep; moderately rapid permeability creates hazard of ground-water pollution.	Severe: moderately steep.	Severe: bedrock at a depth of 3½ to 5 feet; rapid permeability creates hazard of ground-water pollution.

soils used for community development—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Moderate: moderate potential frost action.	Slight	Moderate: slow permeability.	Slight	Moderate: slow permeability.	Slight.
Moderate: moderate potential frost action.	Slight	Moderate: gently sloping.	Slight	Moderate: slow permeability.	Slight.
Moderate: moderate potential frost action.	Moderate: strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: slow permeability; strongly sloping.	Slight.
Moderate: moderate potential frost action.	Severe: very high gravel content.	Severe: very high gravel content.	Severe: very high gravel content.	Severe: very high gravel content.	Severe: very high gravel content.
Severe: steep	Severe: steep	Severe: steep; high gravel content.	Severe: steep; high gravel content.	Severe: steep; high gravel content.	Severe: steep; high gravel content.
Severe: steep	Severe: steep; very stony.	Severe: steep; very stony.	Severe: steep	Severe: steep	Severe: high gravel content.
Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; water table above a depth of 20 inches during season of use.	Severe: subject to frequent flooding; water table above a depth of 20 inches during season of use.	Severe: subject to frequent flooding; water table above a depth of 20 inches during season of use.
Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; seasonal high water table at surface.	Severe: subject to frequent flooding; water table above a depth of 20 inches during season of use.	Severe: subject to frequent flooding; water table above a depth of 20 inches during season of use.	Severe: subject to frequent flooding; water table above a depth of 20 inches during season of use.
Moderate: strongly sloping; moderate potential frost action.	Moderate: strongly sloping; moderate gravel content.	Severe: strongly sloping; excessive gravel content.	Moderate: strongly sloping; moderate gravel content.	Moderate: strongly sloping.	Slight.
Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Moderate: moderately steep.

TABLE 10.—*Degree and kind of limitations of*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Penn: PmA, PmB, PnB	Moderate: rippable bedrock at a depth of 1½ to 3½ feet.	Moderate: frost-action potential.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.
PmC, PnC	Moderate: rippable bedrock at a depth of 1½ to 3½ feet; strongly sloping.	Moderate: strongly sloping; frost-action potential.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.
Quakertown: QkC	Moderate: strongly sloping.	Moderate: strongly sloping.	Moderate: moderately slow permeability; strongly sloping.	Severe: strongly sloping.	Severe: rippable bedrock at a depth of 3½ to 5 feet.
QkD	Moderate: moderately steep; bedrock at a depth of 3½ to 5 feet.	Moderate: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: bedrock at a depth of 3½ to 5 feet.
Raritan: RbA	Severe: seasonal high water table at a depth of ½ foot to 3 feet; hazard of stream overflow on low terraces.	Severe: high frost-action potential.	Severe: seasonal high water table at a depth of ½ foot to 3 feet; hazard of stream overflow on low terraces.	Severe: seasonal high water table at a depth of ½ foot to 3 feet; hazard of stream overflow on low terraces.	Severe: seasonal high water table at a depth of ½ foot to 3 feet; hazard of stream overflow on low terraces.
Readington: RcB	Moderate: seasonal high water table perched at a depth of 1½ to 4 feet; rippable bedrock at a depth of 3½ to more than 5 feet.	Moderate: frost-action potential.	Severe: seasonal high water table perched at a depth of 1½ to 4 feet; moderately slow permeability.	Moderate: gently sloping.	Severe: rippable bedrock at a depth of 3½ to more than 5 feet.
Reaville: ReA, ReB	Severe: seasonal high water table at a depth of ½ foot to 3 feet.	Severe: high frost-action potential.	Severe: seasonal high water table at a depth of ½ foot to 3 feet; bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: seasonal high water table at a depth of ½ foot to 3 feet; rippable bedrock at a depth of 1½ to 3½ feet.
Riverhead: RhC	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent.	Moderate: frost-action potential.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent: rapid permeability in substratum creates hazard of ground-water pollution.	Severe: rapid permeability; strongly sloping in places.	Severe: rapid permeability creates hazard of ground-water pollution.
Rowland: Ro	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.
Royce: RyB	Slight: rippable bedrock at a depth of 3½ to 6 feet.	Moderate: frost-action potential.	Moderate: bedrock at a depth of 3½ to 6 feet; moderately slow permeability in subsoil.	Moderate: gently sloping; bedrock at a depth of 3½ to 6 feet.	Severe: rippable bedrock at a depth of 3½ to 6 feet.

soils used for community development—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Moderate: moderate potential frost action.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Slight	Slight	Slight.
Moderate: moderate potential frost action.	Moderate: bedrock at a depth of 1½ to 3½ feet; strongly sloping.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Moderate: moderate potential frost action; strongly sloping.	Moderate: strongly sloping; moderately slow permeability.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: strongly sloping.	Slight.
Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Severe: moderately steep.	Moderate: moderately steep.
Severe: high potential frost action; hazard of stream overflow on low terraces.	Moderate: seasonal high water table at a depth of ½ foot to 3 feet; hazard of stream overflow on low terraces.	Moderate: seasonal high water table at a depth of ½ foot to 3 feet; moderately slow permeability.	Moderate: water table above a depth of 20 inches for short periods during season of use.	Moderate: water table below a depth of 20 inches during season of use; hazard of stream overflow on low terraces.	Moderate: water table in places is above a depth of 20 inches for short periods during season of use; hazard of stream overflow on low terraces.
Severe: high potential frost action; seasonal high water table perched at a depth of 1½ to 4 feet.	Slight	Moderate: seasonal high water table perched at a depth of ½ to 4 feet; gently sloping.	Slight	Moderate: moderately slow permeability.	Slight.
Severe: seasonal high water table at a depth of ½ foot to 3 feet; high potential frost action.	Moderate: seasonal high water table at a depth of ½ foot to 3 feet.	Severe: seasonal high water table at a depth of ½ foot to 3 feet.	Slight: water table below a depth of 20 inches during season of use.	Moderate: water table below a depth of 20 inches during season of use.	Moderate: water table below a depth of 20 inches during season of use.
Moderate: frost-action potential.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent.	Moderate where slopes are 3 to 8 percent. Severe where slopes are 8 to 15 percent.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent.	Slight.
Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.
Moderate: moderate potential frost action.	Slight	Moderate: gently sloping.	Slight	Slight	Slight.

TABLE 10.—*Degree and kind of limitations of*

Soil series and map symbols	Foundations for dwellings—		Septic-tank absorption fields	Sewage lagoons	Sanitary landfills[1]
	With basements	Without basements			
Udifluvents and Ochrepts: UD.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.
Urban land: Um. Too variable to rate.					
Watchung: Wc	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.
Whippany: WhA	Severe: seasonal high water table at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table at a depth of ½ foot to 1½ feet; high frost-action potential.	Severe: seasonal high water table at a depth of ½ foot to 1½ feet; slow permeability.	Slight	Severe: seasonal high water table at a depth of ½ foot to 1½ feet.

[1] Onsite deep studies of the underlying strata, water table, and hazards of aquifer pollution need to be made for landfills deeper than 5 or

Relief

Somerset County has nearly all of its acreage in the Piedmont Plateau. Only about 6 percent, or 11,800 acres, is in the Highlands. Elevation ranges from 10 feet along the Raritan River near Somerset to 857 feet on a hill north of Bernardsville.

The Piedmont area in the county is made up of gently undulating and moderately sloping upland plains and narrow flood plains along the major streams. A steep ridge, Sourland Mountain, is in the southern part of the county near Neshanic. A pair of V-shaped steep ridges (Watchung Mountains) extends from the vicinity of Watchung through Martinsville and Chimney Rock to Pluckemin. Blufflike escarpments are adjacent to some streams, such as at Dock Watch Hollow and Millington Gorge.

The Highland area is made up of moderate slopes on the uplands that drop abruptly to the bordering lowlands of the Piedmont Plateau. Some streams and drainageways have cut deeply into the hills, making deep indentations.

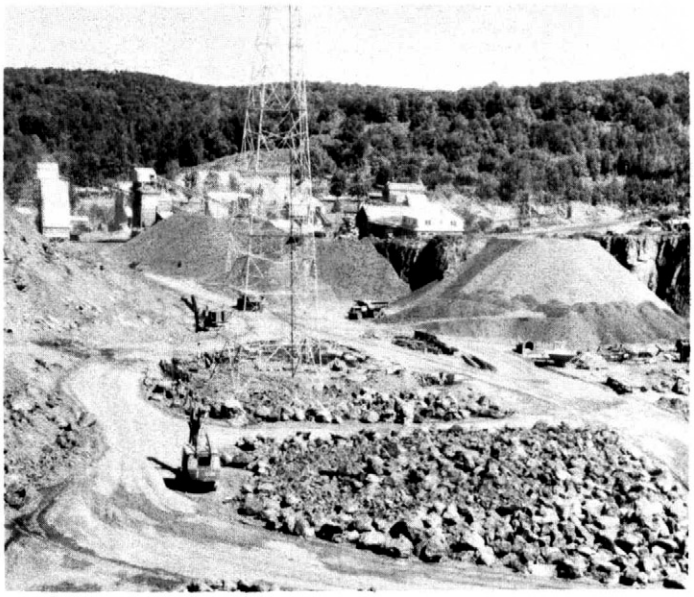

Figure 12.—**Traprock quarry in the Watchung Mountains. The basalt is crushed and used as road mantle, roofing granules, and aggregate.**

Time

The length of time the parent material has been in place and exposed to the active forces of climate and vegetation is reflected in the degree of horizon differentiation, although this is influenced by other factors as well. A mature soil is one that has well-defined, genetically related horizons; an immature soil is one that shows little or no horizonation. In this county deep soils that have clearly expressed horizons indicate that the soil material has been in the same place for thousands of years. Soil horizons have formed as a result of the movement of clays, organic matter, and bases from the A horizon into the B horizon. This movement was caused by the action of water over long periods. Immature soils on flood plains do not have such characteristic horizons.

Processes of Horizon Differentiation

Several processes are involved in the formation of soil horizons in the soils of Somerset County. These include the accumulation of organic matter, the leaching of soluble salts, the reduction and translocation of iron, the formation of soil structure, and some translocation and loss of clay minerals, aluminum, silica, and iron. The processes are continually taking place and generally at the same

soils used for community development—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic and play areas	Campsites for trailers and tents	Paths and trails
Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.	Severe: hazard of frequent stream overflow.
Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.	Severe: seasonal high water table at a depth of 0 to 1 foot.
Severe: seasonal high water table at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table at a depth of ½ foot to 1½ feet.	Severe: seasonal high water table at a depth of ½ foot to 1½ feet.	Moderate: water table above a depth of 20 inches for short periods during season of use.	Severe: water table above a depth of 20 inches for short periods during season of use.	Moderate: water table above a depth of 20 inches for short periods during season of use.

6 feet.

time throughout the profile. They are measured in thousands of years.

The accumulation of organic matter takes place with the decomposition of plant residue. This process darkens the surface layer and helps form the A1 horizon. Organic matter, once it has been lost, takes a long time to be replaced. The surface layers of the soils in the county average about 3.5 percent organic matter.

Mature soils in Somerset County have distinct subsoil horizons. It is believed that some of the lime and other soluble salts are leached before translocation of iron and clay takes place. Many factors affect this leaching, such as the kinds of salt originally present, the depth to which the soil solution percolates, and the texture of the soil profile.

Most well drained and moderately well drained soils in Somerset County have yellowish-brown or reddish-brown horizons in the subsoil. These colors result mainly from thin coatings of iron oxides on sand and silt grains, although in some soils, such as those of the Lehigh series, the colors are inherited from the underlying bedrock. Weak to moderate development of subangular blocky structure has taken place, and the subsoil generally contains considerably more clay than the overlying surface horizons.

The reduction and transfer of iron are associated mainly with the wetter, more poorly drained soils. This process is called gleying. Poorly drained to very poorly drained soils, such as Croton, Cokesbury, and Watchung, have a subsoil and underlying material that are grayish in color, indicating the reduction and transfer of iron. Moderately well drained to somewhat poorly drained soils have yellowish-brown, reddish-brown, and gray mottles, which indicate the segregation of iron.

A fragipan developed in the subsoil of many moderately well drained and somewhat poorly drained soils. This horizon is very firm and brittle when moist and hard when dry. Soil particles are tightly packed, so that bulk density is high and pore space is low. Genesis of fragipans is not fully understood, but studies show that swelling and shrinking take place in alternating wet and dry periods. This may account for the tight packing of soil particles and, also, the gross polygonal pattern of cracks in fragipans. Clay, silica, and oxides of aluminum are the cementing agents that most commonly cause brittleness and hardness.

Major Soil Horizons

The results of the soil-forming factors and processes can be distinguished by the different layers, or soil horizons, seen in a soil profile. The soil profile extends from the surface down to material that is little altered by the soil-forming processes.

The A horizon is the surface layer. The uppermost part, which contains the largest accumulation of organic matter, is called the A1 horizon. Beneath the A1 horizon many soils have a layer of maximum leaching, called the A2 horizon. The A2 horizon of some soils in Somerset County shows brownish colors as a result of the oxidation of iron.

The B horizon lies beneath the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation, or illuviation, of clay, iron, aluminum, or other compounds leached from the A horizon. In some soils the B horizon is formed through alteration in place rather than through illuviation. The alteration may be caused by oxidation and reduction of iron or by the weathering of clay minerals. Generally the B horizon is firmer than the A horizon and has blocky or prismatic structure. It is generally lighter in color than the A1 horizon but darker than the C horizon. Some immature soils do not have a B horizon.

The C horizon is below the A or B horizon. It consists of material that has been little altered by the soil-forming processes but has been modified by weathering.

TABLE 11.—*Guide for landscape planting of deciduous trees*

[The letter "x" indicates species is desirable for the features indicated. The symbol > means more than]

Common and botanical names of deciduous trees	Landscape planting groups	Shape of mature trees	Ornamental features				Growth rate	Potential height
			Flower	Fruit	Shade	Autumn foliage		
								Feet
Ash, white (*Fraxinus americana*)	2, 3	Round			x	x	Rapid	>50
Basswood (*Tilia americana*)	2, 3	Round			x		Rapid	>50
Beech (*Fagus grandifolia*)	2, 3	Round	x		x		Slow	>50
Birch, paper (*Betula papyrifera*)	2, 3	Round		x		x	Rapid	>50
Chestnut, Chinese (*Castanea molissima*)	3	Round		x			Rapid	25–50
Crabapple, flowering (*Malus species*)	3	Round	x			x	Moderate	15–25
Dogwood, flowering (*Cornus florida*)	2, 3	Round	x			x	Slow	25
Ginkgo (*Ginkgo biloba*)	3	Oval			x	x	Moderate	>50
Gum, black (*Nyssa sylvatica*)	2, 3	Oval	x		x		Moderate	25–50
Hawthorn (*Crataegus species*)	2, 3	Round	x				Rapid	15
Honeylocust (*Gleditsia triacanthos*)	3	Oval	x		x		Rapid	>50
Maple, red (*Acer rubrum*)	1, 2, 3	Oval			x	x	Rapid	>50
Maple, sugar (*Acer saccharum*)	2, 3	Round			x	x	Moderate	>50
Mountainash:								
American (*Sorbus americana*)	2, 3	Oval	x				Rapid	25–50
European (*Sorbus aucuparia*)	2, 3	Oval	x				Rapid	25
Oak:								
Pin (*Quercus palustris*)	1, 2, 3	Pyramidal			x	x	Moderate	>50
Red (*Quercus borealis*)	2, 3	Round			x	x	Rapid	>50
Scarlet (*Quercus coccinea*)	2, 3	Pyramidal			x	x	Moderate	>50
White (*Quercus alba*)	3	Round			x		Slow	>50
Serviceberry (Juneberry) (*Amelanchier canadensis*)	3	Round	x			x	Moderate	25–50
Sweetgum (*Liquidambar styraciflua*)	1, 2, 3	Conical			x	x	Rapid	>50
Walnut, black (*Juglans nigra*)	3	Round		x			Rapid	>50
Willow, Babylon weeping (*Salix babylonica*)	1, 2, 3	Umbrella			x		Rapid	25–50
Yellow-poplar (*Lirodendron tulipifera*)	2, 3	Oval	x		x	x	Rapid	>50

TABLE 12.—*Guide for landscape planting of deciduous shrubs*

Common and botanical names of deciduous shrubs	Landscape planting groups	Uses						Potential height
		Wildlife food	Ornamental	Autumn foliage	Screen	Windbreak	Critical area	
								Feet
Arrowwood (*Viburnum dentatum*)	1, 2, 3	x	x	x	x			10–15
Autumn-olive, cardinal (*Elaeagnus umbellata*)	3	x	x		x	x	x	10–15
Azalea, flame (*Rhododendron calendulaceum*)	3		x					10–15
Bayberry (*Myrica caroliniensis*)	2, 3	x	x					6–10
Blackhaw (*Viburnum prunifolium*)	2, 3	x					x	15–20
Coralberry (*Symphoricarpos orbiculatus*)	2, 3	x					x	2–6
Cranberry, highbush (*Viburnum trilobum*)	2, 3	x	x					10–15
Dogwood:								
Redosier (*Cornus stolonifera*)	1, 2, 3	x	x	x	x			10
Silky (*Cornus amomum*)	1, 2, 3	x	x	x				10
Firethorn, laland (*Pyracantha coccinea lalandi*)	3	x						10–20
Forsythia (*Forsythia species*)	3		x		x		x	10–15
Honeysuckle:								
Amur (*Lonicera maacki*)	3	x	x		x		x	10–15
Tatarian (*Lonicera tatarica*)	3	x	x		x		x	10–15
Privet, Amur (*Ligustrum amurense*)	3		x		x	x	x	15–20
Winterberry (*Ilex verticillata*)	1, 2, 3		x					10

TABLE 13.—*Guide for landscape planting of evergreen trees*

Common and botanical names of evergreen trees	Landscape planting group	Uses					Potential height
		Ornamental	Windbreak	Screen	Critical area	Growth rate	
							Feet
Arborvitae:							
American or northern white-cedar (*Thuja occidentalis*)	2, 3	x	x	x		Slow	>50
Oriental (*Thuja orientalis*)	2, 3	x	x	x		Slow	>50
Hemlock, eastern (Canada) (*Tsuga canadensis*)	3	x	x	x		Moderate	>50
Larch:							
European (*Larix decidua*)	3					Rapid	>50
Japanese (*Larix leptolepis*)	3				x	Rapid	>50
Pine:							
Austrian (*Pinus nigra*)	3	x	x	x		Rapid	>50
White (*Pinus strobus*)	1, 2, 3		x	x		Rapid	>50
Spruce:							
Norway (*Picea abies*)	2, 3	x	x	x		Moderate	>50
White (*Picea glauca*)	1, 2, 3		x	x		Moderate	>50

TABLE 14.—*Guide for landscape planting of evergreen shrubs*

Common and botanical names of evergreen shrubs	Landscape planting groups	Uses						Potential height
		Wildlife food	Ornamental	Autumn foliage	Screen	Windbreak	Critical area	
								Feet
Azalea (*Rhododendron species*)	3		x					5–10
Mountainlaurel (*Kalmia latifolia*)	2, 3		x					5–15
Pine, mugo (*Pinus mugo*)	3		x					10
Rhododendron (*Rhododendron maximum*)	2, 3		x		x			10–15
Yew, Japanese (*Taxus cuspidata*)	3		x		x	x		(1)

[1] Variable.

Classification of Soils

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

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison over large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*9, 12*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that soils of similar genesis, or mode of origin, are grouped. In table 16 the soil series of Somerset County are placed in family, subgroup, and order categories of the current system. Classes of the current system are briefly defined in the paragraphs that follow.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ult-i-sol).

SUBORDER. Each order is divided into suborders, based mainly on those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences that result from climate or vegetation. The names of suborders have two syllables, the last of which indicates the order. An example is *Aquult* (*Aqu,* meaning water or wet, and *ult,* from Ultisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is *Fragiaquults* (*Fragi* meaning brittle, *aqu* for wetness or water, and *ult* from Ultisols).

SUBGROUP. Great groups are divided into subgroups, one that represents the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives in front of the name of the great group. An example is *Typic Fragiaquult* (a typical Fragiaquult).

TABLE 15.—*Relationships of the soil series according to physiographic position, parent material, dominant texture, and drainage*

Position, parent material, and dominant texture	Excessively drained, somewhat excessively drained, and well drained	Moderately well drained	Somewhat poorly drained	Poorly drained and very poorly drained
Soils on uplands:				
Soils that formed chiefly in residual material—				
Weathered from underlying red Triassic shale:				
Shallow to rock, loamy-skeletal subsoil	Klinesville			
Moderately deep to rock, fine-loamy subsoil	Penn	Reaville	Reaville	
Deep to rock, fine-loamy subsoil		Readington	Abbottstown	Croton.
Weathered from underlying gray Triassic sandstone or shale, fine-loamy subsoil	Quakertown			
Weathered from red Triassic conglomerate:				
Loamy-skeletal subsoil	Pattenburg			
Fine-loamy subsoil	Arendtsville			
Weathered from underlying metamorphosed shale, fine-loamy subsoil		Lehigh	Lehigh	Croton.
Weathered from underlying dark-gray diabase or basalt (traprock), fine-loamy subsoil	Neshaminy	Mount Lucas	Mount Lucas	Watchung.
Weathered from underlying granitic gneiss:				
Loamy-skeletal subsoil	Parker			
Fine-loamy subsoil	Edneyville	Califon	Califon	Cokesbury.
Soils that formed in transported material—				
Silt loam loess mantle underlain by weathered Triassic shale, fine-loamy or fine-silty subsoil	Bucks[1]	Lawrenceville	Chalfont	
Weathered basalt colluvium underlain by shale or basalt bedrock, fine-loamy subsoil	Neshaminy variant[2]	Amwell	Amwell	
Old till composed chiefly of granitic gneiss, fine-loamy subsoil		Califon	Califon	Cokesbury.
Old till composed chiefly of granitic gneiss and limestone, fine-loamy subsoil		Bartley		
Old till composed chiefly of red shale or siltstone and containing some gneiss:				
Fine-loamy subsoil		Meckesville		
Fine subsoil	Norton	Lansdowne	Lansdowne	
Old sedimentary deposits composed chiefly of red Triassic shale containing some quartzose sand and gravel and underlain by weathered red shale, fine-loamy subsoil	Royce			
Coastal plain sediments mixed with and underlain by weathered Triassic shale or diabase bedrock, clayey subsoil		Keyport		Elkton.
Soils on terraces:				
Soils that formed chiefly in alluvium derived from red Triassic shale, sandstone, or conglomerate but containing granitic gneiss, basalt, and many other materials as well				
Fine-loamy subsoil	Birdsboro	Raritan	Raritan	Lamington.
Coarse-loamy subsoil	Dunellen	Dunellen variant		
Soils that formed chiefly in alluvium derived from granitic gneiss, sandstone, and acid shale, corase-loamy subsoil	Riverhead			
Soils on flood plains and in old glacial lakes:				
Alluvium chiefly derived from red Triassic shale or sandstone, fine-loamy subsoil		Rowland	Rowland	Bowmansville.
Alluvium composed of a mixture of materials derived from granitic gneiss, red shale, conglomerate, sandstone, and quartzite, dominantly loamy subsoil	Udifluvents and Ochrepts.	Udifluvents and Ochrepts.	Udifluvents and Ochrepts.	Fluvaquents.
Lacustrine deposits derived from many different materials and underlain by sandy or gravelly strata, fine subsoil			Whippany	Parsippany, Parsippany variant.

[1] In places, the Bucks soils formed chiefly in residual material.
[2] This soil is moderately well drained in places.

TABLE 16.—*Soils classified according to the current system of classification*

Series	Family	Subgroup	Order
Abbottstown	Fine-loamy, mixed, mesic	Aeric Fragiudalfs	Alfisols.
Amwell	Fine-loamy, mixed, mesic	Aquic Fragiudalfs	Alfisols.
Arendtsville	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Bartley	Fine-loamy, mixed, mesic	Typic Fragiudalfs	Alfisols.
Birdsboro	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Bowmansville	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Bucks	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Califon	Fine-loamy, mixed, mesic	Typic Fragiudults	Ultisols.
Chalfont	Fine-silty, mixed, mesic	Aquic Fragiudalfs	Alfisols.
Cokesbury	Fine-loamy, mixed, mesic	Typic Fragiaquults	Ultisols.
Croton	Fine-silty, mixed, mesic	Typic Fragiaqualfs	Alfisols.
Dunellen	Coarse-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Dunellen variant	Coarse-loamy, mixed, mesic	Aquic Hapludults	Ultisols.
Edneyville	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Elkton	Clayey, mixed, mesic	Typic Ochraquults	Ultisols.
Keyport	Clayey, mixed, mesic	Aquic Hapludults	Ultisols.
Klinesville	Loamy-skeletal, mixed, mesic	Lithic Dystrochrepts	Inceptisols.
Lamington	Fine-loamy, mixed, mesic	Typic Fragiaquults	Ultisols.
Lansdowne	Fine, mixed, mesic	Aquultic Hapludalfs	Alfisols.
Lawrenceville	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.
Lehigh	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Meckesville[1]	Fine-loamy, mixed, mesic	Typic Fragiudults	Ultisols.
Mount Lucas	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Neshaminy	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Neshaminy variant	Fine-loamy, mixed, mesic	Typic Fragiudalfs	Alfisols.
Norton	Fine, mixed, mesic	Ultic Hapludalfs	Alfisols.
Parker	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Parsippany	Fine, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Parsippany variant	Fine, mixed, mesic	Typic Ochraqualfs	Alfisols.
Pattenburg	Loamy-skeletal, mixed, mesic	Typic Hapludults	Ultisols.
Penn	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Quakertown	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Raritan	Fine-loamy, mixed, mesic	Aquic Fragiudults	Ultisols.
Readington	Fine-loamy, mixed, mesic	Typic Fragiudalfs	Alfisols.
Reaville	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Riverhead	Coarse-loamy, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Rowland	Fine-loamy, mixed, mesic	Fluvaquentic Dystrochrepts	Inceptisols.
Royce	Fine-loamy, mixed, mesic	Humic Hapludults	Ultisols.
Watchung	Fine, mixed, mesic	Typic Ochraqualfs	Alfisols.
Whippany	Fine, mixed, mesic	Aquic Hapludalfs	Alfisols.

[1] These soils are taxadjuncts to the Meckesville series. They are outside the defined range for the series in that they are yellower in the upper part of the B horizon, have mottles within a depth of 20 inches, and have a granitic gneiss component.

FAMILY. Soil families are established within a subgroup mainly on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (table 16). An example is the fine-loamy, mixed, mesic family of Typic Fragiaquults.

Physiography and Relief

Somerset County is in two physiographic divisions in New Jersey. That part of the county north of Bernardsville, Far Hills, and Bedminster is known as the Highlands and is the southernmost division of the Appalachian Province. South of the Highlands is the Piedmont Plateau.

In the northern part of Somerset County, and making up about 6 percent of the total area, is an area in the Appalachian Mountains that is part of the Highlands. This area consists of gently sloping to steep uplands that are underlain by gneiss, quartzite, and limestone rock (*3*). It consists of broad, rounded or flat-topped ridges that rise 400 to 600 feet above the lowlands to the south.

The Highlands are dissected by Peapack and Gladstone Brooks, the North Branch of the Raritan River, and the Lamington River. These streams flow in a southerly direction through the Piedmont Plateau.

About 94 percent of Somerset County lies in the Piedmont Plateau. It is mainly a lowland consisting of gently rounded hills separated by wide valleys, but some ridges and isolated hills rise conspicuously above the general surface. The Passaic Basin, partly in the northeastern part of

TABLE 17.—*Temperature and precipitation data*

[All data from Somerville, New Jersey]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—		Days that have snow cover of 1 inch or more	Average depth of snow on days that have snow cover
			Maximum temperature higher than—	Minimum temperature lower than—		Less than—	More than—		
	°F	°F	°F	°F	Inches	Inches	Inches		Inches
January	39	21	55	2	3.3	0.9	4.8	9	5
February	40	21	57	6	2.7	1.8	4.2	8	6
March	50	29	64	15	4.0	2.0	5.9	3	5
April	62	38	77	27	3.7	1.5	5.9	(1)	2
May	73	48	87	35	3.8	1.4	6.3		
June	82	57	95	46	3.9	1.2	5.5		
July	86	62	98	52	4.7	1.4	8.5		
August	84	61	95	50	5.0	1.5	8.4		
September	78	54	89	39	3.8	1.2	6.9		
October	67	43	83	29	3.3	1.0	6.1		
November	54	33	70	20	3.7	1.8	6.1	1	2
December	42	24	60	7	3.3	.9	6.2	7	5
Year	63	41	[2] 99	[3] −3	45.2	33.1	53.1	28	6

[1] Less than 0.5 day.
[2] Average annual maximum temperature.
[3] Average annual minimum temperature.

the county, was the site of the largest glacial lake in New Jersey. Deposits of sediment ranging from several to many feet thick cover the floor of the basin. The underlying bedrock is Brunswick shale or basalt. The Passaic Basin is dissected by the Passaic and Dead Rivers, which flow northeast into Morris County.

Three basalt sheets or lava flows formed the Watchung Mountains in the northeastern part of the county. The second Watchung Mountains formed the boundary of glacial Lake Passaic. Only part of the Watchung Mountains, which extend into Union, Morris, and Passaic Counties, is in Somerset County. In places between the individual lava flows of the Watchung Mountains is as much as 100 feet of shale. Other intruded strata formed the Sourland Mountains and the diabase intrusion at Rocky Hill.

During the most recent period of glaciation, large amounts of meltwater poured onto the Piedmont lowlands south of the Watchung Mountains in the vicinity of North Plainfield, Green Brook, Bound Brook, Manville, and Millstone. Considerable amounts of glacial outwash material were deposited along Green Brook and the Raritan and Millstone Rivers. These glacial deposits are mainly granitic material.

Brunswick shale, the dominant formation in the Piedmont lowlands, is a soft red shale, sandstone, argillite, or siltstone that covers the remaining part of the county. The elevation ranges from about 50 feet to 400 feet above sea level. Where the Brunswick shale is adjacent to an intrusion of basalt or diabase, the shale is baked or metamorphosed to a hard, black or gray shale or slate. The Piedmont lowland is dissected by the lower reaches of the Lamington River, the North and South Branches of the Raritan River, the Millstone River, and several smaller tributaries.

Climate[4]

Somerset County, while humid and temperate, has a continental climate that is influenced only slightly by the ocean. The data given in tables 17 and 18 are from the cooperative weather station at Somerville.

Summer temperatures occasionally exceed 100°F., but temperatures in the middle or upper 90's occur frequently. Winter temperatures generally are not below 10° for long periods, but drainage tile must be placed below a depth of 30 inches for protection against freezing.

The average annual precipitation is about 45 inches, and the monthly averages show the precipitation is well distributed over the year. Nearly every year, however, there are periods when there is not enough rainfall to supply moisture for high-value crops. Consequently, the irrigated acreage has increased considerably in recent years, especially during the drought of 1961-66. Rainfall is heaviest in July and August. Much of the summer rainfall comes as thunderstorms, and about 30 occur annually. Summer rainfall amounts and intensities are greatly affected by the Watchung Mountains. Most summer

[4] By DONALD V. DUNLAP, former State climatologist, Environmental Science Administration, U.S. Department of Commerce.

TABLE 18.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Somerville, New Jersey]

Probability	Dates for given probability and temperatures of—				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	March 25	March 31	April 13	April 28	May 7
2 years in 10 later than	March 19	March 25	April 6	April 22	May 3
5 years in 10 later than	March 10	March 16	March 30	April 15	April 27
Fall:					
1 year in 10 earlier than	November 21	November 17	October 20	October 9	October 2
2 years in 10 earlier than	November 26	November 13	October 28	October 17	October 7
5 years in 10 earlier than	December 5	November 22	November 7	October 28	October 13

showers come from the west, and sometimes the heavily laden clouds pass over Somerville and Bound Brook but cannot readily pass over the mountain. On August 2, 1973, between 8 and 9 inches of rain fell in about 15 hours in the vicinity of North Plainfield, Watchung, Green Brook, and Bound Brook. Even though the stream watersheds are not extensive and are mostly wooded, all streams in the area overflowed their banks and caused severe losses to residential and commercial properties adjacent to the streams.

The average length of the growing season in the county is about 169 days. The average date of the last killing freeze in spring is April 27, and that of the first in fall is October 13. Probabilities for the last damaging cold temperature in spring and the first in fall are listed in table 18.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

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

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

Coarse fragments. Mineral or rock particles more than 2 millimeters in diameter.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Conglomerate. Rock composed of gravel and rounded stones cemented together by hardened clay, lime, iron oxide, or silica.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have uniform color in the A and upper part of the B horizon and mottling in the lower part of the B and C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fine-textured soil. *Moderately fine textured*: Clay loam, sandy clay loam, silty clay loam; *Fine-textured*: sandy clay, silty clay, and clay. Roughly, soil that contains 35 percent or more of clay.

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

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

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

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

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

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are as much as 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Leached soil. A soil from which most of the soluble materials have been removed from the entire profile or have been removed from one part of the profile and have accumulated in another part.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

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

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

Percolation. The downward movement of water through the soil.

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

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 a semisolid to a plastic state.

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

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

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

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

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

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

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

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

Stones. Rock fragments greater than 10 inches in diameter if rounded, and greater than 15 inches along the longer axis if flat.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

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

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

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

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water for more than a month. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which it belongs. The suitability of the soils for use as cropland is discussed in the soil descriptions. Other information is given in tables as follows:

Acreage and extent, table 1, page 9.
Estimated yields, tables 2 and 3, pages 54 through 55.
Woodland, table 4, page 56, and table 5, page 58.
Wildlife, table 6, page 60.
Engineering uses of the soils, tables 7, 8, and 9, pages 64 through 87.
Community development, table 10, page 90.

Map symbol	Mapping unit	Described on page	Capability unit	Woodland suitability group	Landscape planting group
AbA	Abbottstown silt loam, 0 to 2 percent slopes	10	IIIw-71	3w1	2
AbB	Abbottstown silt loam, 2 to 6 percent slopes	10	IIIw-71	3w1	2
AmB	Amwell gravelly loam, 2 to 6 percent slopes	11	IIIw-70	2w1	2
AmC	Amwell gravelly loam, 6 to 12 percent slopes	11	IIIe-70	2w1	2
AnB	Amwell gravelly silt loam, rock substratum, 2 to 6 percent slopes	11	IIIw-70	2w1	2
AnC	Amwell gravelly silt loam, rock substratum, 6 to 12 percent slopes	11	IIIe-70	2w1	2
ArB	Arendtsville gravelly loam, 2 to 6 percent slopes	12	IIe-55	2o1	3
ArC	Arendtsville gravelly loam, 6 to 12 percent slopes	12	IIIe-53	2o1	3
BaC	Bartley loam, 3 to 15 percent slopes	13	IIIe-71	2w1	3
BdA	Birdsboro silt loam, 0 to 2 percent slopes	14	I-55	2o1	3
BdB	Birdsboro silt loam, 2 to 6 percent slopes	14	IIe-55	2o1	3
BdC	Birdsboro silt loam, 6 to 12 percent slopes	14	IIIe-55	2o1	3
Bt	Bowmansville silt loam	15	VIw-86	1w1	1
BuB	Bucks silt loam, 2 to 6 percent slopes	16	IIe-55	2o1	3
BuC2	Bucks silt loam, 6 to 12 percent slopes, eroded	16	IIIe-55	2o1	3
CaB	Califon gravelly loam, 3 to 8 percent slopes	17	IIe-71	2w1	2
CcB	Califon very stony loam, 3 to 8 percent slopes	17	VIs-75	2w1	2
CdB	Chalfont silt loam, 2 to 6 percent slopes	18	IIIw-70	3w1	2
CdC	Chalfont silt loam, 6 to 12 percent slopes	18	IIIe-70	3w1	2
CeB	Chalfont stony silt loam, 2 to 6 percent slopes	18	IIIw-70	3w1	2
CeC	Chalfont stony silt loam, 6 to 12 percent slopes	18	IIIe-70	3w1	2
CeE	Chalfont stony silt loam, 12 to 25 percent slopes	18	VIe-70	3w1	2
CpB	Cokesbury very stony loam, 0 to 8 percent slopes	19	VIIs-77	3w1	1
CrA	Croton silt loam, 0 to 2 percent slopes	20	IVw-80	3w1	1
CrB	Croton silt loam, 2 to 6 percent slopes	20	IVw-80	3w1	1
DnA	Dunellen sandy loam, 0 to 2 percent slopes	21	I-56	2o1	3
DnB	Dunellen sandy loam, 2 to 6 percent slopes	21	IIe-56	2o1	3
DnC	Dunellen sandy loam, 6 to 12 percent slopes	21	IIIe-56	2o1	3
Dw	Dunellen sandy loam, moderately well drained variant	21	IIw-73	2o1	3
EdB	Edneyville gravelly loam, 3 to 8 percent slopes	23	IIe-58	2o1	3
EdC	Edneyville gravelly loam, 8 to 15 percent slopes	23	IIIe-58	2o1	3
EdD	Edneyville gravelly loam, 15 to 25 percent slopes	23	IVe-58	2o1	3
Ek	Elkton silt loam	24	IIIw-71	3w1	1
FL	Fluvaquents	24	VIw-86	2w2	1
KfA	Keyport silt loam, 0 to 2 percent slopes	25	IIw-70	2w1	3
KfB	Keyport silt loam, 2 to 6 percent slopes	25	IIe-71	2w1	3
KlC	Klinesville shaly loam, 2 to 12 percent slopes	26	IVe-66	4d1	3
KlD	Klinesville shaly loam, 12 to 18 percent slopes	26	VIe-66	4d1	3
KlE	Klinesville shaly loam, 18 to 35 percent slopes	26	VIIe-66	4d1	3
La	Lamington silt loam	27	IVw-86	1w1	1
LbA	Lansdowne silt loam, 0 to 2 percent slopes	28	IIIw-70	3w1	2
LbB	Lansdowne silt loam, 2 to 6 percent slopes	28	IIIw-70	3w1	2
LeB	Lawrenceville silt loam, 2 to 6 percent slopes	28	IIe-71	2w1	3
LeC	Lawrenceville silt loam, 6 to 12 percent slopes	29	IIIe-71	2w1	3
LhB	Lehigh silt loam, 2 to 6 percent slopes	29	IIIw-70	3w1	2
LhC	Lehigh silt loam, 6 to 15 percent slopes	29	IIIe-70	3w1	2

Map symbol	Mapping unit	Described on page	Capability unit	Woodland suitability group	Landscape planting group
MeB	Meckesville gravelly loam, 2 to 6 percent slopes	30	IIe-51	2o1	3
MeC	Meckesville gravelly loam, 6 to 12 percent slopes	30	IIIe-51	2o1	3
MoB	Mount Lucas silt loam, 2 to 6 percent slopes	31	IIe-71	2w1	2
MpC	Mount Lucas gravelly silt loam, 6 to 12 percent slopes	31	IIIe-71	2w1	2
MuB	Mount Lucas-Watchung very stony silt loams, 2 to 12 percent slopes	32	VIIs-77	2w1	2
NeB	Neshaminy silt loam, 2 to 6 percent slopes	33	IIe-55	2o1	3
NeC	Neshaminy silt loam, 6 to 12 percent slopes	33	IIIe-55	2o1	3
NhE	Neshaminy very stony silt loam, 18 to 35 percent slopes	33	VIIs-61	2o1	3
NkC	Neshaminy-Mount Lucas very stony silt loams, 2 to 12 percent slopes	34	VIs-61	2o1	3
NkD	Neshaminy-Mount Lucas very stony silt loams, 12 to 18 percent slopes	34	VIs-61	2o1	3
NmB	Neshaminy silt loam, fragipan variant, 2 to 6 percent slopes	35	IIe-55	2o1	3
NmC	Neshaminy silt loam, fragipan variant, 6 to 12 percent slopes	35	IIIe-55	2o1	3
NoA	Norton loam, 0 to 2 percent slopes	36	I-51	3o1	3
NoB	Norton loam, 2 to 6 percent slopes	36	IIe-51	3o1	3
NoC	Norton loam, 6 to 12 percent slopes	36	IIIe-51	3o1	3
NoC2	Norton loam, 6 to 12 percent slopes, eroded	36	IIIe-51	3o1	3
PbC	Parker very gravelly sandy loam, 3 to 15 percent slopes	37	IVs-58	3f1	3
PcE	Parker rocky sandy loam, 25 to 35 percent slopes	37	VIIs-60	3x1	3
PeD	Parker-Edneyville very stony soils, 15 to 25 percent slopes	37	VIs-22	3x1	1
Ph	Parsippany silt loam	38	IVw-80	3w1	1
Pk	Parsippany silt loam, very poorly drained variant	39	VIw-80	3w1	1
PlC	Pattenburg gravelly loam, 6 to 12 percent slopes	40	IIIe-58	2o1	3
PlD	Pattenburg gravelly loam, 12 to 18 percent slopes	40	IVe-58	2o1	3
PmA	Penn silt loam, 0 to 2 percent slopes	40	IIs-65	3o1	3
PmB	Penn silt loam, 2 to 6 percent slopes	41	IIe-65	3o1	3
PmC	Penn silt loam, 6 to 12 percent slopes	41	IIIe-65	3o1	3
PnB	Penn shaly silt loam, 2 to 6 percent slopes	41	IIe-65	3o1	3
PnC	Penn shaly silt loam, 6 to 12 percent slopes	42	IIIe-65	3o1	3
QkC	Quakertown silt loam, 2 to 12 percent slopes	42	IIIe-55	2o1	3
QkD	Quakertown silt loam, 12 to 18 percent slopes	43	IVe-55	2o1	3
RbA	Raritan silt loam, 0 to 4 percent slopes	43	IIw-71	3w1	2
RcB	Readington silt loam, 2 to 6 percent slopes	44	IIe-71	3w1	3
ReA	Reaville silt loam, 0 to 2 percent slopes	45	IIIw-76	4w1	2
ReB	Reaville silt loam, 2 to 6 percent slopes	45	IIIw-76	4w1	2
RhC	Riverhead sandy loam, 3 to 15 percent slopes	46	IIIe-58	3o1	3
Ro	Rowland silt loam	47	Vw-78	2w2	2
RyB	Royce silt loam, 2 to 6 percent slopes	47	IIe-55	2o1	3
UD	Udifluvents and Ochrepts	48	IIw-79	2w2	2
Um	Urban land	48	-------	---	---
Wc	Watchung silt loam	49	Vw-80	1w1	1
WhA	Whippany silt loam, 0 to 4 percent slopes	50	IIw-70	2w1	2

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