SOIL SURVEY OF

Cumberland 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 1971–73. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the New Jersey Agricultural Experiment Station, Cook College, Rutgers, The State University, and the New Jersey Department of Agriculture, State Soil Conservation Committee. The Board of Freeholders of Cumberland County provided financial assistance to complete the soil survey. It is part of the technical assistance furnished to the Cumberland County Soil Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the general management for crops and pasture and use of the soils for woodland.

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

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

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Land-use 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 the soils in the section "Formation and Classification of Soils."

Newcomers in the area 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 in the section "General Nature of the County."

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Summary of Tables

SOIL SURVEY OF CUMBERLAND 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

CUMBERLAND COUNTY is in the southern part of New Jersey (fig. 1). It has an area of 321,536 acres, of which 1,762 acres is bodies of water larger than 40 acres. The population of the county in 1970 was 121,370, an increase of 13.6 percent over the population in 1960. Bridgeton, the county seat, had the largest urban population of 20,435. Millville and Vineland also have urban centers. The average population density in 1970 was 242 per square mile but it ranged from 32 in the most rural township to 3,144 in Bridgeton.

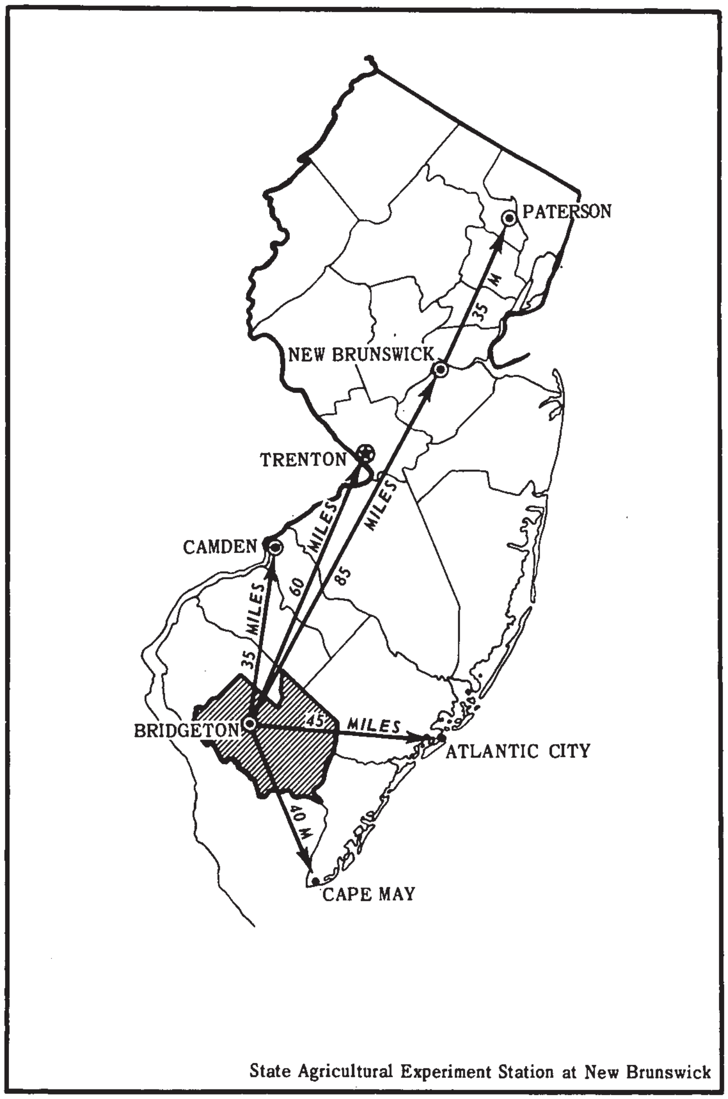

Figure 1.—Location of Cumberland County in New Jersey.

Most soils of the county are well suited to many farm and nonfarm uses. The main exception is Tidal Marsh, which is adjacent to the Delaware River and Delaware Bay. About 63 percent of the soils are suited to cultivation. Of the area not suited to field crops, 14.8 percent is Tidal Marsh, 13.2 percent is dry infertile sand, 5.9 percent is saturated organic deposits that are subject to frequent flooding, and 3.1 percent is wet sand. The dominant concerns of management are inadequate drainage and erosion control. About 22 percent of the soils need better drainage if high-value crops are grown. A large area of Tidal Marsh within the coastal salt meadows, type 16, is rated important to waterfowl by the U.S. Fish and Wildlife Service.

The climate of the county is favorable for general farming, raising poultry and livestock, and growing vegetables, fruits, nursery plants, sod, and woodland crops. According to the 1969 Census of Agriculture, the most extensively grown crops were snap beans, corn, hay, tomatoes, soybeans, potatoes, wheat, orchard fruit, nursery plants, and barley. About 20,123 acres were irrigated. Near Vineland, many small farms produced a variety of leafy vegetables.

In Cumberland County are a wide diversity of economic interests and rapidly developing industries. Among the industries are the manufacture of glass, textiles, and lumber, printing and publishing, boat building, metals, and chemicals. The manufacturing of glass is the largest industry; abundant high-quality glass sand is mined in the county. Food processing is also important to the economy.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Cumberland County, where they are located, and how they can be used. The soil scientists went into the county knowing they were likely to 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 geographic feature near the place where a soil of that series was first observed and mapped. Othello, for example, is the name of a soil series named for a village in Cumberland County. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Aura gravelly sandy loam, 0 to 2 percent slopes, is one of several phases within the Aura 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 in the back of this publication was prepared from the aerial photographs.

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

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so variable that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Tidal Marsh is a land type in Cumberland County.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland, 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 the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations, but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments, and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, drainage, and other characteristics that affect their management.

The soil associations in this survey area are described on the pages that follow.

1. *Matapeake-Chillum-Mattapex association*

Nearly level to sloping, well drained and moderately well drained silty soils; on uplands

This association (fig. 2) is in the western part of the county and in the highest areas at an elevation of 100 to 130 feet. Nearly all areas have been cleared for farming, and the only wooded areas are along the streams.

This association makes up 7 percent of the county. It is about 50 percent Matapeake soils, 20 percent Chillum soils, 10 percent Mattapex soils, and 20 percent minor soils.

Matapeake soils are well drained and are nearly level to sloping.

Chillum soils are well drained. These soils are in high areas and are nearly level or gently sloping. They have a substratum of firm gravelly sandy clay loam.

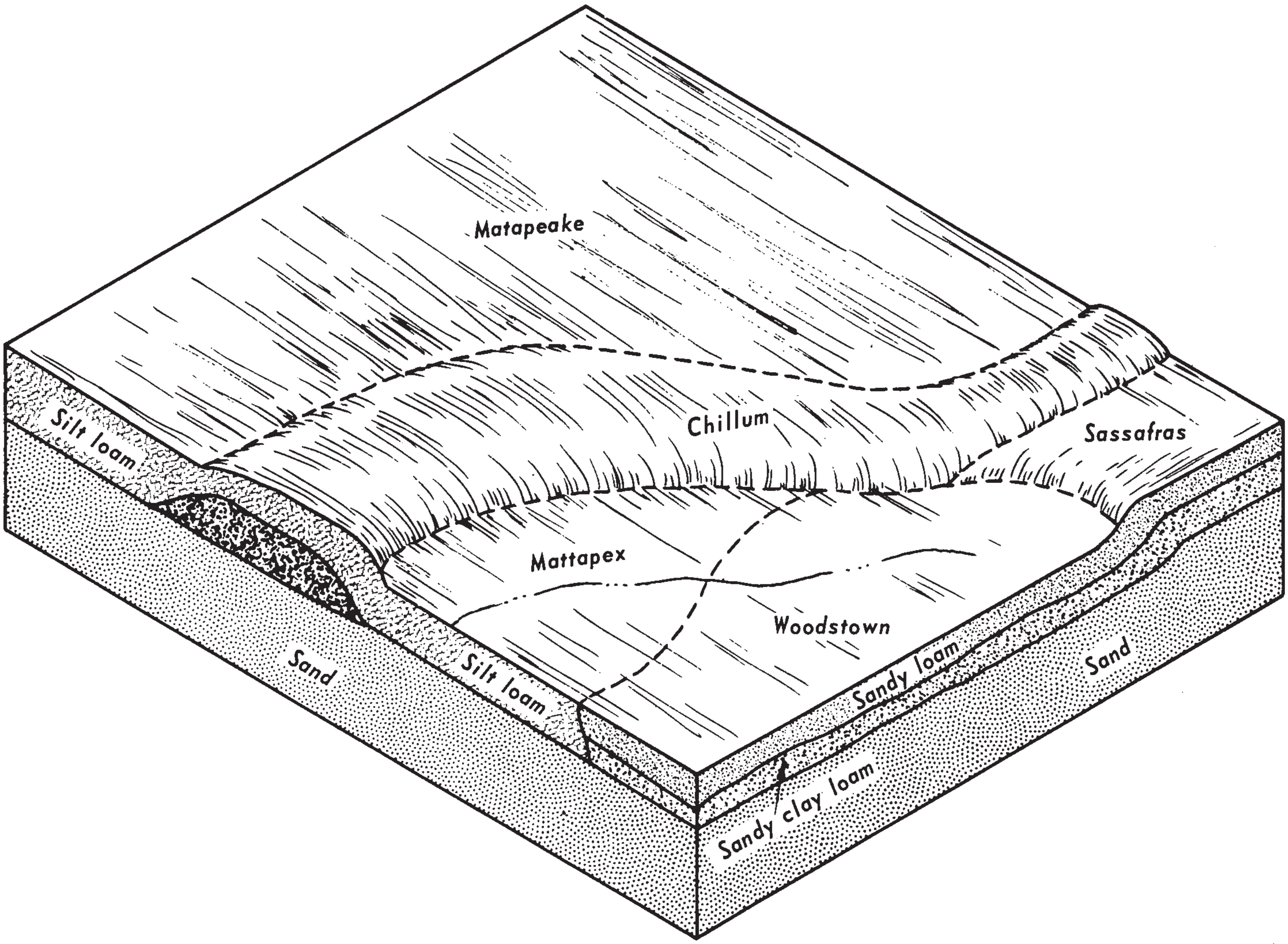

Figure 2.—**Typical soil pattern in the Matapeake-Chillum-Mattapex association.**

Mattapex soils are moderately well drained. They are nearly level or gently sloping. They have a fluctuating water table that is moderately high late in winter and early in spring. Unless the soils are drained, the water table is high enough that water affects crops, rises into the basements of houses, and adversely affects the disposal of effluent from septic tanks.

The minor soils are Sassafras, Woodstown, and Aura soils. Woodstown soils are moderately well drained. Sassafras and Aura soils have a surface layer of loamy sand, sandy loam, and gravelly sandy loam.

The soils of this association are well suited to crops. They are used extensively for vegetables, corn, soybeans, hay, pasture, and nursery plants. On the sloping soils, erosion is a moderate hazard.

2. *Aura-Downer-Sassafras association*

Nearly level to sloping, well-drained, loamy, sandy and gravelly soils; on uplands

This association (fig. 3) is mainly in the central and eastern parts of the county in high areas on the landscape. The elevation is generally 50 to 110 feet. About one-half of the acreage has been cleared for farming.

This association is the largest in the county and makes up 38 percent of the county. It is about 35 percent Aura soils, 20 percent Downer soils, 14 percent Sassafras soils, and 31 percent minor soils.

Aura soils are generally at the highest elevation and are nearly level or gently sloping. Pits left by gravel extraction are common in some places. These soils have a subsoil of reddish, firm, gravelly sandy clay loam that has moderately slow permeability.

Sassafras and Downer soils are either next to Aura soils or occur separately. These soils are nearly level to sloping.

The minor soils are Woodstown, Fort Mott, Evesboro, and Matapeake soils. Woodstown soils have a moderately high seasonal water table. Evesboro soils are deep, droughty, and very sandy. Fort Mott soils have a thick sandy surface layer and a loamy subsoil. Matapeake soils have a surface layer of silt loam.

The soils of this association are used for farming and are moderately productive. The main crops are vege-

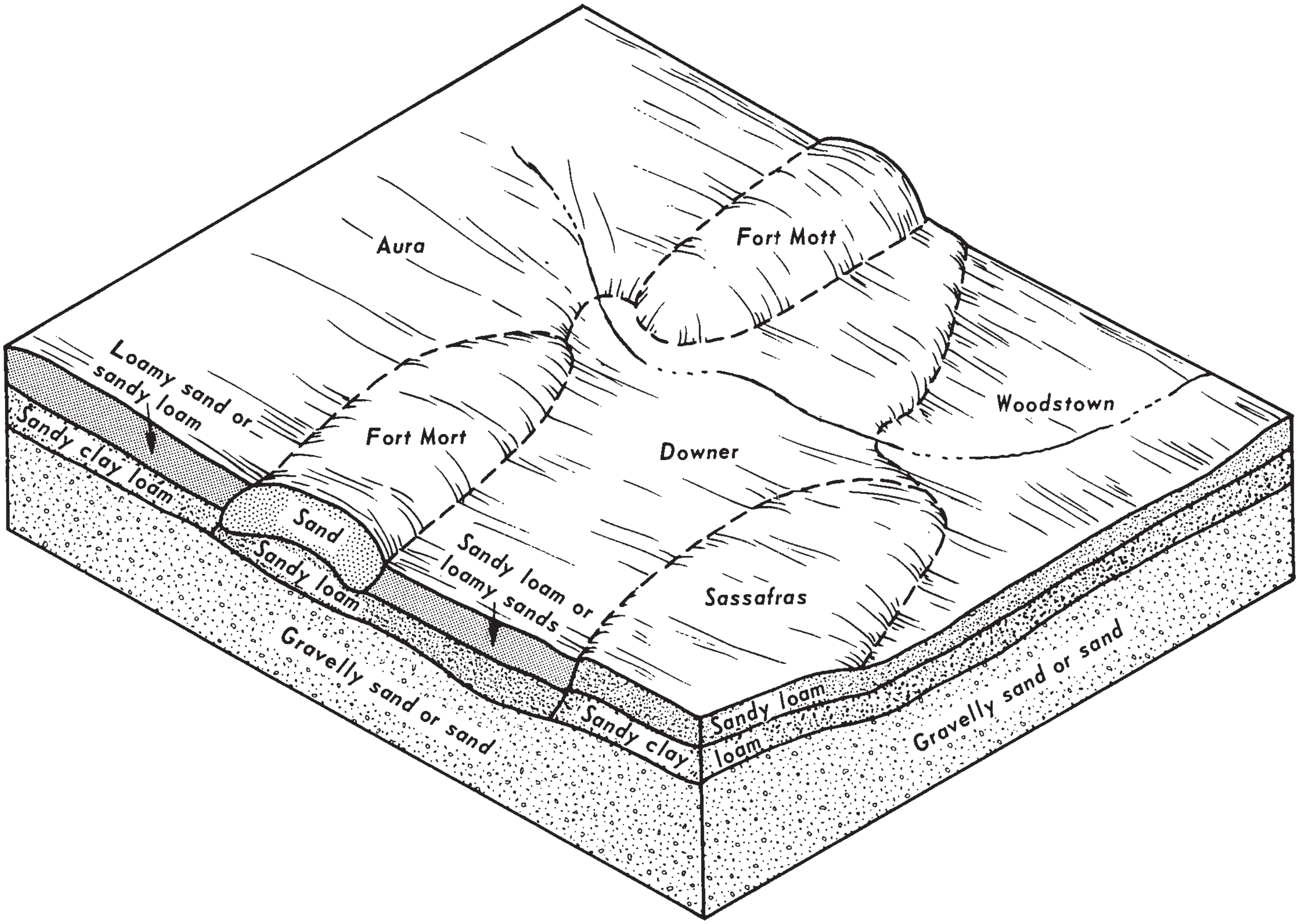

***Figure 3.*—Typical soil pattern in the Aura-Downer-Sassafras association.**

tables, fruit, general crops, and nursery plants. The soils have few limitations for most urban uses.

3. Hammonton-Fallsington-Pocomoke association

Nearly level to gently sloping, moderately well drained to very poorly drained, loamy and sandy soils; on uplands and lowlands

This association (fig. 4) is mainly on a terrace next to Tidal Marsh. The elevation is mainly 10 to 50 feet, but in the eastern part of the county it is somewhat higher.

This association makes up about 24 percent of the county. It is about 40 percent Hammonton soils, 14 percent Fallsington soils, 12 percent Pocomoke soils, and 34 percent minor soils.

Hammonton soils have a moderately high seasonal water table. They have a surface layer of either loamy sand or sandy loam.

Fallsington and Pocomoke soils are on lowlands and are poorly drained or very poorly drained. Most areas are wooded. The soils have a surface layer of sandy loam. The water table is high for more than 6 months of the year.

The minor soils are Woodstown, Mattapex, Atsion, Berryland, Downer, Othello, and Klej soils. For all except Downer soils, the water table is a problem. Mattapex and Othello soils have a surface layer of silt loam. Atsion, Berryland, and Klej soils are very sandy.

This association has moderate or severe limitations for most uses. Less than 50 percent is now farmed. Much more of the acreage was once cleared for farming but, because drainage is a problem, much of the area has been abandoned and is reverting to woodland. All of the major soils in the association have a fluctuating water table, which needs to be lowered if the soils are to be farmed or used for most urban purposes. If drained, Hammonton soils are mostly used for vegetables. Farmed areas of Fallsington and Pocomoke soils are used mainly for soybeans, corn, hay, or pasture. These two soils are well suited as sites for ponds that are fed by ground water.

4. Evesboro-Klej-Lakewood association

Nearly level to moderately steep, excessively drained to somewhat poorly drained sandy soils; on uplands

This association (fig. 5) is a sandy terrace, mainly

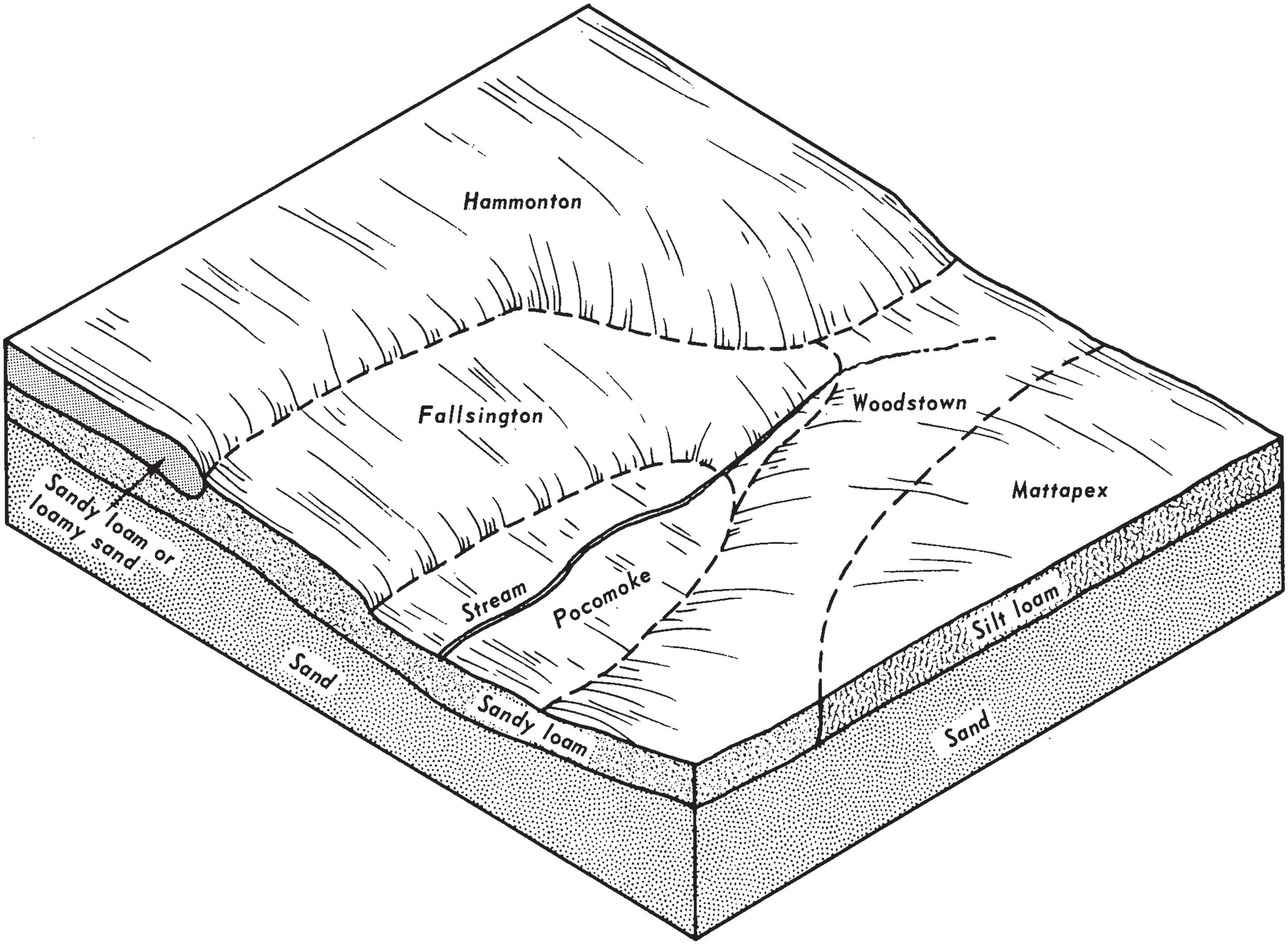

Figure 4.—**Typical soil pattern in the Hammonton-Fallsington-Pocomoke association.**

next to large streams. Areas east of the streams are generally larger than those on the west side. The elevation is 10 to 60 feet.

This association makes up 10 percent of the county. It is about 65 percent Evesboro soils, 15 percent Klej soils, 10 percent Lakewood soils, and 10 percent minor soils.

All the major soils are deep and very sandy. Evesboro and Lakewood soils are excessively drained; Klej soils are moderately well drained or somewhat poorly drained. The soils have low available water capacity and low natural fertility.

Extensive, cleared areas are subject to soil blowing. The use of Evesboro and Klej soils for vegetables is limited. Crops are restricted to special crops that can withstand drought or to soils or crops that can be irrigated. Permeability is rapid, and added fertilizer leaches readily. Lakewood soils are so low in natural fertility that only a small acreage is farmed.

The minor soils are Fort Mott, Lakehurst, Atsion, and Hammonton soils. Fort Mott soils are well drained. Lakehurst, Atsion, and Hammonton soils have a fluctuating water table.

This association is suited to most urban uses, but the low natural fertility and the low available water capacity are limitations to use for lawn and ornamental plantings. Extensive cleared areas are subject to soil blowing. The main use is woodland; pines are more common than oaks. Wildfire is a hazard in the pine woodland.

5. *Muck-Atsion-Berryland association*

Nearly level, poorly drained and very poorly drained, organic and sandy soils; on lowlands

This association (fig. 6) is next to the major streams or just above Tidal Marsh. It is dominantly wooded. The elevation is 5 to 80 feet. Atlantic white-cedar is dominant on Muck, and pitch pine is most common on Atsion and Berryland soils.

This association makes up 6 percent of the county. It is about 70 percent Muck, 15 percent Atsion soils, 10 percent Berryland soils, and 5 percent minor soils.

Muck is very poorly drained and highly organic. Atsion soils are poorly drained and sandy. Berryland soils are very poorly drained and sandy. The water table is high for 6 months or more in all these soils.

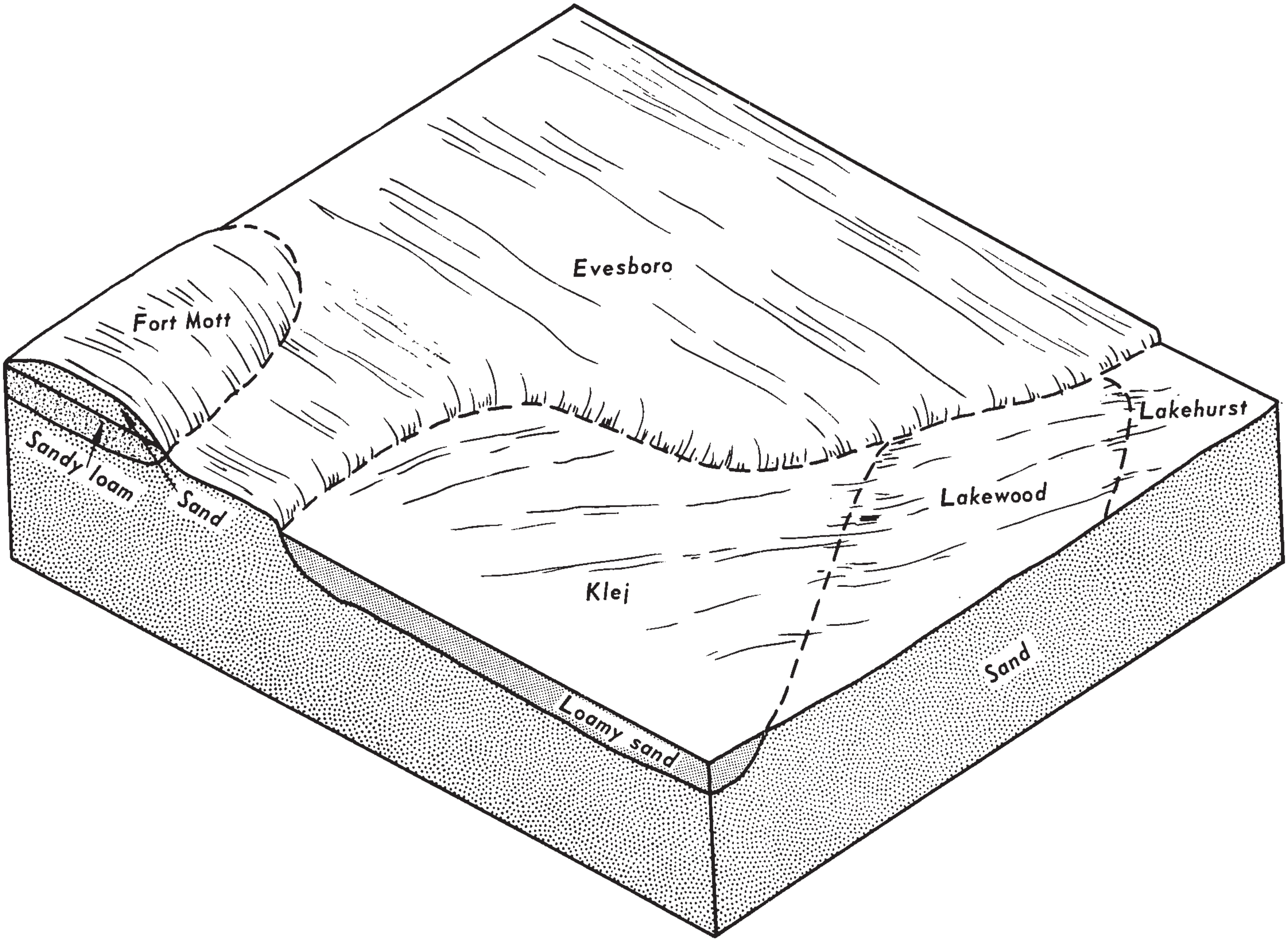

***Figure 5.*—Typical soil pattern in the Evesboro-Klej-Lakewood association.**

Most areas of the association are wooded. Small areas of Atsion and Berryland soils have been cleared for vegetables, but these soils need drainage if they are farmed. If drained, these soils have low available water capacity. Muck has low bearing capacity, and if drained, it subsides severely. Muck is frequently flooded, and some areas of Berryland soils are occasionally flooded in some areas.

The minor soils are Pocomoke and Fallsington soils and Tidal Marsh. Pocomoke and Fallsington soils have a high water table.

This association has severe limitations for most urban uses because the water table is seasonally high and flooding is a hazard.

6. Tidal Marsh association

Nearly level, very poorly drained, silty or mucky tidal flats that are subject to daily flooding; on lowlands

This association occurs in a continuous belt along the Delaware River and Delaware Bay and extends from Salem County to Cape May County. It mainly is one-half mile to about 6 miles wide, but along Cohansey Creek and the Maurice River, it extends inland 12 miles. On the upper reaches of these tributaries the tidal water is low in salt content and in some places is fresh. The association is at or near sea level.

This association makes up 15 percent of the county. It is about 98 percent Tidal Marsh and 2 percent minor soils.

Tidal Marsh normally supports a stand of grasses that can tolerate salts and daily flooding. Some areas have been partly drained and diked so that salt hay can be harvested. Some areas have low bearing capacity. Some areas along the Maurice River were diked to permit farming, but they are not farmed currently because storms have breached the dikes. Drained areas of Tidal Marsh oxidize upon drying. Because of the sulfur, these areas are so acid that no plants grow.

The minor soils are Berryland soils and Muck. Both have a high water table, and some areas are subject to tidal flooding during storms.

This association has severe limitations for all urban uses.

Descriptions of the Soils

This section describes the soil series and mapping units in Cumberland County. Each soil series is de-

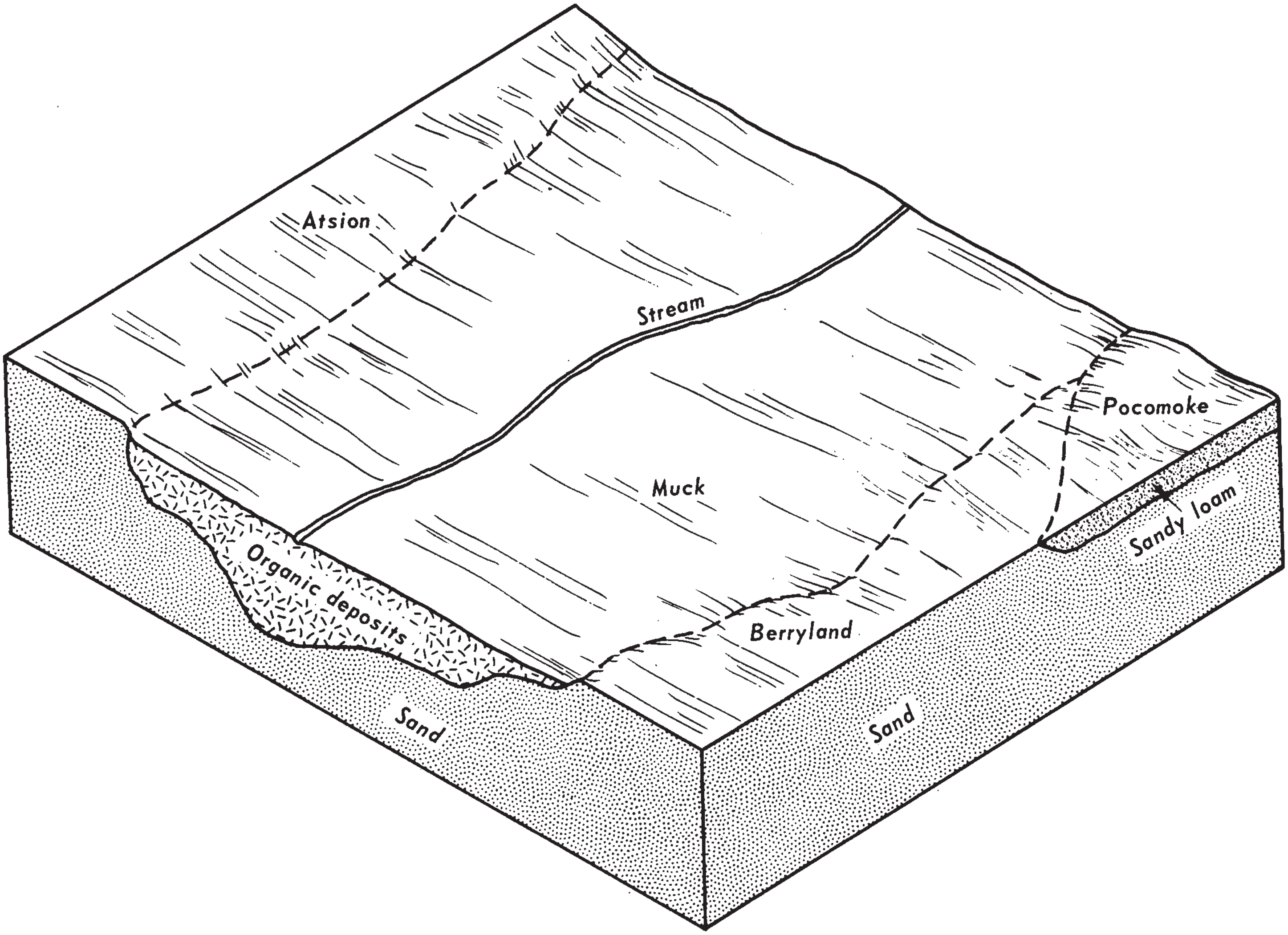

***Figure 6.*—Typical soil pattern in the Muck-Atsion-Berryland association.**

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

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

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

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

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

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[1] Italic numbers in parentheses refer to Literature Cited, p. 67.

Atsion Series

The Atsion series consists of nearly level, poorly drained soils that have an organically stained subsoil. These soils formed in low areas under a pine forest. They are in circular depressions or on terraces adjacent to the main drainageways. When these soils are adjacent to streams they are subject to frequent flooding. Areas that adjoin Tidal Marsh are subject to tidal flooding during severe coastal storms.

In a representative profile, in a forested area, about 4 inches of organic litter overlies a surface layer of black sand about 2 inches thick. The subsurface layer is light-gray sand to a depth of 19 inches. The subsoil is dark reddish-brown sand, which is discontinuously cemented and which extends to a depth of 24 inches. The substratum is very dark gray sand to a depth of 36 inches and below this is strong-brown sand to a depth of 60 inches.

Atsion soils are low in natural fertility and moderate in organic-matter content. Permeability is rapid. In undrained Atsion soils, the seasonal high water table is at a depth of 0 to 1 foot in winter and spring and 2 to 4 feet in summer. The hazard of erosion is slight, and runoff is slow. If these soils are drained, the available water capacity is low, but the water table is high enough that water is available to plants.

Most areas of Atsion soils are in woodland of pitch pine, red maple, and holly trees and a dense understory of highbush blueberry, sweet pepperbush, sheep laurel, and greenbrier. If the soils are used for crops, they have to be drained. Small areas have been cleared and drained for limited growing of vegetables. These soils are easily worked. Open ditches or underdrains can be used to drain the soil and thus lower the water table.

Most areas of Atsion soils are good sites for ponds fed by ground water. The soils have severe limitations for commercial, industrial, and residential uses because the seasonal water table is high for more than 6 months.

Representative profile of Atsion sand, in pine forest on south side of Mays Landing Road, 0.1 mile east of intersection with Sherman Avenue.

O1—4 to 2 inches, loose pine needles, twigs, and fern leaves.

O2—2 inches to 0, black (10YR 2/1) peat; clear, wavy boundary.

A1—0 to 2 inches, black (10YR 2/1) sand and many bleached white sand grains; single grained; loose; common fine roots; extremely acid; clear, wavy boundary.

A2—2 to 19 inches, light-gray (10YR 7/1) sand; single grained; loose; strongly acid; gradual, irregular boundary.

B2h—19 to 24 inches, dark reddish-brown (5YR 2/2) sand; massive; firm in place, friable when removed; discontinuously cemented; common bridgings between sand grains; very strongly acid; gradual, irregular boundary.

C1—24 to 36 inches, very dark gray (10YR 3/1) sand; partly cemented; massive; friable when moist, hard when dry; very strongly acid; gradual, irregular boundary.

C2—36 to 60 inches, strong-brown (7.5YR 5/6) sand; single grained; loose; very strongly acid.

The solum is 20 to 40 inches thick. The content of rounded quartzose pebbles is generally low in the solum and is as much as 20 percent of the C horizon. The soil material is strongly acid to extremely acid. Mottles are rare or lacking.

TABLE 1.—*Acreage and extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Atsion sand	5,850	1.8
Aura gravelly sandy loam, 0 to 2 percent slopes	1,150	.4
Aura gravelly sandy loam, 2 to 5 percent slopes	7,500	2.3
Aura loamy sand, 0 to 5 percent slopes	6,000	1.9
Aura sandy loam, 0 to 2 percent slopes	17,700	5.5
Aura sandy loam, 2 to 5 percent slopes	12,300	3.8
Berryland sand	4,100	1.3
Chillum silt loam, 0 to 2 percent slopes	1,850	.6
Chillum silt loam, 2 to 5 percent slopes	3,050	1.0
Downer loamy sand, 0 to 5 percent slopes	10,300	3.2
Downer loamy sand, 5 to 10 percent slopes	2,950	.9
Downer sandy loam, 0 to 2 percent slopes	6,500	2.0
Downer sandy loam, 2 to 5 percent slopes	7,100	2.2
Evesboro sand, 0 to 5 percent slopes	23,000	7.2
Evesboro sand, 5 to 10 percent slopes	10,000	3.1
Evesboro sand, 10 to 20 percent slopes	1,320	.4
Fallsington sandy loam	11,200	3.5
Fort Mott loamy sand, 0 to 5 percent slopes	8,100	2.5
Hammonton loamy sand, 0 to 5 percent slopes	9,700	3.0
Hammonton sandy loam, 0 to 2 percent slopes	20,000	6.2
Hammonton sandy loam, 2 to 5 percent slopes	3,450	1.1
Klej loamy sand, 0 to 3 percent slopes	8,800	2.8
Lakehurst sand, 0 to 3 percent slopes	2,450	.8
Lakewood sand, 0 to 5 percent slopes	5,300	1.7
Matapeake silt loam, 0 to 2 percent slopes	3,200	1.0
Matapeake silt loam, 2 to 5 percent slopes	5,600	1.8
Matapeake silt loam, 5 to 10 percent slopes, eroded	2,500	.8
Mattapex silt loam, 0 to 2 percent slopes	3,400	1.1
Mattapex silt loam, 2 to 5 percent slopes	1,250	.4
Muck	18,900	5.9
Othello silt loam	1,250	.4
Pocomoke sandy loam	9,800	3.1
Sassafras gravelly sandy loam, 0 to 2 percent slopes	700	.2
Sassafras gravelly sandy loam, 2 to 5 percent slopes	3,400	1.1
Sassafras gravelly sandy loam, 5 to 10 percent slopes, eroded	1,500	.5
Sassafras sandy loam, 0 to 2 percent slopes	5,350	1.7
Sassafras sandy loam, 2 to 5 percent slopes	6,150	1.9
Sassafras sandy loam, 5 to 10 percent slopes, eroded	800	.2
Tidal Marsh	47,300	14.8
Woodstown sandy loam, 0 to 2 percent slopes	10,300	3.2
Woodstown sandy loam, 2 to 5 percent slopes	2,750	.9
Areas without soil symbols		
Made land, sanitary landfill	124	(1)
Pits, sand and gravel	5,100	1.6
Water that covers less than 40 acres	730	.2
Total	319,774	100.0

[1] Less than 0.05 percent.

In plowed areas, the Ap horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 0 or 1. The A2 horizon is 6 to 18 inches thick.

Several Bh horizons occur in some profiles. The B2h horizon has hue of 7.5YR or 5YR, value of 2 or 3, and chroma of

2 to 4. It has consistence that ranges from loose to very firm as a result of organic cementation, but consistence varies greatly within short distances. This horizon is normally hard when the soil is drained.

The C horizon has chroma of 1 to 6. It is sand to sandy clay below a depth of 40 inches.

Atsion soils are near Berryland, Fallsington, Lakehurst, Klej, and Hammonton soils and Muck. Atsion soils lack a thick, very dark A horizon, which is common in Berryland soils. They have a less clayey B horizon than Fallsington and Hammonton soils. They do not have both values and chromas of 4 or more in the B horizon, which are common in Lakehurst and Klej soils. Atsion soils lack an organic surface horizon, which is common in Muck.

Ac—Atsion sand. This soil is nearly level and poorly drained. It is in slight depressions and swales and near streams. It receives runoff from nearby higher soils. Included with this soil in mapping are areas of Lakehurst, Berryland, Klej, and Fallsington soils.

Wetness is the main limitation to the use of this soil. The seasonal high water table limits the choice of plants. Highbush blueberries are well suited if the water table is controlled by ditches and underdrains.

In places where fine-textured material is between depths of 40 and 60 inches, the water table fluctuates more rapidly than where the material is sand. If the fine-textured material is thick, recharge rates in dug-out ponds are reduced. Drainage is more difficult in these areas. Deep drainage is needed for most urban uses. Capability unit Vw–26; woodland group 3w1.

Aura Series

The Aura series consists of nearly level or gently sloping, well-drained soils. These soils formed under a hardwood forest on divides and knolls.

In a representative profile, in a cultivated area, the plow layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam 4 inches thick. The upper 12 inches of the subsoil is yellowish-brown sandy clay loam, and the lower 36 inches is firm and very firm, yellowish-red gravelly sandy clay loam.

Aura soils are medium in natural fertility and moderate or low in organic-matter content. Permeability is moderate or moderately slow in the lower part of the subsoil. Without proper management, intense cultivation causes compaction and results in a plowpan moderately slow in permeability; roots penetrate only cracks and fractures in the dense lower part of the subsoil. The available water capacity is moderate. The water table is below a depth of 5 feet. When rainfall is extremely heavy, the soils contain excess water for several days. In cultivated areas, the hazard of erosion is slight, and runoff is medium.

The natural vegetation is a mixed oak forest that consists of black oak, red oak, scarlet oak, white oak, chestnut oak, hickory, a few pitch pine, Virginia pine, and shortleaf pine, and a shrub understory of mainly lowbush blueberry, mountain laurel, and bracken fern.

Aura loamy sand is subject to soil blowing, and all Aura soils are subject to water erosion. Generally, more water runs off the less sloping Aura soils than runs off other soils that have the same slope.

Most areas of Aura soils have been cleared for farming. They are used most extensively for fruits, vegetables, and general crops, mainly peaches, apples, tomatoes, cabbage, corn, and soybeans. Most high-value crops are irrigated (fig. 7), but irrigation water should not be applied rapidly because Aura soils crust easily and the subsoil has moderately slow permeability. Because the lower part of the subsoil is dense and restricts roots, there is little need to irrigate these soils deeply. Aura soils readily develop a compacted plowpan that is moderately slowly permeable. More water runs off in areas where a plowpan has formed than in other areas.

Aura loamy sand is easily worked and can be cultivated early in spring, but Aura sandy loam and gravelly sandy loam can be cultivated only moderately early in spring. The sandy loam and gravelly sandy loam compact easily under intensive cultivation and become moderately slowly permeable; consequently they are difficult to work after rains. All Aura soils have a subsoil texture that prevents rapid leaching of added fertilizer.

Aura soils are well suited to most urban uses. They are a source of gravel and sand. The lower part of the subsoil contains considerable gravel that is imbedded in the sand and clay. This material has been extensively used for road gravel. Sand deposits are common at a greater depth.

Representative profile of Aura sandy loam, 0 to 2 percent slopes, on the western edge of a gravel pit at the intersection of County Highway 553 and Buckshutem Road.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam, very pale brown (7.5YR 5/4) when dry; very weak, fine to medium, granular structure; friable; fine roots; 5 percent rounded quartzose pebbles; strongly acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) sandy loam; weak, fine and medium, subangular blocky structure; friable; common fine and coarse roots; 5 percent rounded quartzose pebbles; strongly acid; gradual, irregular boundary.

B2t—12 to 24 inches, dark yellowish-brown (10YR 4/4) light sandy clay loam; weak, medium, subangular blocky structure; friable; common fine roots; 5 percent pebbles; strongly acid; clear, wavy boundary.

IIB21t—24 to 40 inches, yellowish-red (5YR 5/6) gravelly sandy clay loam; massive; firm and very sticky when moist, very hard when dry; clay films on sand grains and pebbles, extensive bridgings between grains; common fine and coarse roots in widely spaced, vertical cracks or fracture zones that extend to bottom of horizon; 25 percent rounded quartz pebbles; medium acid; diffuse, irregular boundary.

IIB22t—40 to 60 inches, yellowish-red (5YR 5/6) stratified gravelly sandy clay loam; massive; very hard when dry, very firm when moist; few roots that grow only along strata and crevices; thick clay films on all sand grains and pebbles; very strongly acid.

The solum is 36 to 96 inches thick. The IIB21t horizon is at a depth of 20 to 30 inches. The content of rounded quartzose pebbles is 2 to 50 percent, but the greatest accumulation of pebbles occurs in the lower part of the B horizon and in the C horizon. Unless limed this soil is very strongly or extremely acid.

The A horizon is dark grayish-brown (10YR 4/2) to grayish-brown (10YR 5/2) sandy loam, loamy sand, or gravelly sandy loam.

The B2t horizon is dark yellowish-brown, friable sandy loam or sandy clay loam in most places. The IIB22t horizon is yellowish-red (5YR 5/6) to red (2.5YR 4/6), friable to very firm sandy clay loam, gravelly sandy clay loam, or sandy loam between depths of 40 and 60 inches. In places this horizon extends below a depth of 5 feet.

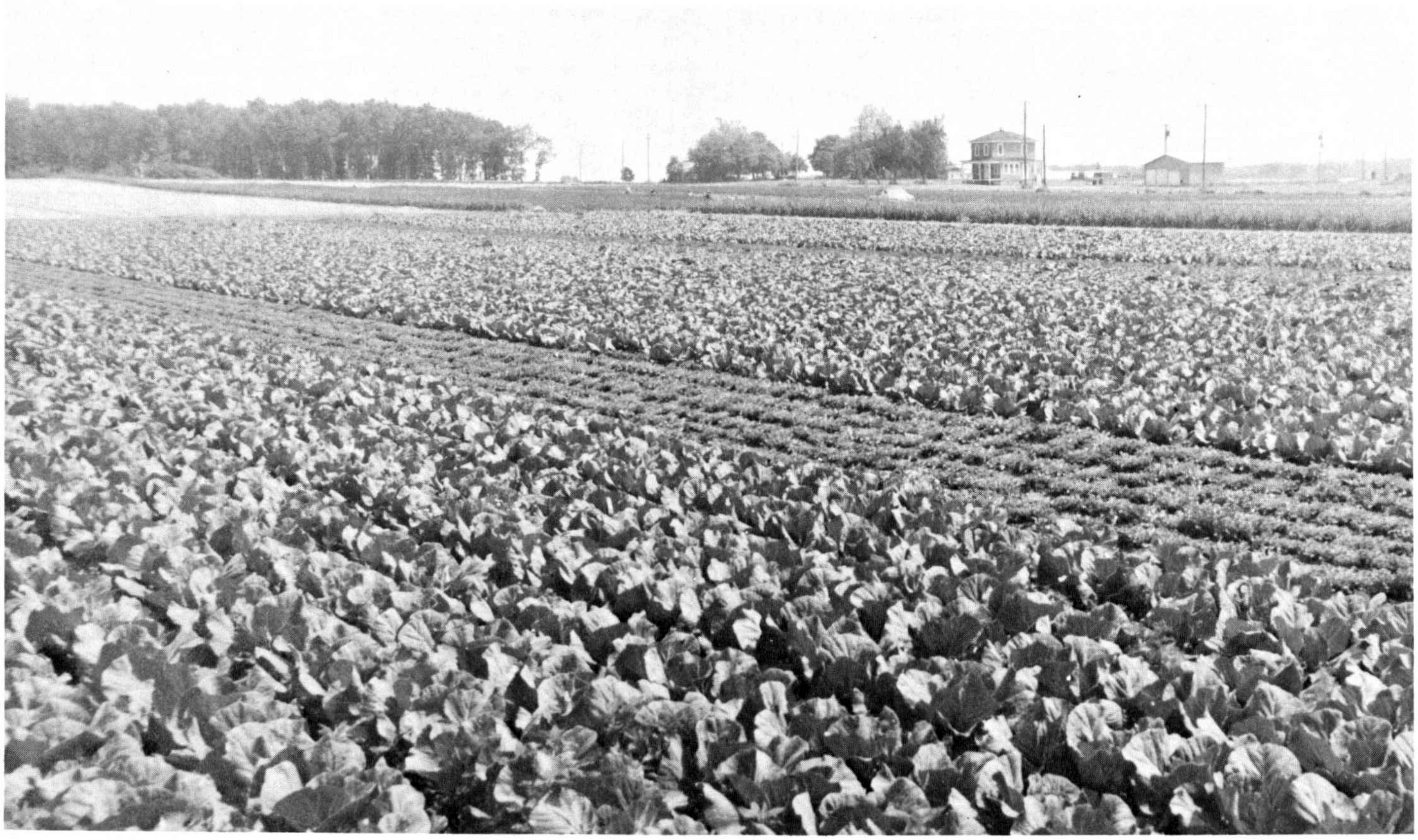

Figure 7.—Cabbage and escarole growing in an area of Aura loamy sand. The soil is well suited to vegetable crops.

The C horizon is similar to that of the IIB22t horizon if it is within 60 inches of the surface. It is dominantly sandy clay loam but ranges to sandy loam and loamy sand or the gravelly analogs. Consistence in this horizon is firm or friable.

Aura soils are near Chillum, Sassafras, Downer, Woodstown, and Mattapex soils. Aura soils do not have mottles, which are common in Woodstown and Mattapex soils. They do not have a high silt content in the upper part of the profile, which is common in Chillum soils. Aura soils have a redder, firmer B horizon than Sassafras and Downer soils.

AgA—Aura gravelly sandy loam, 0 to 2 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer is 15 to 40 percent rounded quartzose pebbles and in places there are pebbles throughout the profile.

Included with this soil in mapping are areas of well-drained Sassafras and Chillum soils and moderately well drained Woodstown soils. The Woodstown soils are in depressed areas.

This well-drained soil is suited to general crops, fruits, and vegetables that are grown from transplants. Unless this soil is irrigated, crops that mature early are better suited than crops that mature late in summer. Because of the gravel, tillage is more difficult and the available water capacity is less. In most places, the organic-matter content can be maintained by cover crops. Drainage needs improvement in some areas of the included Woodstown soils. Capability unit IIs–9; woodland group 3o2.

AgB—Aura gravelly sandy loam, 2 to 5 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer is 15 to 40 percent rounded quartzose pebbles and in places there are pebbles throughout the profile.

Included with this soil in mapping are areas of the well-drained Sassafras and Downer soils and small areas of sloping Aura soils. The Sassafras and Downer soils lack a red, firm subsoil, which is common in Aura soils.

This well-drained soil is suited to general crops, fruits, and vegetables. It is better suited to vegetables that have been transplanted than to crops that have been seeded in the field. The gravel interferes with tillage, hinders germination of seeds, and reduces the available water capacity. Droughtiness is the main limitation to the use of this soil. The erosion hazard is slight. Cover crops, contour tillage, stripcropping, and crop rotation that includes hay are used to control erosion. Capability unit IIs–9; woodland group 3o2.

AmB—Aura loamy sand, 0 to 5 percent slopes. The profile of this soil is similar to the one described as representative of the series, but the surface layer is loamy sand about 18 inches thick.

Included with this soil in mapping are small areas of Sassafras, Downer, and Fort Mott soils.

This soil is somewhat droughty. Water erosion and soil blowing are hazards. The surface layer is porous, has a rapid intake rate, and is leached of plant nutrients.

This Aura soil is easy to till. Droughtiness is the main limitation. Damage to vegetables by windblown sand is common in March and April. Practices that increase the content of organic matter, replace plant nutrients, and help control water erosion and soil blowing are needed. Cover crops, windstrips, or privet windbreaks can reduce damage by soil blowing. Capability unit IIIs–10; woodland group 3o2.

ArA—Aura sandy loam, 0 to 2 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping are areas of Sassafras, Woodstown, Downer, and Chillum soils and areas of gently sloping Aura sandy loam.

Conserving moisture is the chief concern in managing this Aura soil, but practices are also needed that maintain or improve fertility and the organic-matter content. Because the subsoil has moderately slow permeability and is compacted in many places, temporary wetness occurs. Because of the droughtiness, crops that mature early grow better than crops that mature late in summer and early in fall. Generally cover crops maintain organic-matter content and reduce the hazard of erosion. Capability unit IIs–9; woodland group 3o2.

ArB—Aura sandy loam, 2 to 5 percent slopes. Included with this soil in mapping are small areas of sloping Aura soils and areas of Sassafras and Downer soils. Small gravelly areas are indicated by a symbol for gravel.

This Aura soil is suited to most vegetables, fruits, and general crops. Droughtiness and compaction are the main limitations to the use of this soil. Returning large amounts of crop residue to the soil is needed to maintain a porous soil. Unless this naturally droughty soil is irrigated, crops that mature early are better suited than crops that mature late in summer. Control of erosion is needed. Because intensive cultivation has caused compaction, the soil has less permeability. Runoff and erosion are greater than on other gently sloping soils. Cover crops, contour cultivation, terraces, or stripcropping, as well as the rotation of well chosen crops help control erosion. Capability unit IIs–9; woodland group 3o2.

Berryland Series

The Berryland series consists of nearly level, very poorly drained soils. These soils formed under a pine forest in low areas next to large streams or in circular depressions. They are mainly at a low elevation, generally between 0 to 40 feet. Where these soils are next to streams, they are subject to frequent flooding for short periods. Areas of these soils that adjoin Tidal Marsh are subject to tidal flooding during some coastal storms.

In a representative profile, in a wooded area, about 3 inches of leaf litter and organic matter overlies a surface layer of black sand about 10 inches thick. The subsurface layer is light-gray sand 3 inches thick. The subsoil is 21 inches thick. In sequence from the top it is 2 inches of dark reddish-brown sand stained by organic matter; 5 inches of brown sand stained by organic matter; 5 inches of pale-brown sand; and 9 inches of dark reddish-brown sand stained by organic matter. The substratum is loose, grayish-brown sand to a depth of 60 inches.

Berryland soils are low in natural fertility and high in organic-matter content. Permeability is moderately rapid. The hazard of erosion is slight, and runoff is slow. Because the soils are mostly loose sand, they move or shift readily.

Berryland soils that adjoin areas of Muck are subject to frequent flooding of short duration. The root zone is largely restricted to the subsoil, which contains most of the organic matter. Below the subsoil, the soil material is saturated with water nearly all the time.

If adequately drained, Berryland soils are easily worked. They cannot be cultivated early in spring because the water table is high and drainage is very poor. Applied fertilizer is readily leached because permeability is moderately rapid.

In a year of normal rainfall, undrained Berryland soils are ponded or they have a water table that is at the surface late in winter and in spring but at a depth of 1 to 3 feet or more in summer. These soils are so low and wet that they cannot be easily drained in all places. If an outlet is available, the water table can be lowered if either open ditches or underdrains are used. In drained areas, the available water capacity is low but the water table is high enough that ground water is available to plants.

Nearly all areas of Berryland soils have a forest cover of pitch pine, red maple, Atlantic white-cedar, black gum, and holly trees and a dense undergrowth of highbush blueberry, sweet pepperbush, bay magnolia, leather leaf, gallberry, and greenbrier. Small areas that have been cleared and drained are used for soybeans, corn, and summer vegetables.

Berryland soils are generally good sites for ponds fed by ground water. They have restrictions for many urban uses because the seasonal water table is high for more than 6 months.

Representative profile of Berryland sand, in a wooded area, 660 feet west of Delsea Drive, 0.7 mile northwest of Port Elizabeth.

O1—3 to 2 inches, loose pine needles and ferns.

O2—2 inches to 0, very dark brown (10YR 2/2) organic matter; clear, wavy boundary.

A1—0 to 10 inches, black (10YR 2/1) sand; single grained; loose; many fine roots; extremely acid; clear, wavy boundary.

A2—10 to 13 inches, light-gray (10YR 6/1) sand; single grained; loose; common fine roots; very strongly acid; gradual, irregular boundary.

B21h—13 to 15 inches, dark reddish-brown (5YR 2/2) sand; massive; friable when moist, hard when dry; few roots; sand grains coated with organic matter; very strongly acid; clear, irregular boundary.

B22h—15 to 20 inches, brown (7.5YR 4/4) sand; massive; friable when moist, hard when dry; sand grains coated with organic matter; very strongly acid; gradual, irregular boundary.

B3—20 to 25 inches, pale-brown (10YR 6/3) sand; common, medium, distinct, reddish-yellow (5YR 7/8) mottles; massive; friable when moist, hard when dry; very strongly acid; gradual, irregular boundary.

B′2h—25 to 34 inches, dark reddish-brown (5YR 3/2) sand; massive; friable when moist, hard when dry; sand grains coated with organic matter; very strongly acid; clear, irregular boundary.

C—34 to 60 inches, grayish-brown (10YR 5/2) sand; common, medium, light-gray (10YR 7/2) and yellowish-brown (10YR 5/4) mottles; single grained; loose; very strongly acid.

The solum is 28 to 40 inches thick. The content of gravel in the solum is generally less than 5 percent, but in places it is more than 10 percent in some parts of the C horizon. The pebbles are rounded quartzose, and generally less than 2 inches in diameter. The soil material is extremely acid or very strongly acid unless it is limed.

The Bh horizon is dark reddish-brown (5YR 3/2) to very dark brown (10YR 2/2) sand or loamy sand. It is not mottled in some places. The consistence of the soil material in the Bh horizon is mainly loose but ranges to very firm. This horizon commonly becomes hard when drained. Cementation is generally caused by organic matter but also by iron in places. Several Bh horizons commonly occur in one profile. These horizons formed at the level that the ground water reaches in summer, and they indicate changes in water level.

The C horizon generally is gray (10YR 5/1) or grayish-brown (10YR 5/2). It is sand to sandy loam below a depth of 40 inches.

Berryland soils are near Atsion, Klej, and Hammonton soils and Muck and Tidal Marsh. Berryland soils do not have the thick organic deposits, which are common in Muck. They are sandier than Tidal Marsh. They do not have yellowish-brown color, which is common in Klej and Hammonton soils, and they have a thicker A1 horizon than Atsion soils.

Bp—Berryland sand. This soil is nearly level and very poorly drained and is in depressions. Included with this soil in mapping are areas of Atsion soils, of Muck, and of a soil that has a surface layer that is highly organic to a depth of 16 inches. Also included are areas of soils that have a subsoil of sandy loam or loamy sand that lacks organic stains.

Excessive wetness is the main limitation to the use of this soil, but it can be corrected by artificial drainage. Underdrains can be used in most places, and ponding can be reduced by shallow ditches.

This soil has severe limitations for commercial, industrial, and residential uses because the seasonal water table is high more than 6 months in a year. This soil also has severe limitations for use as septic-tank filter fields. Such use can cause the pollution of ground water. For these uses, deep drainage is essential. Capability unit Vw–26; woodland group 3w1.

Chillum Series

The Chillum series consists of well-drained, nearly level or gently sloping soils. These soils formed under a hardwood forest in high areas of divides and the adjacent slopes.

In a representative profile, in a cultivated area, the plow layer is dark yellowish-brown silt loam about 10 inches thick. The subsoil is strong-brown silt loam 20 inches thick. The substratum is very firm, yellowish-red gravelly sandy clay loam to a depth of 60 inches.

Chillum soils are medium in natural fertility and moderate in organic-matter content. Permeability is moderately slow or moderate, and the available water capacity is high above the substratum. The substratum is very firm and restricts roots.

The natural vegetation is mostly oak, yellow-poplar, beech, and hickory. Most areas have been cleared and are used for high-value vegetables, nursery plants, corn, wheat, barley, hay, or pasture. Irrigation is profitable for high-value crops. The soils are easily worked, but they can be cultivated only moderately early in spring.

The firm substratum that has moderately slow permeability is a limitation to the use of these soils for the disposal of septic-tank effluent. In places deep excavations can be made to a more permeable substratum.

Representative profile of Chillum silt loam, 2 to 5 percent slopes, on edge of gravel pit, 2,300 feet east of New Jersey Highway 77 south of County Road No. 12.

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

B2t—10 to 30 inches, strong-brown (7.5YR 5/6) silt loam; moderate, medium and coarse, subangular blocky structure; friable; common roots; thin clay films; slightly acid; gradual, wavy boundary.

IIC—30 to 60 inches, yellowish-red (5YR 4/6) gravelly sandy clay loam; massive; very firm when moist, hard when dry; 35 percent rounded pebbles; few roots, which are dominantly in cracks; strongly acid; clear, smooth boundary.

The mantle of silt is 20 to 30 inches thick. Gravel is generally rare in the solum, but in some places it makes up as much as 20 to 40 percent of the C horizon. Unless limed the soils are strongly acid to extremely acid.

The Ap horizon is dark yellowish brown (10YR 4/4) to dark grayish brown (10YR 4/2). The B horizon is silt loam to silty clay loam. The IIC horizon is gravelly loam to gravelly sandy clay loam.

Chillum soils are near Matapeake, Mattapex, Sassafras, and Aura soils. Chillum soils have a firm gravelly substratum, but Matapeake and Mattapex soils do not. Chillum soils have a silt loam solum but Aura and Sassafras soils do not.

ChA—Chillum silt loam, 0 to 2 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thicker and depth to the gravelly substratum is greater. Included with this soil in mapping are areas of Matapeake and Mattapex soils and small areas of a gently sloping Chillum soil.

This Chillum soil is easily worked, and crops can be planted fairly early in spring. Surface runoff is slow, and the hazard of erosion is slight. The soil is suited to common field crops, special crops, hay, and pasture. Cover crops have been used to maintain the organic-matter content. Capability unit I–4; woodland group 3o1.

ChB—Chillum silt loam, 2 to 5 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping are small areas of nearly level Chillum soils and Matapeake, Sassafras, Mattapex, and Aura soils. Mattapex soils are in depressed areas and need better drainage in places. Also included are a few knolls where the gravel content in the soils ranges from 10 to 20 percent. The most gravelly areas are indicated by a spot symbol for gravel.

Surface runoff is medium, and the hazard of erosion is moderate in cultivated areas. On long slopes, contour cultivation, contour stripcropping, and minimum tillage are used to help control runoff and erosion and to maintain the organic-matter content (fig. 8). The soil is suited to many uses. It is extensively used for high-value vegetables, nursery plants, and general crops. It has few limitations for most urban uses. Capability unit IIe–4; woodland group 3o1.

Downer Series

The Downer series consists of nearly level to sloping, well-drained soils. These soils formed mainly under a hardwood forest in marine or fluvial deposits. They are in high areas.

Figure 8.—**Nursery plants growing in an area of Chillum silt loam, 2 to 5 percent slopes. Crops planted on the contour help to control runoff and erosion.**

In a representative profile, in a cultivated area, the plow layer is dark grayish-brown loamy sand about 10 inches thick. The subsurface layer is yellowish-brown loamy sand 6 inches thick. The subsoil is yellowish-brown sandy loam 12 inches thick. The substratum is yellowish-brown loamy sand to a depth of 60 inches.

Downer soils are medium in fertility and low to moderate in organic-matter content. Permeability is moderately rapid, and the available water capacity is moderate. The water table is below a depth of 4 feet. The soils warm early. Extensive cultivated areas of the loamy sand soils are subject to soil blowing if left bare in winter (fig. 9).

The natural vegetation is mainly a forest of black oak, white oak, chestnut oak, southern red oak, scarlet oak, hickory, a few pitch pine, Virginia pine, and shortleaf pine, and a shrub understory of mountain-laurel, lowbush blueberries, and brackens. About half the acreage of Downer soils has been cleared for farming. The soils are best suited to vegetables and fruits. Nearly all high-value crops are irrigated (fig. 10). The soils are not well suited to pasture and hay. They are easily worked. Fertilizer leaches rapidly.

Representative profile of Downer loamy sand, 0 to 5 percent slopes, in a cultivated area, south of Bridgeton, 1,650 feet west of County Road No. 90 and 660 feet north of County Road No. 100.

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; many fine roots; slightly acid; abrupt, smooth boundary.

A2—10 to 16 inches, yellowish-brown (10YR 5/6) loamy sand; very weak, medium, subangular blocky structure; very friable; common fine roots; slightly acid; clear, wavy boundary.

Bt—16 to 28 inches, yellowish-brown (10YR 5/6) sandy loam; weak, medium, subangular blocky structure; friable; common fine roots; sand grains bridged with clay; medium acid; clear, wavy boundary.

C—28 to 60 inches, yellowish-brown (10YR 5/6) loamy sand; single grained; loose; few fine roots; 10 percent rounded quartzose pebbles; very strongly acid.

The solum is 20 to 38 inches thick. The content of gravel commonly is less than 5 percent in the solum but as much as 20 percent in some parts of the stratified C horizon. The gravel consists of rounded quartzose pebbles as much as 2 inches in diameter. Unless limed, Downer soils are extremely acid in the surface layer and very strongly acid in the other horizons.

The Ap horizon ranges from dark grayish-brown (10YR 4/2) to dark yellowish-brown (10YR 4/4) loamy sand or sandy loam.

In some profiles, the C horizon is sand to sandy clay loam between depths of 40 and 60 inches. The finer textured soil materials are more slowly permeable than the coarser textured ones.

Downer soils are near Aura, Hammonton, Evesboro, Sassafras, Fort Mott, and Klej soils. Downer soils do not have the gravelly, reddish, firm B horizon, which Aura soils commonly have. They lack mottles, which are common in Hammonton and Klej soils. Downer soils are not so sandy as Evesboro and Klej soils. Their B horizon does not contain so much clay as that of Sassafras soils. Downer soils have an A horizon that is not so thick as the one in Fort Mott soils.

DoB—Downer loamy sand, 0 to 5 percent slopes.

This soil has the profile described as representative of the series. Included with this soil in mapping are areas of Fort Mott, Evesboro, and Hammonton soils. Hammonton soils are in depressed areas.

Surface runoff is slow, and the hazard of erosion is slight. The moderate available water capacity is the main limitation to use of this soil for cultivated crops. The soil is subject to soil blowing where extensive cultivated areas are exposed, but cover crops, windstrips, or windbreaks help reduce soil blowing (fig. 11). The soil is suited to a variety of vegetables and early crops. Irrigation can be used to advantage, especially if high-value crops are grown. Wooded areas need protection from wildfires. Better drainage is needed in some areas where the included Hammonton soils occur. Capability unit IIs–6; woodland group 3o2.

DoC—Downer loamy sand, 5 to 10 percent slopes. Included with this soil in mapping are small areas of Aura and Sassafras soils and areas of Downer sandy loam. In places the surface layer is 10 to 20 percent rounded quartzose pebbles. In other places, erosion has removed so much of the surface layer that plowing now exposes the subsoil, which is more sticky when wet than the original surface layer.

The erosion hazard is moderately severe, and gullies have formed in some fields. Runoff is moderately rapid. In farmed areas erosion control is needed. Contour farming, stripcropping, cover crops, and a crop rotation that includes grass can reduce erosion. In wooded areas, protection from wildfires is needed. Capability unit IIIe–6; woodland group 3o2.

DrA—Downer sandy loam, 0 to 2 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam. Included with this soil in mapping are areas of Sassafras, Aura, and Hammonton soils. Hammonton soils are in depressed areas.

This Downer soil can be plowed and cultivated early in spring and soon after heavy rain. In cultivated areas, surface runoff is slow, and the hazard of erosion is slight. Intensive cultivation is possible under a high level of management. The soil is suited to vegetables, fruits, and general crops. Irrigation is an advantage, especially if high-value crops are grown. The use of cover crops alone generally can maintain the organic-matter content. Better drainage is needed in some areas of included Hammonton soils. Capability unit I–5; woodland group 3o2.

DrB—Downer sandy loam, 2 to 5 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam and the depth to the substratum is about 2 feet.

Figure 9.—**Escarole, Boston lettuce, and iceberg lettuce growing in an area of Downer loamy sand. Privet hedge in the background protects these crops from damage from wind-blown sand.**

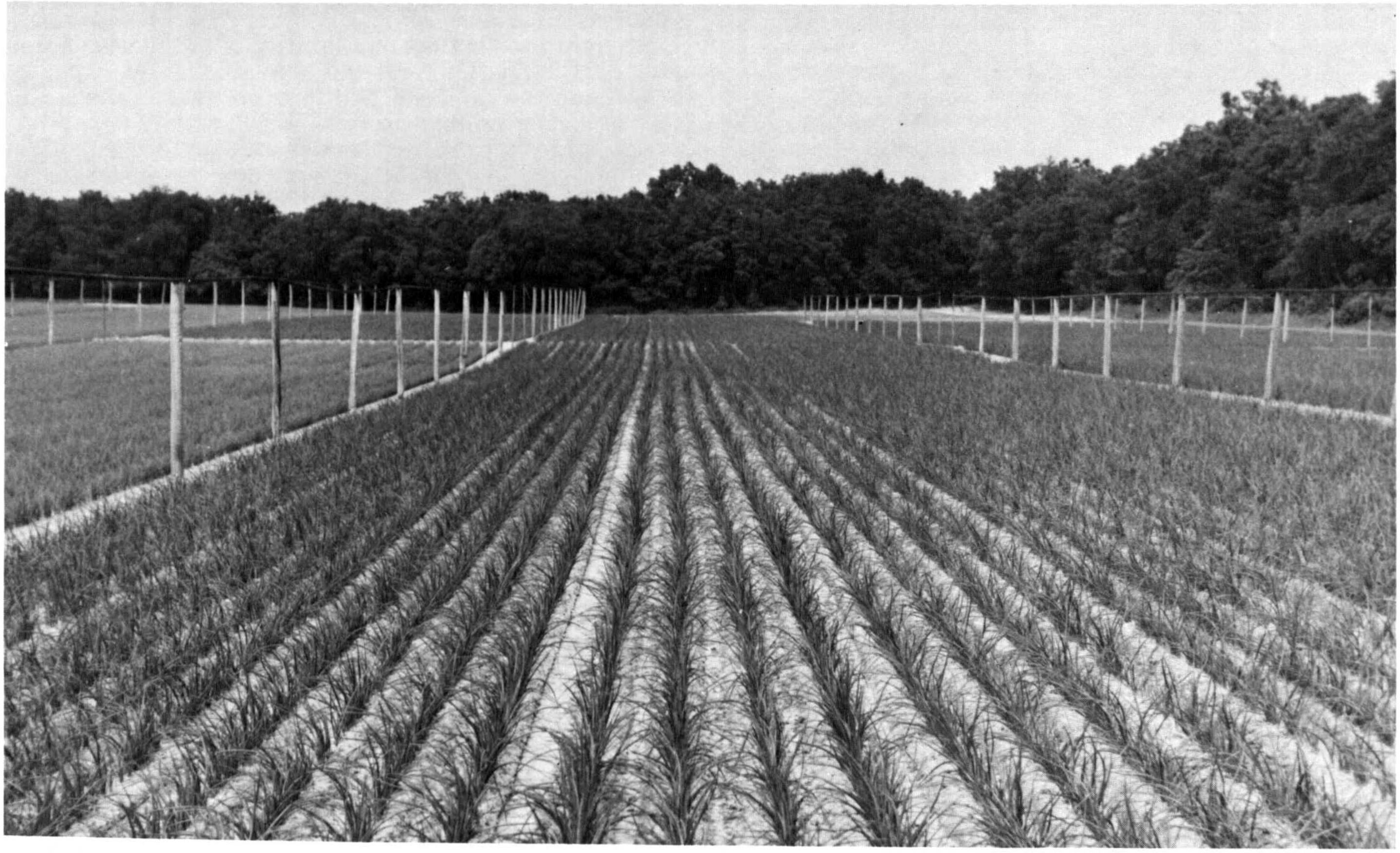

Figure 10.—**Onions growing in an area of Downer loamy sand.**

Included with this soil in mapping are small areas of Sassafras, Aura, and Hammonton soils and a few areas of nearly level Downer soils.

This Downer soil is easily worked, and crops can be planted early in spring. In cultivated areas, surface runoff is medium, and the hazard of erosion is moderate. On long slopes, contour cultivation, contour stripcropping, and minimum tillage can help control runoff and erosion and maintain the organic-matter content. The soil is suited to vegetables, fruits, and general crops. Irrigation can be used to advantage, especially if high-value crops are grown. Capability unit IIe–5; woodland group 3o2.

Evesboro Series

The Evesboro series consists of nearly level to moderately steep, excessively drained soils. These soils formed under a forest of mainly mixed oak and some pine. They are on side slopes and in high areas.

In a representative profile, in a wooded area, the surface layer is black sand about 2 inches thick. The subsurface layer is grayish-brown sand 3 inches thick. The subsoil is yellowish-brown sand 31 inches thick. The substratum is brownish-yellow sand to a depth of 60 inches.

Evesboro soils are low in natural fertility and organic-matter content. Permeability is rapid, and the available water capacity is low. The water table is below a depth of 5 feet. The soils are easily worked and warm early in spring. Fertilizer and lime leach readily. Extensive farmed areas are subject to soil blowing if they are not protected.

Most areas of Evesboro soils are in woodland. The natural vegetation is black oak, white oak, chestnut oak, hickory, and scattered pitch, shortleaf, and Virginia pines. Idle farmland generally supports pines in a short time. Areas cleared for farming are used mainly for vegetables. High-value crops need irrigation. Drought-resistant grasses and landscape plants should be used in areas used as sites for houses.

Representative profile of Evesboro sand, 0 to 5 percent slopes, in a wooded area, 0.25 mile south of Cumberland County College and 0.3 mile east of Union Lake.

O1—1½ inches to ½ inch, loose oak leaves and pine needles.

O2—½ inch to 0, dark reddish-brown (5YR 2/2) organic matter, many fine roots; friable.

A1—0 to 2 inches, black (10YR 2/1) sand mixed with many light-gray (10YR 7/1) grains; single grained; loose; common fine roots; extremely acid; clear, wavy boundary.

A2—2 to 5 inches, grayish-brown (10YR 5/2) sand; single grained; few fine roots; very strongly acid; clear, wavy boundary.

B—5 to 36 inches, yellowish-brown (10YR 5/6) sand; single

Figure 11.—**Parsley growing in an area of Downer loamy sand. It is protected from blowing by a strip of rye.**

grained; loose; few fine roots; sand grains coated; very strongly acid; wavy boundary.

C—36 to 60 inches, brownish-yellow (10YR 6/6) sand; single grained; loose; very strongly acid.

The solum is 30 to 48 inches thick. The content of gravel in the solum generally is less than 5 percent, but in places it is as much as 20 percent in some parts of the C horizon. The pebbles are rounded, quartzose, and less than 2 inches in diameter. The soil is extremely acid to very strongly acid unless it is limed.

The A1 horizon is black (10YR 2/1) to grayish brown (10YR 5/2). The B horizon and C horizon are sand or loamy sand. The C horizon has value of 4 to 7 and chroma of 3 to 6. It is sand to sandy clay loam including gravelly analogs between depths of 40 and 60 inches.

Evesboro soils are near Klej, Downer, Hammonton, Fort Mott, Lakewood, and Lakehurst soils. Evesboro soils do not have mottles, which are common in Hammonton and Klej soils. They do not have a finer textured Bt horizon, which is common in Downer and Fort Mott soils. Evesboro soils have a thinner A2 horizon than Lakewood and Lakehurst soils.

EvB—Evesboro sand, 0 to 5 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping are areas of Evesboro soils that have a surface layer of loamy sand and areas of Downer, Fort Mott, and Klej soils. Klej soils are in depressed areas and have a fluctuating seasonal high water table.

Because fertility is low and the available water capacity is low, this Evesboro soil is not well suited to general field crops and is commonly too droughty for pasture or hay. It is best suited to woodland. In cultivated areas, irrigation is needed for nearly all crops. Permeability is rapid, and added fertilizer is leached readily. Bare areas of this soil blow readily, and crops can be scalded when temperatures are high. Cover crops, windstrips, or windbreaks can help reduce soil blowing. Wooded areas need protection from wildfires. The wood is used mostly for pulp. Better drainage is needed in some areas of included Klej soils. Capability unit VIIs–8; woodland group 4s1.

EvC—Evesboro sand, 5 to 10 percent slopes. Included with this soil in mapping are areas of Downer soils.

Droughtiness is the main limitation to the use of this soil. Fertility is low and the available water capacity is low, and the choice of plants or crops is limited. The soil is better suited to woodland, wildlife habitat, parks, and other recreational uses. Surface runoff is medium, and the hazard of erosion is moderate in cleared areas. The soil is used mostly for pulpwood production, and woodland needs protection from wildfires. Capability unit VIIs–8; woodland group 4s1.

EvD—Evesboro sand, 10 to 20 percent slopes. Included in mapping are areas of Downer soils, areas of Evesboro soils that are finer textured between depths of 40 and 60 inches, and areas of soils where the lower part of long slopes contain excess water.

This Evesboro soil is generally not suited to cultivation because of an erosion hazard and droughtiness. It is best suited to woodland. It needs a permanent cover to reduce the erosion hazard. Capability unit VIIs–8; woodland group 4s1.

Fallsington Series

The Fallsington series consists of nearly level, poorly drained soils. These soils formed under a dominantly hardwood forest in marine or fluvial deposits. They are in low flats where they receive much runoff from slopes above. Where these soils are next to streams, they are subject to frequent flooding. Areas of these soils that adjoin Tidal Marsh are subject to flooding during severe coastal storms.

In a representative profile, in a wooded area, about 2 inches of leaf litter and organic material overlies a surface layer of very dark brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam 3 inches thick. The upper 6 inches of the subsoil is light brownish-gray sandy loam, and the lower 16 inches is mottled light brownish-gray sandy clay loam. The substratum is pale brown sand to a depth of 60 inches.

Fallsington soils are medium in natural fertility and moderate in organic-matter content. Permeability is moderate. If the soils are drained, the available water capacity is moderate but the water table is high enough that water is available to plants. Normally, the water table is at a depth of less than 1 foot; it is 2 feet to more than 4 feet deeper in summer. The water table reaches its peak late in October and remains high until June. When the water table is high, the soils have low bearing capacity.

Fallsington soils can be readily drained if an outlet is available. Either open ditches or subsurface drains can be used to lower the water table. The soils can be worked easily when they are adequately drained.

Most areas of Fallsington soils are wooded. The natural vegetation is white oak, pin oak, southern red oak, willow oak, red maple, sweetgum, black gum, and scattered pitch pine. The understory is a dense stand of highbush blueberry, sheep laurel, sweet pepperbush, gallberry, and greenbrier.

If drained, Fallsington soils are suited to farming. They are suited to corn, soybeans, hay, and late-planted vegetables. The soils warm slowly in spring and are generally in frost pockets. They are poorly suited to alfalfa, asparagus, fruit, and vegetables that are not water tolerant.

Fallsington soils have severe limitations for building foundations and onsite septic tank disposal systems because the seasonal water table is high for more than 6 months. The soils are generally good sites for ponds fed by ground water. They must be deeply drained if they are used for urban purposes. Water-tolerant landscape plantings are best suited.

Representative profile of Fallsington sandy loam in a wooded area on west side of County Road No. 10, 0.3 mile southwest of Center Grove.

O1—2 to 1 inches, loose maple leaves, oak leaves, pine needles, and twigs.

O2—1 to 0 inches, dark reddish-brown (5YR 2/2) organic matter; many fine roots; abrupt, smooth boundary.

A1—0 to 3 inches, very dark brown (10YR 2/2) sandy loam; moderate, fine and medium, subangular blocky structure; friable; many fine roots; extremely acid; clear, irregular boundary.

A2—3 to 6 inches, brown (10YR 5/3) sandy loam; moderate, fine and medium, subangular blocky structure; very friable; many fine roots; strongly acid; clear, irregular boundary.

B1g—6 to 12 inches, light brownish-gray (2.5Y 6/2) sandy loam; moderate, fine and medium, subangular blocky structure; friable; common, fine roots; very strongly acid; clear, wavy boundary.

B2g—12 to 28 inches, light brownish-gray (2.5Y 6/2) sandy clay loam; common, medium, prominent, yellowish-brown (10YR 5/8) mottles; weak, fine and medium, subangular blocky structure; friable; common, fine roots; clay bridgings of sand grains; very strongly acid; abrupt, smooth boundary.

C—28 to 60 inches, pale-brown (10YR 6/3) sand; single grained; loose; 10 percent rounded, quartzose pebbles; very strongly acid; few roots.

The solum is 24 to 38 inches thick but averages about 30 inches thick. The content of gravel is low in most places, but it makes up as much as 20 percent in some strata of the C horizon. The soil material is extremely acid to very strongly acid unless it is limed.

The A1 horizon ranges from very dark brown (10YR 2/2) to black (10YR 2/1). It is less than 6 inches thick.

The Bt horizon ranges from gray (10YR 6/1) to olive (5Y 4/3). Chromas of 3 occur only below a depth of 30 inches. Mottles range from common to many, fine to medium, and distinct to prominent. The B horizon is heavy sandy loam or sandy clay loam.

The C horizon is similar in color to the B horizon but in places chromas are higher. It ranges from sand to sandy loam in texture.

Fallsington soils are near Woodstown, Hammonton, Pocomoke, Atsion, and Berryland soils. Fallsington soils are grayer than Woodstown and Hammonton soils. They do not have a thick, very dark A1 horizon, which is common in Pocomoke soils. Fallsington soils are finer textured than Atsion and Berryland soils.

Fd—Fallsington sandy loam. This soil is nearly level. It is in large areas, mainly on flats where the elevation is less than 40 feet. Included with this soil in mapping are areas of soils that have a surface layer of loam and areas of Atsion, Berryland, Pocomoke, and Hammonton soils.

In places, the substratum is as much as 20 percent gravel, and in other places it is fine textured between depths of 40 and 60 inches. If the substratum is thick, the recharge rate for ground water in ponds is reduced.

Drained areas of this Fallsington soil are suited to corn, soybeans, vegetables, hay, or pasture. Most undrained areas are wooded. Because this soil is moderately permeable and has a surface layer of sandy loam, it is easy to work and not difficult to drain. Underdrains are generally effective where adequate outlets are available. Capability unit IIIw–21; woodland group 2w1.

Fort Mott Series

The Fort Mott series consists of nearly level or gently sloping, well drained soils. These soils formed under a dominantly hardwood forest in alluvial deposits that likely were redeposited by wind. They are in high areas.

In a representative profile, in a cultivated area, the plow layer is dark grayish-brown loamy sand about 10 inches thick. The subsurface layer is yellowish-brown loamy sand 16 inches thick. The upper 14 inches of the subsoil is yellowish-brown sandy clay loam, and the lower 5 inches is strong-brown sandy loam. The substratum is strong-brown loamy sand to a depth of 60 inches.

Fort Mott soils are low in natural fertility and organic-matter content. Permeability is moderate or moderately rapid, and the available water capacity is moderate. The water table is below a depth of 5 feet.

The natural vegetation is mainly black oak, white oak, southern red oak, chestnut oak, scarlet oak, Virginia pine, and hickory. The understory is lowbush blueberries and brackens. Most areas are in woodland. Areas cleared for farming are used for vegetables. The soils are best suited to deep-rooted perennial crops such as peaches and grapes, but sweetpotatoes, pumpkins, and cantaloups are also suited. Extensive farmed areas are subject to soil blowing which can be controlled by cover crops or privet windbreaks.

Fort Mott soils are suited to most urban uses. Because the soil is sandy to a moderate depth, drought-resistant grasses and landscape plants are best suited.

Representative profile of Fort Mott loamy sand, 0 to 5 percent slopes, 1.5 miles south of Millville on west side of road to Laurel Lake.

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand; single grained; loose; many fine roots; strongly acid; clear, irregular boundary.

A2—10 to 26 inches, yellowish-brown (10YR 5/6) loamy sand; single grained; loose; common fine roots; strongly acid; clear, irregular boundary.

B2t—26 to 40 inches, yellowish-brown (10YR 5/8) sandy clay loam; moderate, fine and medium, subangular blocky structure; friable; sand grains bridged with clay; strongly acid; clear, irregular boundary.

B3—40 to 45 inches, strong-brown (7.5YR 5/8) sandy loam; weak, fine and medium, subangular blocky structure; friable; sand grains weakly bridged with clay; strongly acid; clear, smooth boundary.

C—45 to 60 inches, strong-brown (7.5YR 5/8) loamy sand; single grained; loose; strongly acid.

The solum is 40 to 60 inches thick but averages 45 inches. The content of gravel is normally low in the solum, but in places it is as much as 30 percent in some strata of the C horizon. The gravel consists dominantly of rounded, quartzose pebbles as much as 2 inches in diameter. The soil is extremely acid to strongly acid unless it is limed.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 4/3). The B horizon is sandy loam or sandy clay loam. The C horizon is sand to sandy loam.

Fort Mott soils are near Downer, Hammonton, Aura, and Sassafras soils. Fort Mott soils have a thicker A horizon than Downer and Sassafras soils. They do not have mottles, which are common in Hammonton soils. Fort Mott soils do not have a firm, reddish B horizon, which is common in Aura soils.

FrA—Fort Mott loamy sand, 0 to 5 percent slopes. This soil occupies large areas. Included with this soil in mapping are areas of Downer, Sassafras, Hammonton, and Klej soils. Hammonton and Klej soils are in depressed areas and need better drainage in places. Also included are areas of soils that have a sand, sandy loam, or gravelly surface layer.

This Fort Mott soil is droughty because it is sandy to a moderate depth. Not enough water is available for satisfactory growth of nearly all annual crops. Care must be taken to insure that seedlings obtain enough moisture until their roots can reach the subsoil, which retains moisture. Soil blowing causes exposure and sandblasting of tender roots and damage to new tender leaves of plants. When temperatures are high, crops may be scalded by the heat rising from the surface of the soil. Cover crops normally maintain the organic-matter content. Privet windbreaks and wind strips can be used to reduce the losses from soil blowing and the damage to crops. Capability unit IIIs–7; woodland group 3o2.

Hammonton Series

The Hammonton series consists of nearly level and gently sloping, moderately well drained or somewhat poorly drained soils. These soils formed under a hardwood forest in marine deposits.

In a representative profile, in a cultivated area, the plow layer is brown sandy loam about 10 inches thick. The upper part of the subsoil is mottled yellowish-brown sandy loam that extends to a depth of 16 inches. The lower part of the subsoil is yellowish-brown sandy loam to a depth of 24 inches. The upper part of the substratum is mottled yellow loamy sand to a depth of 42 inches. Below this is yellowish-brown gravelly sand to a depth of 60 inches.

Hammonton soils are medium in natural fertility and low in organic-matter content. Permeability is moderately rapid. The available water capacity is moderate but the water table is still high enough in spring that ground water is available to plants. Depth to the seasonal high water table is 1½ to 4 feet, except that it is more than 5 feet in summers when rainfall is normal. The water table is highest from December to May. The soils are easily worked. Large areas of Hammonton loamy sand that are farmed are subject to soil blowing.

The natural vegetation is black oak, white oak, scarlet oak, chestnut oak, hickory, black gum, and scattered pitch pine, shortleaf pine, and Virginia pines. Among the shrubs are lowbush blueberry, mountain laurel, and scattered sheep laurel, gallberry, and highbush blueberry.

About half the acreage of Hammonton soils has been cleared for farming. The soils are suited to vegetables and fruit. Better drainage is needed if perennial plants and annuals that cannot tolerate saturated soils for short periods are grown. Either underdrains or open ditches can be used to lower the water table. Irrigation is needed for high-value crops (fig. 12).

Hammonton soils must be deeply drained if they are used for septic-tank filter fields or as sites for houses that have a basement.

Representative profile of Hammonton sandy loam, 0 to 2 percent slopes, 15 yards west of West Avenue, 100 yards north of intersection of West Avenue and Arbor Avenue in Vineland, in a field that was formerly cultivated.

Ap—0 to 10 inches, brown (10YR 4/3) sandy loam; weak, fine, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B1t—10 to 16 inches, yellowish-brown (10YR 5/4) sandy loam; few, fine, faint, light brownish-gray (10YR 6/2) and dark yellowish-brown (10YR 6/4) mottles; weak, medium, subangular blocky structure; friable; few roots; thin, patchy clay films; slightly acid; gradual, wavy boundary.

B2t—16 to 24 inches, yellowish-brown (10YR 5/6) sandy loam; weak, medium and coarse, subangular blocky structure; friable; few roots; sand grains bridged; slightly acid; clear, wavy boundary.

C1—24 to 42 inches, yellow (10YR 7/6) loamy sand; few, fine, faint, very pale brown (10YR 7/4) and light-gray (10YR 7/2) mottles; single grained; loose; few roots; strongly acid; abrupt, wavy boundary.

C2—42 to 60 inches, yellowish-brown (10YR 5/6) stratified gravelly sand; single grained; loose; 15 percent pebbles; strongly acid.

The solum is 20 to 40 inches thick but averages about 28 inches thick. The content of gravel is low in the solum, but in places it is as much as 20 percent in some parts of the C horizon. The soil is very strongly acid to extremely acid unless it is limed.

The A horizon is brown (10YR 4/3) to dark grayish brown (10YR 4/2). Mottles in the Bt horizon range from faint to prominent, few to many, and fine to medium. In some profiles mottles are throughout the B horizon. The C horizon is dominantly loamy sand, but there are strata where sandy loam and gravelly sand occur.

Hammonton soils are near Downer, Fallsington, Sassafras, Evesboro, and Klej soils. The Hammonton soils are mottled, but Downer and Sassafras soils are not. They are not so gray as Fallsington soils. They have a finer textured B horizon than Evesboro and Klej soils.

HaA—Hammonton loamy sand, 0 to 5 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer is loamy sand. Included with this soil in mapping are areas of Downer and Klej soils and small areas of Fallsington soils. Fallsington soils are poorly drained and need better drainage if they are to be farmed.

Drainage needs to be improved to keep the water table low if perennial plants or high-value crops are grown. In orchards, deep drainage is needed to prevent the blowing down of trees when the soil is saturated. Irrigation is needed where high-value summer crops are grown. Cover crops or privet windbreaks can help reduce soil blowing in large farmed areas. Capability unit IIw–15; woodland group 2o1.

HbA—Hammonton sandy loam, 0 to 2 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping are areas of Woodstown, Downer, Klej, and Fallsington soils. Fallsington soils are poorly drained and should be drained if they are to be farmed.

Improvement of drainage is needed if perennial plants or high-value crops are grown. In orchards, deep drainage is needed to prevent the blowing down of trees when the soil is saturated. Irrigation is needed in places if some high-value crops are grown. Cover crops normally can be used to maintain the organic-matter content. Capability unit IIw–14; woodland group 2o1.

HbB—Hammonton sandy loam, 2 to 5 percent slopes. Included with this soil in mapping are areas of Downer,

***Figure 12.*—Irrigated lettuce growing in an area of Hammonton sandy loam.**

Sassafras, and Woodstown soils. Downer and Sassafras soils are well drained.

Improvement of drainage is needed if perennial plants or high-value crops are to be grown, especially if the soil is to be irrigated. Erosion control practices are needed in farmed areas. If drained, the soil is suited to vegetables, fruits, and nursery plants. Cover crops normally can be used to maintain the organic-matter content. Capability unit IIw–14; woodland group 2o1.

Klej Series

The Klej series consists of nearly level, moderately well drained and somewhat poorly drained soils. In this county Klej soils are dominantly moderately well drained. They formed under a hardwood forest in marine or fluvial deposits.

In a representative profile, in a cultivated area, the plow layer is dark grayish-brown, loose loamy sand about 10 inches thick. The subsoil is mottled light yellowish-brown, loose loamy sand 17 inches thick. The substratum is white sand to a depth of 60 inches.

Klej soils are low in natural fertility and organic-matter content. Permeability is rapid or moderately rapid. The available water capacity is low but the water table is high enough early in spring that moisture is available to plants. Depth to the seasonal high water table ranges from 1½ to 4 feet in the period January to April, but in summers, when rainfall is normal, it is more than 5 feet deep. The soil is so coarse textured that little moisture rises upward in the soil in summer through capillary action. Fertilizer leaches readily. Large cultivated areas are subject to soil blowing, and crops, such as tomatoes and peppers, are subject to sandblasting. The soils are easily worked and warm early in spring.

The natural vegetation is mainly black oak, white oak, chestnut oak, scarlet oak, hickory, black gum, and scattered pines. Pine regenerate in idle areas if seed trees are nearby. Among the shrubs are lowbush blueberry and a few highbush blueberry and sheep laurel. Areas cleared for farming are used for vegetables. The soils are too droughty for most pasture or hay. Most high-value crops are irrigated. In areas where high-value crops and perennial plants are grown better drainage is needed to keep the water table low enough that wetness does not hinder the growth of crops. Either open ditches or underdrains can be used.

Klej soils must be deeply drained if they are to be used as septic-tank filter fields or as sites for houses that have a basement. Drought-tolerant grasses and landscape plants are best suited.

Representative profile of Klej loamy sand, 0 to 3 percent slopes, 0.4 mile south of Buckshutem, in a cultivated area.

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand; single grained; loose; many fine roots; slightly acid; abrupt, smooth boundary.

B2—10 to 37 inches, light yellowish-brown (10YR 6/4) loamy sand; few, fine, faint, brownish-yellow (10YR 6/6) mottles and few, fine, faint, light-gray (10YR 7/2) mottles; single grained; loose; sand grains coated; medium acid; gradual, irregular boundary.

Cg—37 to 60 inches, white (2.5Y 8/2) sand; common, medium to coarse, prominent, light yellowish-brown (10YR 6/4) mottles; single grained; loose; very strongly acid.

The soil has textures of sand to loamy sand to a depth of 40 inches, but below this, sand to sandy clay loam. Mottles are at a depth of 10 to 30 inches but are normally at a depth of more than 20 inches. The content of gravel in the upper 30 inches is generally less than 5 percent, but it is as much as 20 percent in some horizons below a depth of 30 inches. The soil is extremely acid or very strongly acid unless it is limed.

Klej soils are near Evesboro, Downer, Hammonton, and Atsion soils. Klej soils are mottled, but Evesboro and Downer soils are not. Klej soils do not have the sandy loam B horizon, which is common in Hammonton soils. They are not so gray as Atsion soils.

KmA—Klej loamy sand, 0 to 3 percent slopes. This soil is dominantly moderately well drained. Included with this soil in mapping are areas of Hammonton, Downer, and Evesboro soils and areas of soils that have a substratum of clay or sandy clay. Also included are some areas where the soils do not have gray mottles but do have few to many mottles of colors brighter than gray.

Wetness and low fertility are the main limitations to the use of this Klej soil for crops. Because the soil is permeable, underdrains or open drains are effective. If drained, the soil is droughty and subject to soil blowing. Irrigation is needed if high-value summer crops are grown. Capability unit IIIw–16; woodland group 3s1.

Lakehurst Series

The Lakehurst series consists of nearly level, moderately well drained and somewhat poorly drained soils. In this county Lakehurst soils are dominantly moderately well drained. They formed under a pine forest.

In a representative profile, in a wooded area, 6 inches of leaf litter and organic material overlies a surface layer of dark-gray sand about 1 inch thick. The subsurface layer is bleached, light brownish-gray sand 9 inches thick. The upper 1 inch of the subsoil is discontinuous, dark-brown sand, the next 9 inches is strong-brown sand, and the lower 20 inches is reddish-yellow and yellow sand. The substratum is brown sand to a depth of 60 inches.

Lakehurst soils are very low in natural fertility and low in organic-matter content. Permeability is rapid, and the available water capacity is low. The water table is high enough in spring that water is available to plants. Depth to the seasonal high water table ranges from 1½ to 4 feet from January to April but is more than 5 feet in summer, when rainfall is normal. Runoff is slow.

The natural vegetation is mostly pitch pine, but there are also some black oak, white oak, chestnut oak, and scrub oak. The understory is sheep laurel, lowbush blueberry, and gallberry. In areas of frequent severe fires, scrub oak and blackjack oak are common. In this county very few areas of Lakehurst soils are cultivated. Both drainage and irrigation are needed if these are used for high-value crops.

Lakehurst soils must be deeply drained if they are used as septic-tank filter fields or as sites for houses that have a basement.

Representative profile of Lakehurst sand, 0 to 3 percent slopes, 50 feet south of Weymouth Road at junction with Roberts Drive, 0.25 mile east of Willow Grove Lake, in a wooded area.

O1—6 to 3 inches, pine needles, oak leaves, and twigs.

O2—3 inches to 0, dark-brown (7.5YR 3/2), partly decomposed remains of plants and animals.

A1—0 to 1 inch, dark-gray (10YR 4/1) sand; single grained; loose; many fine roots; very strongly acid; clear, wavy boundary.

A2—1 inch to 10 inches, light brownish-gray (10YR 6/2) sand; single grained; loose; few roots; very strongly acid; clear, wavy boundary.

B21h—10 to 11 inches, dark-brown (7.5YR 4/4) sand; single grained; mostly friable; some common, firm nodules, ½ to 1 inch in diameter; many fine roots; very strongly acid; clear, broken boundary.

B22h—11 to 20 inches, strong-brown (7.5YR 5/6) sand; single grained; mostly loose; few, scattered, friable to firm nodules as much as ½ inch in diameter; few roots; very strongly acid; gradual, wavy boundary.

B3—20 to 40 inches, reddish-yellow (7.5YR 6/6) sand, grading with increasing depth to yellow (10YR 7/6); few, fine, faint mottles of similar value and chroma; single grained; loose; few roots; very strongly acid; diffuse, wavy boundary.

C—40 to 60 inches, brown (10YR 5/3) sand; few, fine, faint, mottles of similar value and croma; single grained; loose, few roots; free water at a depth of 42 inches; very strongly acid.

The solum is 25 to 40 inches thick. It is mainly sand throughout the A horizon and B horizon, but in some places there is a thin Bh horizon of loamy sand. Pebbles are generally lacking, but in some places the C horizon has discontinuous, thin strata that are as much as 30 percent pebbles. The soil is extremely acid to strongly acid throughout.

The A1 horizon has value of 4 or 5 and chroma of 1 or 2. It is discontinuous but occurs in more than half the profiles. The A2 horizon has value of 5 or 6 and chroma of 1 or 2. It is 8 to 20 inches thick.

The Bh horizon is unevenly developed. In some places the upper part of this horizon is thin, dark brown (7.5YR 3/2) to dark yellowish brown (10YR 4/4), and friable or firm. In other places the Bh horizon is nearly uniform, brownish yellow (10YR 6/6) to brown (7.5YR 5/4), and friable or loose throughout.

The distinction between the B3 horizon and C horizon is vague. Color, mottles, and texture are similar, but the C horizon is typically paler and has strata of gravelly sand to sandy loam.

Lakehurst soils are near Lakewood, Atsion, Evesboro, Klej, and Hammonton soils. Lakehurst soils have a more pronounced Bh horizon than Lakewood soils, and they have a paler C horizon. They have a thicker A2 horizon than Evesboro, Klej, or Hammonton soils and have brighter (higher chroma) colors in the lower part of the B horizon than Atsion soils.

LaA—Lakehurst sand, 0 to 3 percent slopes. This soil is dominantly moderately well drained. Included with this soil in mapping are small areas of Lakewood, Klej, Atsion, and Hammonton soils and soils that have a bleached layer more than 20 inches thick. Also included are areas where the substratum is sandy clay loam below a depth of 40 inches.

Most areas of this Lakehurst soil are in woodland, where fire protection is needed. Only a small acreage is used for crops. The soil is low in fertility, and added fertilizers leach readily. The seasonal high water table is a limitation to the use of this soil for many purposes, but it can be lowered by use of open ditches or underdrains in most areas. Capability unit IVw–17; woodland group 4s1.

Lakewood Series

The Lakewood series consists of gently sloping, excessively drained soils. These soils formed in high areas under a coniferous forest.

In a representative profile the surface layer is black sand about 2 inches thick. The subsurface layer is light brownish-gray sand 10 inches thick. The subsoil is yellowish-brown sand 18 inches thick. The substratum is brownish-yellow sand to a depth of 60 inches.

Lakewood soils are very low in natural fertility and low in organic-matter content. Permeability is rapid, and the available water capacity is low. Depth to the water table is more than 5 feet.

The natural vegetation is dominantly pitch pine, white oak, black oak, chestnut oak, and scrub oak, generally of poor quality. The shrub understory is lowbush blueberry, mountain laurel, and bayberry.

Nearly all areas of Lakewood soils are wooded. Near Vineland, large areas are used for industrial, commercial, or residential development. Frequent irrigation and fertilization are needed if the soils are to support grass and landscape plants.

Representative profile of Lakewood sand, 0 to 5 percent slopes, 0.9 mile east of N.J. 55 on Millville-Mays Landing Road, in a wooded area.

O1—1 inch to 0, loose pine needles, oak leaves, and twigs, discontinuous but covering most of the surface.

A1—0 to 2 inches, black (10YR 2/1) sand; single grained; loose; common roots; extremely acid; clear, broken boundary.

A2—2 to 12 inches, light brownish-gray (10YR 6/2) sand; single grained; loose; few roots; extremely acid; clear, irregular boundary.

B2h—12 to 30 inches, yellowish-brown (10YR 5/6) sand; single grained; loose; common roots; extremely acid; gradual, wavy boundary.

C—30 to 60 inches, brownish-yellow (10YR 6/6) sand grading to yellow (10YR 7/6) in the lower part; single grained; loose; very strongly acid.

The solum is 20 to 40 inches thick. The sand fraction in most places is dominantly medium-sized particles but ranges from mainly fine to coarse particles in some strata or in some places. Pebbles are typically lacking but range to 15 percent in a few places. The soil is extremely acid to very strongly acid.

The A1 horizon is black (10YR 2/1) to very dark grayish brown (10YR 3/2). The A2 horizon has value of 5 or 6 and chroma of 1 or 2. It is 7 to 20 inches thick.

The B horizon is brownish yellow (10YR 6/8) to reddish brown (5YR 4/3). The redder hue and lower value and chroma are not common, but occur as discontinuous, ¼- to 2-inch horizons or as friable to firm nodules distributed throughout the B horizon in less than half of any individual profile. The B horizon is mostly sand but part of it has textures ranging to loamy sand in some places.

The C horizon is typically similar to the lower part of the B horizon, but it is yellower and paler colored. It is sand to a depth of 60 inches in most places, but it ranges to sandy loam below a depth of 40 inches in some places.

Lakewood soils are near Lakehurst, Downer, Aura, Evesboro, and Klej soils. Lakewood soils have a less distinct Bh horizon than Lakehurst soils, but they do not have pale colors in the lower part of the C horizon. They are coarser textured than Downer and Aura soils, but they do not have a finer textured Bt horizon. Lakewood soils have a thicker A2 horizon than Evesboro or Klej soils.

LeB—Lakewood sand, 0 to 5 percent slopes. This soil is most extensive directly east of the Maurice River. Included with this soil in mapping are small areas of a similar soil that has a subsoil of sandy loam and areas of Downer, Lakehurst, and Evesboro soils. Also included are small areas of soils that have slopes of more than 5 percent, areas of soils that are dominantly fine sand or coarse sand, and areas where the substratum is sandy clay loam, especially below a depth of 40 inches.

Nearly all areas of this Lakewood soil are in woodland. Fire protection is the main management need if woodland is to be improved for pulp production or recreation. Little acreage is used for cultivated crops. The soil is droughty and subject to soil blowing. It is very low in fertility, and fertilizer leaches readily. Capability unit VIIs–8; woodland group 5s1.

Matapeake Series

The Matapeake series consists of nearly level to sloping, well-drained soils. These soils formed in high areas under a hardwood forest in material deposited by wind or water over sand of marine origin.

In a representative profile, in a cultivated area, the plow layer is brown silt loam about 8 inches thick. The subsoil is strong-brown silt loam 26 inches thick. The substratum is yellow loamy sand to a depth of 60 inches.

Matapeake soils are medium in natural fertility and moderate in organic-matter content. Permeability is moderately slow, and the available water capacity is high. The water table is below a depth of 5 feet.

The natural vegetation is red oak, scarlet oak, white oak, black oak, yellow-poplar, beech, and hickory. In the shrub understory are lowbush blueberries and mountain-laurel. Most areas of Matapeake soils have been cleared for farming. The soils are easily worked, and most high-value crops are irrigated. The most extensively grown crops are corn, small grain, soybeans, vegetables, hay, pasture, nursery plants, and sod.

Matapeake soils are suited to most urban uses.

Representative profile of Matapeake silt loam, 0 to 2 percent slopes, 0.3 mile west of County Road 63, 20 yards south of County Road 540.

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

B1—8 to 15 inches, strong-brown (7.5YR 5/6) silt loam; weak, medium, subangular blocky and fine, granular structure; friable; weak clay flows along root and earthworm channels; common fine roots; neutral; clear, irregular boundary.

B2t—15 to 34 inches, strong-brown (7.5YR 5/6) silt loam; moderate, medium, subangular blocky structure; friable; moderate clay films in root and worm channels; few fine roots; mildly acid; clear, smooth boundary.

C—34 to 60 inches, yellow (10YR 7/8) loamy sand; single grained; loose; 10 percent quartzose pebbles; strongly acid.

The solum is 24 to 40 inches thick. Gravel is rare in the solum, but in some places it makes up as much as 10 percent in parts of the C horizon. Unless limed, Matapeake soils are extremely acid in the surface layer and very strongly acid in the other horizons.

The B horizon is silt loam to light silty clay loam. The C horizon is sand to sandy loam.

Matapeake soils are near Chillum, Mattapex, and Sassafras soils. Matapeake soils do not have the firm gravelly C horizon which is common in Chillum soils. They lack mottles, which are common in Mattapex soils. They contain more silt than Sassafras soils.

MoA—Matapeake silt loam, 0 to 2 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping are areas that have a surface layer of loam or fine sandy loam. Also included are small areas of Mattapex and Chillum soils. Mattapex soils are in depressed areas and need improved drainage if high-value crops are grown, especially if the soil is irrigated.

This Matapeake soil can be plowed and worked early in spring. Surface runoff is slow, and the hazard of erosion is slight. The soil can be cultivated intensively under a high level of management. It is used for common field crops, special crops, and hay and pasture. The use of cover crops generally is enough to maintain the organic-matter content. Capability unit I–4; woodland group 3o1.

MoB—Matapeake silt loam, 2 to 5 percent slopes. This soil has a profile similar to the one described as representative of the series, except in some places the soil has been thinned by sheet erosion and some shallow gullies have formed. Included with this soil in mapping are areas of Chillum, Sassafras, and Mattapex soils.

In cultivated areas, surface runoff is medium, and the hazard of erosion is moderate (fig. 13). Most areas of the soil are used for general crops, fruits, and vegetables. Contour cultivation, cover crops, and a crop rotation that includes sod can help reduce erosion and maintain the organic-matter content. Capability unit IIe–4; woodland group 3o1.

MoC2—Matapeake silt loam, 5 to 10 percent slopes, eroded. This soil has a profile similar to the one described as representative of the series, but the combined surface layer and subsoil are generally several inches thinner. Erosion has thinned the surface layer, and in places gullies have formed. In these areas the organic-matter content is lower than in the representative profile.

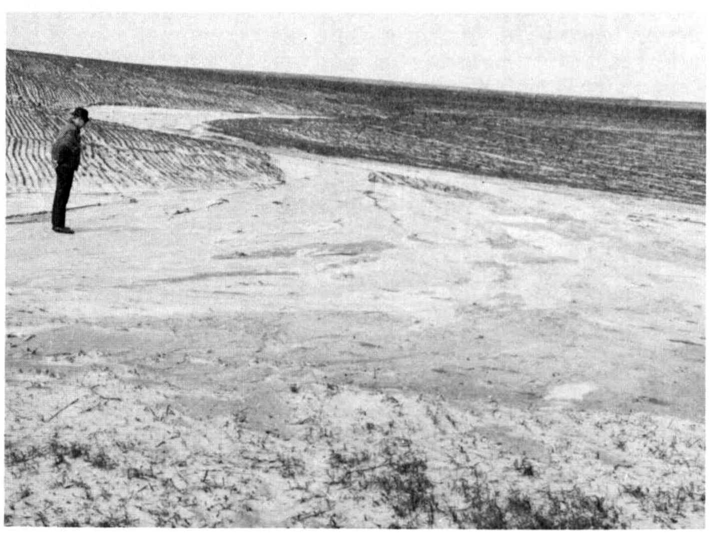

***Figure 13.*—A newly seeded cover crop growing in an area of Matapeake silt loam, 2 to 5 percent slopes. Additional conservation practices are needed on long slopes.**

Included with this soil in mapping are small areas of soils that have slopes of more than 10 percent and areas that have seep spots, especially on the lower part of long slopes.

Runoff is rapid, and the erosion hazard is moderately severe. This soil is used mainly for general crops, hay, and pasture. Contour cultivation, cover crops, stripcropping, and terracing are used to control erosion and increase the organic-matter content. Capability unit IIIe–4, woodland group 3o1.

Mattapex Series

The Mattapex series consists of nearly level or gently sloping, moderately well drained soils. These soils formed under a hardwood forest on marine terraces at an elevation of mostly less than 25 feet, but some areas are higher. They are commonly downslope from Matapeake soils.

In a representative profile, in a cultivated area, the plow layer is brown silt loam about 9 inches thick. The upper part of the subsoil is yellowish-brown silt loam that extends to a depth of 15 inches. The middle part is yellowish-brown silt loam to a depth of 28 inches, and the lower part is light yellowish-brown silt loam to a depth of 37 inches. The upper part of the substratum is pale-brown fine sandy loam to a depth of 47 inches. Below this is brownish-yellow sandy loam to a depth of 60 inches.

Mattapex soils are medium in natural fertility and moderate in organic-matter content. Permeability is moderately slow, and the available water capacity is high. Depth to the seasonal high water table ranges from 2 to 3 feet in the period January to April but is generally more than 5 feet in summer.

The natural vegetation is red oak, white oak, scarlet oak, yellow-poplar, beech, and hickory. Most areas of Mattapex soils have been cleared for farming. The most extensively grown crops are corn, soybeans, small grain, hay, pasture, vegetables, nursery plants, and sod. Better drainage is needed if perennial plants or high-value crops are grown. If drained, the soils are easily worked.

Mattapex soils must be deeply drained if they are used as septic-tank filter fields or as sites for houses that have a basement.

Representative profile of Mattapex silt loam, 0 to 2 percent slopes, on north side of County Road No. 5, 0.4 mile east of Roadstown, in a cultivated area.

Ap—0 to 9 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many fine roots; slightly acid; abrupt, smooth boundary.

B1—9 to 15 inches, yellowish-brown (10YR 5/8) silt loam; moderate, fine, granular structure; friable; common roots; slightly acid; clear, wavy boundary.

B21t—15 to 28 inches, yellowish-brown (10YR 5/6) silt loam; moderate, medium, subangular blocky structure; friable; few roots; thin, discontinuous, clay films; medium acid; gradual, wavy boundary.

B22t—28 to 37 inches, light yellowish-brown (10YR 6/4) silt loam; common, medium, strong-brown (7.5 YR

5/6) mottles and common, fine, light gray (10YR 7/2) mottles; moderate, medium, subangular blocky structure; friable; few roots; thick, discontinuous, clay films; medium acid; gradual, wavy boundary.

IIC1—37 to 47 inches, stratified pale-brown (10YR 6/3) fine sandy loam; moderate, medium, subangular blocky structure; friable; few roots; very strongly acid; abrupt, smooth boundary.

IIC2—47 to 60 inches, stratified brownish-yellow (10YR 6/8) sandy loam; single grained; friable; few roots; very strongly acid.

The solum is 30 to 40 inches thick. Rounded, quartzose pebbles are rare in the solum, but in some places they make up as much as 10 percent in some parts of the C horizon. Unless limed, Mattapex soils are extremely acid in the A1 horizon and very strongly acid in the other horizons.

The B horizon is loam to light silty clay loam. It ranges from friable to firm but is friable in most places. Mottles range from 2.5Y to 7.5YR in hue, 5 to 7 in value, and 1 to 8 in chroma. This horizon has mottles in chromas of 1 or 2 in all places. The mottles range from faint to prominent, fine to medium, and few to many.

The C horizon is fine sandy loam to loamy sand.

Mattapex soils are near Matapeake, Othello, Woodstown, Sassafras, and Chillum soils. The B horizon of Mattapex soils is not so gray as that of Othello soils. Mattapex soils have low-chroma mottles but Matapeake, Sassafras, and Chillum soils do not. They contain more silt than Woodstown soils.

MrA—Mattapex silt loam, 0 to 2 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping and making up 10 to 15 percent of the mapped areas is a somewhat poorly drained soil. This soil is wetter for longer periods, and is grayer than the Mattapex soil and needs more drainage.

Also included are areas of Mattapex soils that have a surface layer of loam and areas of Woodstown, Matapeake, and Othello soils. Mattapex soils contain more silt than Woodstown soils. They are not so well drained as Matapeake soils and are better drained than Othello soils.

This Mattapex soil needs drainage improvement if high-value crops are to be grown, especially if the soil is to be irrigated. If drained, the soil is suited to common field crops, vegetables, hay, pasture, sod, and nursery plants. Surface drainage or smoothing is needed in places to remove water. Underdrains can remove excess water efficiently in most places. The use of cover crops is generally sufficient to maintain the organic-matter content. Areas of the included Woodstown soil are managed about the same as this Mattapex soil, but areas of the included, poorly drained Othello soils need better drainage if they are farmed. Capability unit IIw–13; woodland group 3o1.

MrB—Mattapex silt loam, 2 to 5 percent slopes. Included with this soil in mapping are Mattapex soils that have a surface layer of loam. Also included are areas of Woodstown soils and well drained Matapeake soils.

Erosion and drainage are problems on the slopes of this Mattapex soil. On the long slopes that are farmed erosion control practices are needed. In these areas, contour cultivation, stripcropping, and crop rotations that include sod can be used to reduce erosion. Underdrains are efficient in removing excess water in most places. Drainage needs to be improved if high-value crops are to be grown. This soil is suited to common field crops, vegetables, hay, pasture, sod, and nursery plants. Cover crops are generally sufficient to maintain the organic-matter content. Capability unit IIw–13; woodland group 3o1.

Muck

Muck (MS) is nearly level and consists of black, finely decomposed, saturated organic material. At most times, the saturated soil material is essentially liquid and has little bearing capacity. Muck ranges from 16 inches to 10 feet or more in thickness, but it generally is 3 feet or more thick.

Muck is in low areas that are stream courses or are transitional from Tidal Marsh to mineral soils of the uplands. It is subject to frequent, short-duration flooding. The water table is at the surface throughout the year except during extreme droughts. Included in mapping are some mineral soils near streamheads.

Natural fertility is medium. If drained, these soils have high available water capacity. Permeability is rapid.

Most areas are in forest that consists of dense stands of Atlantic white-cedar, red maple, bay magnolia, and pitch pine. The white-cedar has been killed by recent flooding in some places where saltwater is encroaching in areas of freshwater.

Muck is extremely acid. Drained areas subside severely and are subject to burning. A few small areas were cleared for farming, but they have been abandoned and are reverting to woodland. Corduroy roads constructed from the tops of cedar trees are commonly used to bring logs out of the cedar swamps. Capability unit VIIw–30; woodland group 4w1.

Othello Series

The Othello series consists of nearly level, poorly drained soils. These soils formed in low areas under a hardwood forest in deposits of marine origin. Areas that adjoin Tidal Marsh are subject to tidal flooding during severe coastal storms.

In a representative profile, in a wooded area, the surface layer is dark-gray silt loam about 3 inches thick. The subsurface layer is mottled light-gray silt loam 5 inches thick. The subsoil is mottled light-gray silt loam 20 inches thick. The upper part of the substratum is mottled light-gray fine sandy loam to a depth of 40 inches. Below this is light-gray loamy sand to a depth of 60 inches.

Othello soils are medium in natural fertility and moderate in organic-matter content. Permeability is moderately slow. In drained areas, the available water capacity is high. The seasonal high water table is at the surface or at a depth of 1 foot from late October until June but at a depth of 3 to 5 feet in summer. Because the soils are nearly level, outlets for draining the excess water are difficult to obtain in some places. These soils are generally in frost pockets.

The natural vegetation is hardwood forest, consisting mainly of pin oak, white oak, southern red oak, willow oak, red maple, sweetgum, black gum, and holly. The shrub understory is a dense stand of highbush blueberry, sweet pepperbush, sheep laurel, and greenbrier. Most areas of Othello soils are in woodland. Much of the areage that was cleared is now idle and reverting to woodland. Sweetgum trees volunteer readily when farming is abandoned on these soils.

These soils warm late in spring. If drained, the soils are suited to corn, soybeans, hay, pasture, late-planted vegetables, and woodland production.

Because these soils are in low areas and receive much water from the slopes above, they need drainage if they are to be farmed. Bedding has been extensively used to provide surface drainage, but many bedded fields are now idle. Underdrains are generally not efficient enough for use in removing excess water because they do not provide drainage rapidly enough to prevent damage to crops.

Othello soils are good sites for ponds fed by ground water. The seasonal high water table is a severe limitation for many urban uses.

Representative profile of Othello silt loam, in a wooded area, 20 yards west of Gum Tree Corners.

A1—0 to 3 inches, dark-gray (10YR 4/1) silt loam; moderate, fine and medium, granular structure; very friable; many fine roots; extremely acid; clear, wavy boundary.

A2g—3 to 8 inches, light-gray (10YR 6/1) silt loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; friable; common roots; very strongly acid; clear, irregular boundary.

B21tg—8 to 20 inches, light-gray (10YR 6/1) silt loam; common, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm when moist, slightly plastic and sticky when wet; common roots; discontinuous, thin, clay films; very strongly acid; gradual, irregular boundary.

B22tg—20 to 28 inches, light-gray (10YR 6/1) silt loam; common, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; firm when moist, plastic and sticky when wet; few roots; thin clay films on ped faces; very strongly acid; gradual, irregular boundary.

IIC1g—28 to 40 inches, stratified light-gray (10YR 7/1) fine sandy loam; common to many, fine to medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; very friable; very strongly acid; clear, smooth boundary.

IIC2g—40 to 60 inches, light-gray (N 7/0) loamy sand; single grained; loose; friable; strongly acid.

The solum is 24 to 40 inches thick. The content of gravel is low in the solum, but in some places it is as much as 10 percent of some part of the IIC horizon. Unless limed, Othello soils are extremely acid in the surface layer and very strongly acid in the other horizons.

The B horizon is silt loam to silty clay loam. It has mottles that range from few to many, fine to medium, faint to prominent.

The IIC horizon is sandy loam to loamy sand.

Othello soils are near Mattapex, Woodstown, Fallsington, and Pocomoke soils. Othello soils are grayer than Mattapex or Woodstown soils. They contain more silt in the solum than is common in Fallsington and Pocomoke soils.

Ot—Othello silt loam. This soil is nearly level and is most extensive near Othello. Included with this soil in mapping are areas of soils that have a surface layer of loam and areas of Fallsington, Pocomoke, Mattapex, and Woodstown soils. Fallsington, Pocomoke, and Woodstown soils are sandier than Othello soils, and Mattapex soils are not so wet. Also included are soils that have strata of sandy clay loam in the substratum below a depth of 40 inches.

If this Othello soil is to be farmed, it must be drained. The water table can be lowered by the use of open ditches, and surface water can be drained by bedding. If drained, the soil is suited to corn, soybeans, hay, and pasture. It is not suited to alfalfa, fruit, and most vegetables.

The soil is generally a good site for ponds fed by ground water. The seasonal high water table is a severe limitation for many urban uses. Capability unit IIIw-20; woodland group 3w2.

Pocomoke Series

The Pocomoke series consists of nearly level, very poorly drained soils. These soils formed in marine or fluvial deposits. They are in low areas and receive much runoff from higher areas. Where these soils are next to streams, they are subject to frequent flooding. Areas that adjoin Tidal Marsh are subject to flooding during severe coastal storms.

In a representative profile the surface layer is very dark brown sandy loam about 9 inches thick. The subsurface layer is gray sandy loam 3 inches thick. The subsoil is mottled gray sandy loam 15 inches thick. The substratum is light brownish-gray sand to a depth of 60 inches.

Pocomoke soils are medium in natural fertility and high in organic-matter content. Permeability is moderate. If these soils are drained, the available water capacity is moderate but the water table is still high enough that water is available to plants. Undrained Pocomoke soils have a seasonal high water table at the surface during the period October to May but at a depth of 2 feet or more in summer. If Pocomoke soils are saturated, they have low bearing capacity.

The natural vegetation is red maple, pin oak, willow oak, southern red oak, white oak, sweetgum, black gum, bay magnolia, holly, and a few pitch pine. The understory is a dense stand of highbush blueberry, sweet pepperbush, sheep laurel, bayberry, and greenbrier. Most Pocomoke soils are in woodland.

Pocomoke soils must be drained if they are farmed. Normal drainage can reduce crop losses and make farming feasible. Because the soils are nearly level, outlets are difficult to obtain in places and if they cross many properties, are difficult to maintain. Where outlets are available, open ditches or underdrains can be used. The soils drain slowly and warm late in spring. If drained, Pocomoke soils are suited to corn, soybeans, hay, pasture, blueberries, and limited summer-planted vegetables. The soils are generally in frost pockets.

Pocomoke soils are good sites for ponds fed by ground water. The seasonal high water table is a severe limitation for many urban uses.

Representative profile of Pocomoke sandy loam on the west side of Cox's Road, 680 feet south of Delsea Drive, in Delmont.

A1—0 to 9 inches, very dark brown (10YR 2/2) sandy loam; very weak, fine, granular structure; friable; many fine roots; extremely acid; clear, irregular boundary.

A2g—9 to 12 inches, gray (10YR 6/1) sandy loam; very weak, fine, subangular blocky structure; friable; many fine roots; extremely acid; clear, wavy boundary.

B2g—12 to 27 inches, gray (10YR 6/1) sandy loam; common, fine to medium, faint, light-gray (10YR 7/1) and distinct yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; many fine roots; sand grains bridged with clay; extremely acid; clear, wavy boundary.

IICg—27 to 60 inches, stratified light brownish-gray (10YR 6/2) sand; common, medium, faint, light-gray (10YR 7/1) and distinct, yellowish-brown (10YR 5/6) mottles; single grained; loose; few roots; extremely acid.

The solum is 22 to 40 inches thick. The content of gravel is 0 to 5 percent in the solum, but in places it is as much as 20 percent in some part of the IIC horizon. The pebbles are rounded, quartzose, and generally less than 2 inches in diameter. The soil is extremely acid to very strongly acid unless it is limed.

The A horizon is very dark brown (10YR 2/2) or black (10YR 2/1) and 8 to 16 inches thick. Mottles in the B horizon range from faint to prominent, few to many, and fine to coarse, but in places the B horizon is not mottled. The C horizon is dominantly sand or loamy sand, but in some places it has strata of sandy loam, especially between depths of 40 and 60 inches.

Pocomoke soils are near Fallsington, Othello, Woodstown, and Hammonton soils. Pocomoke soils have a darker colored A horizon than Fallsington and Othello soils, and they have less silt than Othello soils. They are grayer than Woodstown and Hammonton soils.

Ps—Pocomoke sandy loam. This soil is nearly level and the largest areas are on flats where the elevation is less than 40 feet. Included with this soil in mapping are areas of Pocomoke soils that have a loam or an organic surface layer, areas of Fallsington and Othello soils, and less commonly areas of Woodstown and Hammonton soils. Also included are small areas of soils that have a subsoil of sandy clay loam and areas where the surface layer and subsoil are as much as 20 percent gravel.

Wetness is the main limitation to the use of this Pocomoke soil. Carefully installed and maintained deep drainage is needed if the soil is to be farmed. Open ditches or underdrains can be used to drain the soil and thus lower the water table. If adequately drained, the soil is best suited to summer crops. Capability unit IIIw–24; woodland group 2w1.

Sassafras Series

The Sassafras series consists of nearly level to sloping, well-drained soils. These soils formed under a hardwood forest in marine and fluvial deposits. They are in high areas and on side slopes.

In a representative profile, in a cultivated area, the plow layer is dark yellowish-brown sandy loam about 10 inches thick. The upper part of the subsoil is yellowish-brown sandy loam to a depth of 14 inches. The middle part is yellowish-brown sandy clay loam to a depth of 30 inches. The lower part is yellowish-brown sandy loam to a depth of 40 inches. The substratum is brownish-yellow loamy sand to a depth of 60 inches.

Sassafras soils are medium in natural fertility and moderate in organic-matter content. Permeability is moderate, and the available water capacity is moderate. The depth to the water table is more than 5 feet in most places.

The natural vegetation is northern red oak, southern red oak, black oak, white oak, scarlet oak, and chestnut oak, hickory, yellow-poplar, beech, and a few pitch pine, Virginia pine, and shortleaf pine. The understory is lowbush blueberry, laurel, and holly.

Most areas of Sassafras soils have been cleared for farming. They are used extensively for vegetables, fruits, general crops, nursery plants, hay, and pasture. Nearly all high-value crops are irrigated. These soils warm moderately early and are easily worked.

Sassafras soils are suited to most urban uses.

Representative profile of Sassafras sandy loam, 0 to 2 percent slopes, in a peach orchard on County Highway 100, 1,320 feet west of County Highway 50.

Ap—0 to 10 inches, dark yellowish-brown (10YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; common fine roots; slightly acid; abrupt, smooth boundary.

B1—10 to 14 inches, yellowish-brown (10YR 5/6) heavy sandy loam; weak, medium, subangular blocky structure; friable; common fine roots; slightly acid; clear, wavy boundary.

B2t—14 to 30 inches, yellowish-brown (10YR 5/6) sandy clay loam; moderate, medium, subangular blocky structure; friable; strong clay bridgings between sand grains; pores nearly filled; common fine roots; slightly acid; clear, wavy boundary.

B3—30 to 40 inches, yellowish-brown (10YR 5/6) sandy loam; weak, fine and medium, subangular blocky structure; friable; few roots; medium acid; abrupt, smooth boundary.

C—40 to 60 inches, brownish-yellow (10YR 6/6) loamy sand; single grained; very friable to loose; very strongly acid; abrupt, smooth boundary.

The solum is 30 to 40 inches thick. The content of gravel ranges from 0 to 20 percent in the solum, but in some places it is as much as 30 percent in some parts of the C horizon. The pebbles are rounded, quartzose, and generally less than 2 inches in diameter. The soil is extremely acid to strongly acid unless it is limed.

The A horizon is sandy loam to gravelly sandy loam. The B horizon is sandy clay loam to heavy sandy loam and gravelly analogs. The C horizon is dominantly loamy sand, but generally contains thin strata of sandy loam.

Sassafras soils are near Woodstown, Fallsington, Aura, Downer, Hammonton, Matapeake, and Mattapex soils. Sassafras soils do not have the gray mottles, which are common in Woodstown soils. They differ from Fallsington soils in having different matrix colors. They differ from Aura soils in that the lower part of the B horizon is not reddish and firm. They contain more clay in the B horizon than Downer and Hammonton soils. Sassafras soils do not have a high silt content, which is common in Matapeake and Mattapex soils.

SgA—Sassafras gravelly sandy loam, 0 to 2 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 20 percent gravel.

Because the soil is gravelly, the available water capacity is less and generally the soil is less suited to fine-seeded vegetables, nursery plants, and sod. Cultivation is also more difficult. The use of cover crops is generally sufficient to maintain the organic-matter content. Capability unit I–5; woodland group 3o2.

SgB—Sassafras gravelly sandy loam, 2 to 5 percent slopes. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 20 percent gravel.

Because the soil is gravelly, the available water capacity is less, the soil, generally, is less suited to fine-seeded vegetables and nursery plants, cultivation is more difficult, and growing sod is more difficult. Cover crops generally are sufficient to maintain the organic matter content. On long slopes, contour farming, stripcropping, and crop rotations that include sod can be used to reduce erosion. Capability unit IIe–5; woodland group 3o2.

SgC2—Sassafras gravelly sandy loam, 5 to 10 percent slopes, eroded. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 20 percent gravel.

Because the soil is gravelly the available water capacity is less and cultivation is difficult. In farmed areas, runoff is rapid, and the erosion hazard is severe. Among the practices that can be used to control erosion are contour farming, stripcropping, diversions, or crop rotations that include sod. A combination of practices can be used. Capability unit IIIe–5; woodland group 3o2.

SrA—Sassafras sandy loam, 0 to 2 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping are areas of Downer, Hammonton, Aura, Woodstown, Matapeake, and Mattapex soils.

Depressed areas of this Sassafras soil that have no natural outlet need surface drainage in places. Drainage is also needed in places for the included Mattapex, Woodstown, and Hammonton soils, especially if high-value crops are grown. Runoff is slow and the erosion hazard is slight. Crop rotation or cover crops generally can maintain the organic-matter content and tilth. Capability unit I–5; woodland group 3o2.

SrB—Sassafras sandy loam, 2 to 5 percent slopes. Included with this soil in mapping are areas of Aura, Downer, and Matapeake soils. Aura soils have a firm, root-restricting layer in the subsoil, and Downer soils are sandier and droughtier than this Sassafras soil. Because they contain more silt, Matapeake soils are less droughty than Sassafras soils.

In farmed areas, runoff is moderate and the erosion hazard is moderate. Erosion control practices are needed; contour farming, crop rotation, and cover crops can be used to control erosion (fig. 14). Capability unit IIe–5; woodland group 3o2.

SrC2—Sassafras sandy loam, 5 to 10 percent slopes, eroded. This soil has a profile similar to the one described as representative of the series, but in cultivated areas erosion has thinned the soil somewhat. Included with this soil in mapping are some wooded areas that are not eroded.

Runoff is rapid and the erosion hazard is severe. Many gullies have formed in the fields. Most have been filled with soil obtained nearby, but some fields still have gullies. Crop rotation, cover crops, stripcropping, and diversions maintain a porous surface layer and keep gullies from forming. Capability unit IIIe–5; woodland group 3o2.

Tidal Marsh

Tidal Marsh (TM) is very poorly drained, silty and mucky tidal flats that are near sea level. It is flooded twice a day by the tide; as a result, it is almost constantly saturated and has low bearing capacity. The soil material is soft and brownish. It ranges from 1 foot to 10 feet in thickness but averages about 6 to 10 feet. The underlying material is either highly organic, or it is sandy, gravelly, or in a few places clay. The decaying underlying vegetation produces methane gas. Freshly excavated material ranges from alkaline to slightly acid, but most dry material becomes more acid, as low as pH 2. Spoil banks along drainage ditches are so acid in places that vegetation does not grow or grows very slowly. Included in mapping is a strip of beach that is immediately next to the bay and is generally less than 50 feet wide.

For 50 years the Mosquito Commission has constructed many ditches to speed drainage of flooded land and the pools where mosquitoes breed. Extensive areas of Tidal Marsh were diked and drained so that they could be farmed, especially along the Maurice River. Storm tides repeatedly breached the dikes and now none is farmed. Thousands of acres have been partly drained and diked so that native salt-tolerant grasses could be mowed and baled. The salt hay is extensively used as mulch for such crops as strawberries, for new grass seedlings, and as a cover for curing cement paving.

Natural fertility is high, and the organic-matter content is high. The available water capacity is high.

In most places tidal water is salty, but in the areas furthest inland along the major streams, such as the Maurice River, it is only brackish or even fresh in places. Tides that normally flood Tidal Marsh are 2 to 3 feet high but in coastal storms, tides as high as 8 to 10 feet have been recorded. During these storms the tidal water covers extensive low areas that are wooded and fields.

Tidal Marsh is extremely valuable as wildlife habitat for waterfowl, mammals, and crustaceans.

Special foundation designs are needed for roads, buildings, and other structures because the mucky and silty material in Tidal Marsh has low bearing capacity. Capability unit VIIIw–29; not assigned to a woodland group.

Woodstown Series

The Woodstown series consists of nearly level to gently sloping, moderately well drained soils. These soils formed under a dominantly hardwood forest. They are at an intermediate elevation and also on terraces just above Tidal Marsh.

In a representative profile, in a cultivated area, the plow layer is dark grayish-brown sandy loam about 8 inches thick. The upper part of the subsoil is mottled yellowish-brown heavy sandy loam to a depth of 26 inches. The middle part is mottled light yellowish-brown sandy clay loam to a depth of 30 inches. The lowest part is mottled light yellowish-brown heavy sandy loam to a depth of 36 inches. The substratum is stratified very pale brown, strong-brown, and light-gray loamy sand to a depth of 60 inches.

Woodstown soils are medium in natural fertility and moderate in organic-matter content. Permeability is moderate. The available water capacity is moderate, and water is available to plants through capillary action. The seasonal high water table is at a depth of 2 to 4 feet from January to April but is below a depth of 5 feet in summer unless rainfall is excessive.

The natural vegetation is hardwood forest consisting of northern red oak, southern red oak, black oak, white oak, scarlet oak, chestnut oak, hickory, beech, yellow-poplar, and a few pines. The understory is lowbush blueberry, mountain-laurel, and holly.

Drainage needs improvement for optimum crop production. Either open ditches or underdrains can

Figure 14.—This peach orchard was planted on the contour in an area of Sassafras sandy loam, 2 to 5 percent slopes.

be used to drain the soil and thus lower the water table.

Most areas have been cleared for farming. If drained, these soils are suited to vegetables, fruits, sod, nursery plants, and general crops. High-value vegetables are generally irrigated.

Woodstown soils must be deeply drained if they are to be used as septic-tank filter fields or as sites for houses that have a basement.

Representative profile of Woodstown sandy loam, 0 to 2 percent slopes, 1 mile north of Heislerville on road to Delsea Drive, in a field.

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

B1t—8 to 26 inches, yellowish-brown (10YR 5/6) heavy sandy loam; few, fine, pale-brown (10YR 6/3) mottles; weak, medium, subangular blocky structure; friable; thin, discontinuous clay films and clay bridgings; slightly acid; clear, wavy boundary.

B2t—26 to 30 inches, light yellowish-brown (10YR 6/4) sandy clay loam; common to many, fine to medium, faint to distinct, yellowish-brown (10YR 5/6) and light-gray (10YR 7/2) mottles; weak, medium, subangular blocky structure; friable; thick clay films and bridgings; medium acid; clear, wavy boundary.

B3t—30 to 36 inches, light yellowish-brown (10YR 6/4) heavy sandy loam; common, fine, faint, yellowish-brown (10YR 5/6) and distinct, light-gray (10YR 7/2) mottles; weak, medium, subangular blocky structure; friable; clay films and bridgings; medium acid; clear, smooth boundary.

IIC—36 to 60 inches, stratified very pale brown (10YR 7/4), strong-brown (7.5YR 5/6), and light-gray (10YR 7/2) loamy sand; single grained; loose; strongly acid.

The solum is 24 to 40 inches thick. The content of gravel is 0 to 10 percent in the solum, but in some places it is as much as 20 percent in some parts of the C horizon. Pebbles are rounded, quartzose, and generally less than 2 inches in diameter. The soil is strongly acid to extremely acid unless it is limed.

In undisturbed areas the A1 horizon is dark grayish brown and is several inches thick. In places a light yellowish-brown (2.5Y 6/4) A2 horizon occurs. Mottles in the B horizon range from few to many, fine to coarse, and distinct to prominent. The B horizon is heavy sandy loam to sandy clay loam.

In most places the IIC horizon is loamy sand and generally strata of sandy loam but in some places it is sandy loam.

Woodstown soils are near Sassafras, Aura, Fallsington, Matapeake, Mattapex, Downer, and Hammonton soils. Woodstown soils have low-chroma mottles, which Sassafras and Aura soils do not have. They lack gray matrix colors, which are common in Fallsington soils. They do not have high silt content, which Matapeake and Mattapex soils commonly have. They contain more clay than Downer and Hammonton soils.

WmA—Woodstown sandy loam, 0 to 2 percent slopes. This soil has the profile described as representative of the series. Included with this soil in mapping are areas of Woodstown soils that have a surface layer of loam or gravelly sandy loam and a few small areas of Sassafras, Aura, Downer, Hammonton, Matapeake, and Mattapex soils. Also included are areas where the lower part of the substratum is sandy clay or sandy clay loam in places.

Wetness is the main limitation to the use of this Woodstown soil. If high-value crops are grown, the soil should be drained. Underdrains can be used in most places to drain the soil and thus lower the water table. If adequately drained, the soil is suited to vegetables, fruits, sod, nursery plants, general crops, hay, and pasture. Capability unit IIw–14; woodland group 2o1.

WmB—Woodstown sandy loam, 2 to 5 percent slopes. Included with this soil in mapping are Woodstown soils that have a surface layer of loam or gravelly sandy loam and areas of Sassafras, Aura, Downer, Matapeake, and Mattapex soils.

Wetness is the main limitation to the use of this Woodstown soil. Surface runoff and erosion are hazards. Artificial drainage is needed if high-value crops are grown. Contour farming, cover crops, and crop rotation can be used to reduce surface runoff and control erosion. If adequately drained, the soil is well suited to corn, soybeans, summer vegetable crops, nursery plants, hay, and pasture. Capability unit IIw–14; woodland group 2o1.

Use and Management of the Soils

The soils of Cumberland County are used mainly for woodland, crops, and pasture. This section describes 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 soils in relation to wildlife management, to woodland management, to engineering, and to town and country planning.

This is a general guide for managing the soils and does not suggest specific management for individual soils (*11*). 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 of Rutgers, the State University.

Crops and Pasture

About 95,492 acres in the county were farmed in 1969. Of this, 67,259 acres were used for crops. The most extensive crop is snap beans, but tomatoes, corn, soybeans, and hay are also important. About 20,319 acres are irrigated each year.

The main concerns in managing soils for crops and pasture are maintaining fertility, providing drainage, and controlling erosion. Practices that are suited to crops and pasture are discussed in the descriptions of the mapping units.

Applications of lime and fertilizer are needed on all soils that are farmed. The amount depends on the natural content of lime and the supply of plant nutrients, on past cropping and level of management, on the need of the crop, and on the level of yield desired. This survey only gives general suggestions about the use of lime and fertilizer. Soils should be limed and fertilized according to the results of soil tests and in accordance with current recommendations of the Agricultural Extension Service and Cook College of Rutgers, the State University.

The soils of Cumberland County range from low to high in content of natural organic matter. This content can be maintained or increased through proper residue management that includes plowing in cover crops, growing sod in the cropping system, and returning crop residue to the soils. Commercial fertilizer is beneficial to all crops. On soils subject to rapid leaching, such as Evesboro and Klej soils, fertilizer is more effective if more than one application is made.

Tillage is needed to prepare a seedbed and to 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 a breakdown of structure are adding organic matter and growing sod, cover crops, and green-manure crops.

All sloping soils in the county are susceptible to erosion and, if farmed, to losses of organic matter and plant nutrients from the surface layer. Because most erosion occurs while the cultivated crop is growing or soon after the crop has been harvested, a cropping system that minimizes losses of soil and water should be selected. Contour planting, minimum tillage, proper use of crop residue, cover crops, applications of fertilizer and lime as needed, contour stripcropping, diversion terraces, and other conservation practices may be needed to control erosion.

In Cumberland County many of the soils are wet because of a seasonal high water table. Berryland, Fallsington, Pocomoke, Hammonton, and Woodstown soils are examples of wet soils. The soil can be drained by either open ditches or underdrains, thus lowering the water table. Where tile drainage is practical, it generally provides better drainage than open ditches. For drainage by either system, suitable outlets are required.

In Cumberland County, more than 70 kinds of plants are harvested each year beginning with dandelion early in March and ending with spinach late in November.

In Cumberland County, two contrasting types of farms grow vegetables. In the Shiloh, Deerfield, Rosenhayn, and Cedarville areas, the fields are large and vegetables are alternated with other cash crops. The vegetables are produced largely for either freezing or canning. The most extensively grown vegetables in these areas are snap beans, lima beans, spinach, tomatoes, asparagus, peas, and onions. Plants at Bridgeton, Cedarville, Port Elizabeth, Seabrook, and Vineland buy and process the vegetables.

In the Vineland area, the fields are small and are intensively managed for vegetables that are grown almost entirely for marketing as fresh produce. Nearly all crops are grown on Aura loamy sand, Aura sandy loam, and Downer sandy loam. Parsley, scallions, cabbage, Boston lettuce, romaine lettuce, escarole, endive, chicory, yellow summer squash, cucumbers, broccoli, winter squash, beets and beet greens, leeks, mustard greens, turnip tops, dandelion, kale, collards, radishes, zucchini squash, and anise are common crops. Markets for the fresh vegetables are the Vineland Cooperative Produce Auction, broker-shippers, the nearby cities of Philadelphia, Baltimore, and New York, and roadside stands. The markets are the same for flowers, nursery plants, and other special crops.

Snap beans.—Snap beans, which have green and yellow pods, are the most extensively grown crop in the county. They were grown on more than 8,000 acres in 1971. Snap beans are adapted to nearly all well drained and moderately well drained silt loams, sandy loams, or loamy sands, especially if the sandy loams and loamy sands are irrigated. Snap beans are planted to mature by specific dates, both for the processing market and for the fresh produce market. More than 30 million pounds were processed through the Seabrook Farms processing plant and 267,000 bushels passed through Vineland Auction in 1972.

Tomatoes.—Tomatoes were grown on 3,900 acres in 1971. They are grown on silt loams of the Chillum, Matapeake, and Mattapex series and on sandy loams of the Aura, Sassafras, and Downer series. Nearly all the soils are irrigated but usually only in periods of extremely dry weather or of critical growth. Most tomatoes are processed.

Lettuce.—Iceberg lettuce was grown on 2,100 acres in 1971, and all kinds of lettuce were grown on 3,900 acres. Lettuce is grown almost entirely on sandy loam or gravelly sandy loam of the Aura, Downer, Hammonton, Sassafras, and Woodstown series. Most lettuce is grown in the Cedarville and Vineland areas, but some acreage is in the Rosenhayn area. Both fall and spring varieties are grown.

Peppers.—Peppers were grown on 1,850 acres in 1971. They are grown mainly on sandy loam or gravelly sandy loam of the Aura, Downer, Hammonton, Sassafras, and Woodstown series. Peppers are grown both for the fresh-produce market and for processing.

Spinach.—Spinach was grown on 1,800 acres in 1971. In Deerfield, most of the acreage in spinach is on Chillum silt loam and Matapeake silt loam, but near Seabrook, some is on Sassafras loamy sand and Aura loamy sand. In Vineland, spinach is grown on Aura loamy sand and Downer sandy loam for market as fresh produce. Spinach is grown both for the fresh-produce market and for processing as frozen food.

Lima beans.—Baby lima beans were grown on 1,800 acres in 1971. The acreage grown on silt loam of the Chillum, Matapeake, and Mattapex series was about the same as that grown on sandy loam of the Aura, Sassafras, and Downer series. Recently there has been a change to larger beans, notably the Fordhook variety. Nearly all lima beans are grown for processing.

Onions.—Onions are grown on Downer and Hammonton soils in the Fairton and Cedarville areas and on Downer sandy loam soils and Matapeake silt loam soils in the Dutch Neck area. Some are grown on Aura loamy sand or Downer sandy loam in the Vineland area. These onions are grown mainly for the fresh-produce markets. About 1,200 acres were reported in 1971. On about 40 percent of the acreage, the onions are grown from sets, but on the rest, they are grown from seed. Yields from seeds are approximately double those from sets.

Asparagus.—About 1,200 acres were harvested in 1971. Asparagus is suited only to well-drained soils. Many soils are either infected with Fusarium root rot, which drastically reduces yields, or are in poor condition after years of intensive tillage. Mattapex, Hammonton, Woodstown, Klej and other wet soils generally are more susceptible to Fusarium root rot than are well-drained soils. As yields have decreased, profits and acreage have declined.

Peas.—Peas are an important crop in Cumberland County and are grown mainly on the well-drained sandy loams of the Aura, Downer, and Sassafras series. Nearly all peas are machine-harvested and processed by freezing.

Nursery plants.—Nurseries of ornamental plants have been important in the county for many years. Some of the stock has roots balled in burlap, and some has bare roots. In silt loams of the Chillum or Matapeake series, the roots are generally balled in burlap. In sandy loams of the Aura, Sassafras, or Downer series or loamy sand, the plants are generally sold as bare-root stock. In these sandy loams or loamy sands, plants grow rapidly, but the soils do not make into a good ball.

Protection from erosion is important because nursery stock is clean cultivated to stimulate growth and eliminate plant competition. Quick storms can cause excessive runoff and erosion if conservation practices are not adequate. Considerable acreage in nurseries has been planted on the contour to control erosion. Recently the growing of plants in containers of sand mixed with peat has come into use.

Strawberries.—Strawberries are commonly grown on gravelly sandy loams of the Aura and Sassafras series in the Rosenhayn area, but a small acreage is grown on sandy loams of the Downer and Hammonton series in the Cedarville and Dragston areas. Nearly all berries are grown for the fresh-produce market. About 500 acres were harvested in 1971.

Eggplant.—Eggplants are commonly grown on Aura loamy sand, Aura sandy loam, and Downer sandy loam, particularly in the Vineland area. They are grown for the fresh-produce market and for processing.

Sweetpotatoes.—Sweetpotatoes are grown on Aura loamy sand, Downer loamy sand, and Downer sandy loam. Sweetpotato production has declined because of disease-infected soil; about 1,600 acres were planted in sweetpotatoes in 1971. Sweetpotatoes are grown both for the fresh-produce market and for processing.

Capability grouping

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

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

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

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII (fig. 15). The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat.

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

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

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

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, but not in this county, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils

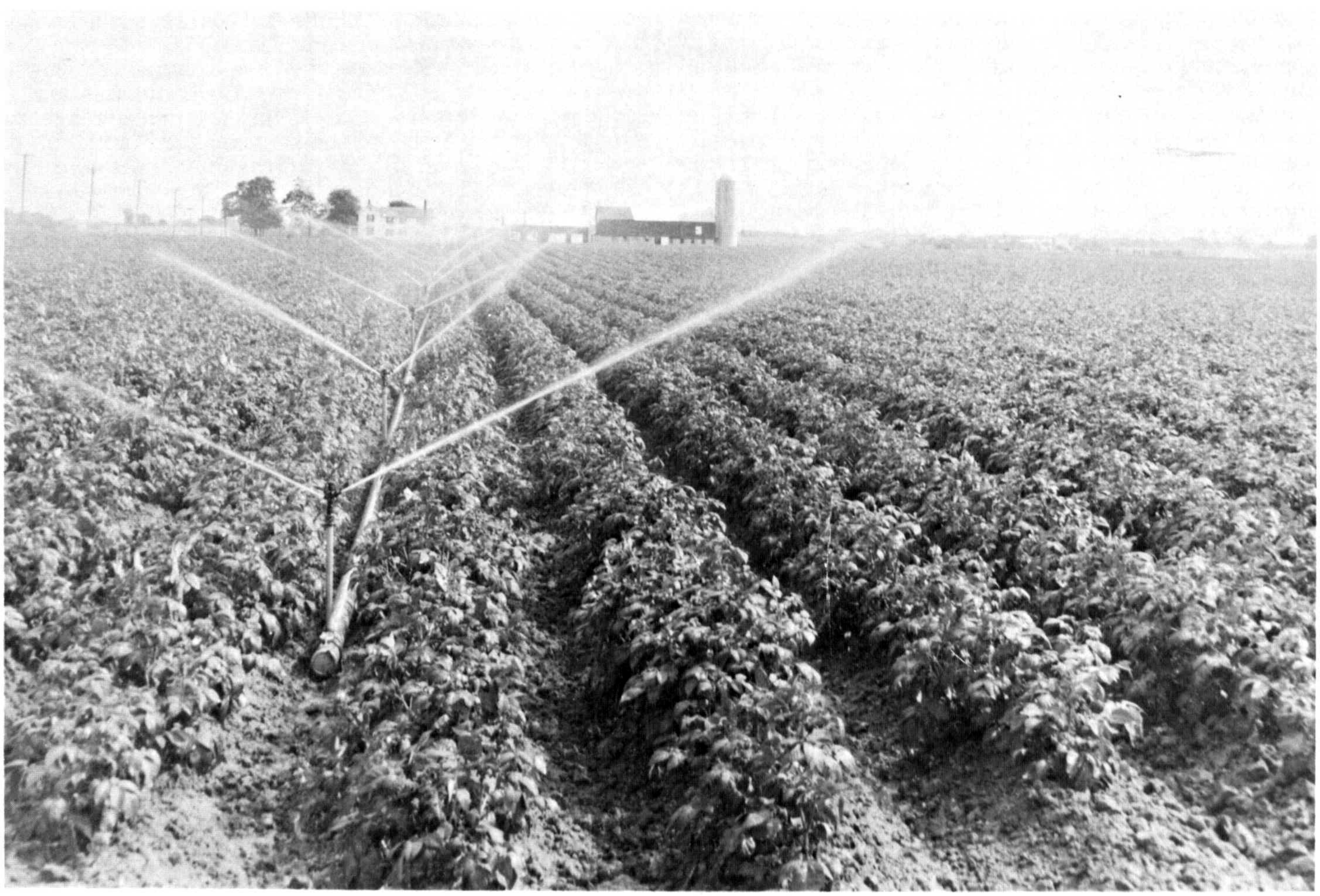

***Figure 15.*—Potatoes growing in an area of Matapeake silt loam, 0 to 2 percent slopes. This Class I soil is well suited to most crops grown in the county.**

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–5 or IIIw–16. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Cumberland County are described. Suggestions for the use and management of the soils are given in the mapping units.

Estimated yields

Estimated numerical ratings for crop yields under two levels of management are shown in table 2, and the conversion of these ratings into units of measure per acre for each crop is shown in table 3. These two tables are interdependent and must be used together if the estimated yield of any specified crop is to be learned. The ratings in table 2 range from 1, the lowest, to 10, the highest. Each number represents a different yield for each of the 14 crops shown in the boxheads of table 2. For example, according to table 3, the number 4 means 80 bushels (56 pounds) of field corn, 20 bushels (60 pounds) of soybeans, 25 bushels (48 pounds) of wheat, but 14 tons of tomatoes.

Ratings in columns A are based on yields expected under prevalent management, and those in columns B are based on yields expected under the best current management. The ratings in columns B do not represent maximum yields obtained under ideal conditions. They are based on averages of yields obtained over a period of at least 4 years after allowance had been made for exceptional weather and for insect pests and plant diseases. The difference between the ratings in columns A and columns B for any crop may be the result of one factor or a combination of factors. In general, all factors must be favorable to obtain the ratings in columns B.

Details of recommended practices change somewhat from year to year. Current detailed recommendations are published each year in bulletins of the Agricultural Extension Service. In general, they include the following: Choose varieties of crops that are suited to the soil and climate and that are resistant to the common insect pests and plant diseases. Treat seed by sterilizing or inoculating, when appropriate. Plant seed at the proper rate, and maintain the proper number of plants per acre. Apply fertilizer after choosing the formula and determining the amount per acre, the time of application in relation to the soil, crop, the plant population, and the amount of available water in the soil. Apply lime according to the results of soil tests and the needs of the crop. Take measures to control insect pests, plant diseases, and weeds. Install drainage if the water table is too high for the growth of crops. Irrigate lima beans, tomatoes, and other high-value crops. Use practices that control runoff, erosion, and soil blowing. Plant crops in an appropriate sequence, grow cover crops, and use minimum tillage, where applicable. Keep the soil in good tilth.

Estimated yields on soils for which records are not available are based on yields from similar soils. The county agricultural agent and other agricultural leaders helped make all estimates.

Woodland

The soils of the county have been assigned to woodland groups to assist in planning the use of soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need about the same management, and that have the same potential production.

Each woodland group is identified by a three-part symbol, such as 2o1 or 3o1. 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, low; and 5, very low. These ratings are estimates based on field determination of average site index for similar soils in other survey areas. Site index of a given soil is the height, in feet, that the dominant and co-dominant trees of a given species reach in a natural, essentially unmanaged stand in 50 years. It can be converted into approximate expected growth and yield per acre in cords and board feet. In Cumberland County, conversions of average site index into volumetric growth and yield are based on research on upland oaks (*10*) and yellow-poplar (*4*).

The second part of the symbol is a small letter. In this county *w*, *s*, and *o* are used. Except for the *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 *w* shows that the main limitation for woodland use or management is excessive wetness, either seasonal or all year. The soils have restricted drainage or a high water table. The letter *s* stands for sandy soils that have little or no difference in texture between surface layer and subsoil. These soils have moderate to severe restrictions for woodland use. They have low available water capacity and are low in available plant nutrients.

The last part of the symbol, another number, differentiates woodland groups that have identical first and second parts in their identifying symbol. Soils in woodland group 3w1, for example, require somewhat different management than soils in group 3w2.

Table 4 lists suitable trees to favor in existing stands and suitable trees for planting. The estimated site index in table 4 is the height, in feet, that the dominant and co-dominant trees reach at 50 years of age on the soils of each group. The relation between site index and yield is given in table 5.

In table 4 each woodland group in the county is

TABLE 2.—*Estimated ratings*

[Use with table 3, which shows the units of measure for the ratings listed in this table. The number 1 indicates the lowest yield
Absence of a rating indicates that the crop generally

Soil	Field corn		Soybeans		Wheat		Alfalfa		Snap beans	
	A	B	A	B	A	B	A	B	A	B
Aura gravelly sandy loam, 0 to 2 percent slopes	4	6	5	7	6	8	4	6	5	7
Aura gravelly sandy loam, 2 to 5 percent slopes	4	6	5	7	6	8	4	6	5	7
Aura loamy sand, 0 to 5 percent slopes	2	3	3	5	3	5	2	4	4	5
Aura sandy loam, 0 to 2 percent slopes	4	6	5	7	7	9	5	7	6	7
Aura sandy loam, 2 to 5 percent slopes	4	6	5	7	7	9	5	7	6	7
Chillum silt loam, 0 to 2 percent slopes	7	9	7	9	8	10	7	9	6	9
Chillum silt loam, 2 to 5 percent slopes	7	9	7	9	8	10	7	9	6	9
Downer loamy sand, 0 to 5 percent slopes	3	5	3	5	4	6	2	4	3	5
Downer loamy sand, 5 to 10 percent slopes	2	4	3	4	4	6	2	4	3	5
Downer sandy loam, 0 to 2 percent slopes	4	6	4	7	4	7	4	6	5	8
Downer sandy loam, 2 to 5 percent slopes	4	6	4	7	4	7	4	6	5	8
Evesboro sand, 0 to 5 percent slopes	----	----	----	----	----	----	----	----	1	3
Fallsington sandy loam	3	7	----	7	----	----	----	----	----	6
Fort Mott loamy sand, 0 to 5 percent slopes	2	5	3	5	4	6	2	5	3	5
Hammonton loamy sand, 0 to 5 percent slopes	3	5	4	6	4	6	3	6	5	7
Hammonton sandy loam, 0 to 2 percent slopes	4	6	4	6	4	6	3	6	5	7
Hammonton sandy loam, 2 to 5 percent slopes	4	6	4	6	4	6	3	6	5	7
Klej loamy sand, 0 to 3 percent slopes	2	5	3	6	----	----	1	3	----	----
Matapeake silt loam, 0 to 2 percent slopes	8	10	7	9	8	10	8	10	6	8
Matapeake silt loam, 2 to 5 percent slopes	8	10	7	9	8	10	8	10	6	8
Matapeake silt loam, 5 to 10 percent slopes, eroded	7	9	6	8	6	8	7	9	4	6
Mattapex silt loam, 0 to 2 percent slopes	8	10	7	9	7	9	6	8	6	8
Mattapex silt loam, 2 to 5 percent slopes	8	10	7	9	7	9	6	8	6	8
Othello silt loam	4	7	5	8	----	----	----	----	----	5
Pocomoke sandy loam	3	6	----	8	----	----	----	----	----	5
Sassafras gravelly sandy loam, 0 to 2 percent slopes	7	9	7	9	6	8	5	7	8	9
Sassafras gravelly sandy loam, 2 to 5 percent slopes	7	9	7	9	6	8	5	7	8	9
Sassafras gravelly sandy loam, 5 to 10 percent slopes, eroded	5	7	6	8	4	6	3	5	6	8
Sassafras sandy loam, 0 to 2 percent slopes	7	9	7	9	6	8	5	7	9	10
Sassafras sandy loam, 2 to 5 percent slopes	7	9	7	9	6	8	5	7	9	10
Sassafras sandy loam, 5 to 10 percent slopes, eroded	6	8	6	8	5	7	3	5	6	8
Woodstown sandy loam, 0 to 2 percent slopes	6	9	5	8	5	7	6	8	4	7
Woodstown sandy loam, 2 to 5 percent slopes	6	9	5	8	5	7	6	8	4	7

rated for various hazards or limitations that affect management. These ratings are slight, moderate, or severe, and they are described in the following paragraphs for all management concerns, except erosion hazard.

Equipment restrictions 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 time of year it is used; *moderate* means that use of equipment is restricted for 3 months of the year or less; *severe* means that special equipment is needed and that its use is severely restricted for more than 3 months of the year.

Seedling mortality refers to mortality of naturally occurring or planted tree seedlings. It is affected by differences in soil or topography when plant competition is assumed not to be a factor. *Slight* means an expected loss of 0 to 25 percent; *moderate* means expected loss of 25 to 50 percent; and *severe* means expected loss of more than 50 percent of the seedlings.

Plant competition is the degree to which undesirable plants invade openings in the tree canopy. *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 rate of growth, but does not prevent the development of fully stocked normal stands; *severe* means that competition prevents adequate natural or artificial regeneration unless the site is prepared properly and maintenance practices are used.

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; *severe* means that many trees are expected to blow down during periods when the soil is wet and winds are moderate or high.

Because demands for woodland products and values change from time to time, current information on what trees to plant or how to manage woodland should be obtained from the Soil Conservation Service technical guides.

of crop yields

and 10 the highest yield. Ratings in columns A are for average management; those in columns B are the best current management. is not grown on this soil. Only arable soils are listed]

Tomatoes		Iceburg lettuce		Peppers		Spinach		Fordhook lima beans		Onions		Cabbage		Eggplant		Asparagus	
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
5	7	6	8	6	9	4	7	4	6	7	9	5	7	5	7	4	5
3	6	5	7	5	8	4	7	4	6	7	9	5	7	5	7	4	5
5	7	3	5	4	8	3	5	3	5	5	8	4	6	4	6	4	5
5	7	5	8	6	9	7	9	4	6	7	9	5	7	5	7	5	6
5	7	5	8	6	9	4	7	4	6	7	9	5	7	5	7	5	6
9	10	5	7	6	9	8	10	8	10	3	5	6	9	6	9	6	9
9	10	5	7	6	9	8	10	8	10	3	5	6	9	6	9	6	9
3	5	5	7	3	6	3	5	3	5	5	7	3	6	3	6	5	6
3	5	5	7	3	6	3	5	3	5	5	7	3	6	3	6	5	6
5	7	8	10	5	8	4	6	4	6	7	9	5	8	5	8	6	8
5	7	8	10	5	8	4	6	4	6	7	9	5	8	5	8	6	8
2	4	------	------	1	3	------	------	3	4	------	------	------	------	------	------	2	4
------	7	3	7	2	6	------	------	------	------	3	7	2	6	2	6	3	6
5	7	3	5	3	7	------	------	3	5	5	7	3	6	3	6	5	6
4	7	3	5	4	7	------	------	3	5	5	7	4	7	5	7	5	7
4	7	8	10	4	7	3	5	4	7	7	9	4	7	4	7	6	8
4	7	8	10	4	7	3	5	4	7	7	9	4	7	4	7	6	8
------	------	------	------	3	6	------	------	2	5	------	------	------	------	------	------	------	------
8	10	5	7	6	9	8	10	8	10	3	5	8	10	8	10	8	10
8	10	5	7	6	9	8	10	8	10	3	5	8	10	8	10	8	10
6	8	------	------	5	7	5	7	4	6	------	------	7	9	7	9	7	9
7	10	5	7	6	9	4	6	7	9	3	5	6	9	6	9	5	8
7	10	5	7	6	9	4	6	7	9	3	5	6	9	6	9	5	8
------	5	------	------	1	4	------	------	------	------	------	------	1	4	1	4	3	7
------	5	------	------	------	------	------	------	------	------	3	5	------	------	------	------	------	------
6	9	5	7	6	9	4	7	5	7	7	9	5	8	5	8	6	8
6	9	5	7	6	9	4	7	5	7	7	9	5	8	5	8	6	8
------	------	------	------	3	8	------	------	------	------	3	5	4	7	4	7	5	7
6	9	6	8	6	9	7	9	6	8	7	9	6	9	6	9	7	9
6	9	6	8	6	9	7	9	6	8	7	9	6	9	6	9	7	9
5	8	------	------	3	8	2	4	------	------	------	------	4	7	4	7	5	7
6	9	6	9	4	9	7	9	5	8	6	9	6	9	6	9	5	8
6	9	6	9	4	9	7	9	5	8	6	9	6	9	6	9	5	8

Wildlife [2]

The welfare of wildlife depends largely on the amount and distribution of food, cover, and water. If any essential elements are missing, inadequate, or inaccessible, the animal cannot live or is scarce. The kinds of wildlife that live in a given area and the number of each kind are closely related to land use, which results in different kinds and patterns of vegetation, and to the supply and distribution of water. These, in turn, are generally related to the kinds of soils.

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

The suitability of the soils of Cumberland County is shown in table 6 for seven elements of wildlife habitat (*1*) and for three general kinds of wildlife. The ratings, the elements, and the general kinds of wildlife are explained in the paragraphs that follow.

The suitability ratings 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 not practical to manage for specific kinds of wildlife.
5. Determining areas that are suitable for acquisition for use by wildlife.

Not considered in the ratings are present land use, location of a soil in relation to other soils, and the mobility of wildlife. The suitability ratings are good, fair, poor, and very poor.

Good means that the habitat is generally easily created, improved, or maintained. There are few or no

[2] LAWRENCE H. ROBINSON, biologist, Soil Conservation Service, helped prepare this section.

TABLE 3.—*Conversion of numerical ratings in table 2 to units of measure per acre*

Rating in table 2	Field corn	Soy-beans	Wheat	Alfalfa	Snap beans	Tomatoes	Iceburg lettuce	Peppers	Spinach	Fordhook lima beans (shelled)	Dry onions	Cabbage	Egg-plant	Aspara-gus
	Bu (56 lbs)	*Bu (60 lbs)*	*Bu (48 lbs)*	*Tons*	*Bu (30 lbs)*	*Tons*	*Crates (24 heads)*	*Bu (30 lbs)*	*Tons*	*100 lbs*	*50 lbs*	*50 lbs*	*Bu (33 lbs)*	*100 lbs*
1	50	5	10	1.0	165	8	250	150	3.0	30	125	335	350	8
2	60	10	15	1.5	180	10	300	200	3.5	35	200	350	400	11
3	70	15	20	2.0	195	12	350	250	4.0	40	275	365	450	14
4	80	20	25	2.5	210	14	400	300	4.5	45	350	380	500	17
5	90	25	30	3.0	225	16	450	350	5.0	50	425	395	550	20
6	100	30	35	3.5	240	18	500	400	5.5	55	500	410	600	23
7	110	35	40	4.0	255	20	550	450	6.0	60	575	425	650	26
8	120	40	45	4.5	270	22	600	500	6.5	65	650	440	700	29
9	130	45	50	5.0	285	24	650	550	7.0	70	725	455	750	32
10	140+	45+	55+	5.5+	300+	26+	700+	600+	7.5+	75+	800+	470+	800+	35+

soil limitations in habitat management and satisfactory results are well assured. *Fair* means that the habitat generally can be created, improved, or maintained, but that the soils have moderate limitations that affect the creation, improvement, or maintenance of the habitat. A moderate intensity of management and fairly frequent attention is required to assure satisfactory results. *Poor* means that the habitat generally can be created, improved, or maintained, but that there are rather severe soil limitations. Habitat management may be difficult, expensive, and require intensive effort. Satisfactory results are questionable. *Very poor* means that it is impractical to create, improve, or maintain habitat because of the very severe soil limitations. Unsatisfactory results are probable.

The seven elements of wildlife habitat considered important and shown as column heads in table 6 are discussed in the following paragraphs.

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

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

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

Hardwood plants.—This element includes 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 may be planted. Among the native kinds are oak, American holly, cherry, maple, poplar, apple, hawthorn, dogwood, persimmon, sumac, sassafras, black walnut, hickory, sweetgum, bayberry, blueberry, huckleberry, blackhaw, virburnum, grape, and briers. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, and texture of the surface layer and subsoil.

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

Coniferous plants.—This element consists of cone-bearing evergreen trees and shrubs that are used by wildlife primarily as cover, though they also provide browse and seeds or fruitlike cones. Among them are Norway spruce, Virginia pine, loblolly pine, shortleaf pine, pitch pine, Scotch pine, Eastern red-cedar, and Atlantic white-cedar. 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, natural drainage, and texture of the surface layer and subsoil.

Wetland plants.—Making up this group are wild, herbaceous, annual and perennial plants that grow on moist to wet sites exclusive of submerged or floating aquatics. They produce food and cover extensively used mainly by wetland forms of wildlife. They include smartweed, wild millet, bulrush, sedges, duckweed, duckmillet, arrow arum, pickerelweed, wetland grasses, wildrice, and cattails. The major soil properties affecting this habitat element are natural drainage, frequency of flooding or ponding, slope, and texture of the surface layer and subsoil.

Shallow water areas.—These are impoundments or excavations that provide areas of shallow water, generally not more than 5 feet deep, 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 in Cumberland County are natural drainage, slope, hazard of flooding, and permeability. Natural wet areas that are aquifer-fed are rated on the basis of drainage class without regard to permeability. Permeability of the soil applies only to those non-aquifer areas with a potential for development, and water is assumed to be available offsite.

The kinds of wildlife shown as column heads in table 6 are discussed, as follows:

Openland wildlife.—Examples of openland wildlife are quail, pheasant, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. These birds and mammals normally make their home in areas of crops, pasture, meadow, and lawns and in areas overgrown with grasses, herbs, shrubs, and vines.

Woodland wildlife.—Among the birds and mammals that prefer woodland are ruffed grouse, woodcock, thrushes, vireos, scarlet tanager, gray and red squirrels, gray fox, white-tailed deer, and raccoon. They obtain food and cover in stands of hardwoods, coniferous trees, shrubs, or a mixture of these plants.

Wetland wildlife.–Ducks, geese, rails, herons, shore birds, and muskrat are familiar examples of birds and mammals that normally make their home in wet areas, such as ponds, marshes, and swamps.

Each rating under "Suitability for 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 upland plants, and either hardwood plants, or coniferous plants, whichever is most applicable. The rating for woodland wildlife is based on the ratings listed for grasses and legumes, wild herbaceous plants, and either hardwood woody plants or coniferous woody

TABLE 4.—*Woodland*

[Tidal marsh is not in a woodland suitability

Woodland suitability groups and map symbols	Tree	Estimated site index	Trees to favor in existing stands
		Feet	
Group 2o1: HaA, HbA, HbB, WmA, WmB	Oak	75–85	Upland oaks
Group 2w1: Fd, Ps	Oak Sweetgum	75–85 85–95	Sweetgum, pin oak, willow oak, southern red oak, and white oak.
Group 3o1: ChA, ChB, MoA, MoB, MoC2, MrA, MrB	Yellow-poplar	85–95	Yellow-poplar and upland oaks
Group 3o2: AgA, AgB, AmB, ArA, ArB, DoB, DoC, DrA, DrB, FrA, SgA, SgB, SgC2, SrA, SrB, SrC2.	Oak	65–75	Virginia pine and upland oaks
Group 3s1: KmA	Oak	65–75	Virginia pine and upland oaks
Group 3w1: Ac, Bp	Pitch pine	65–75	Pitch pine
Group 3w2: Ot	Sweetgum	75–85	Sweetgum, pin oak, willow oak, and southern red oak.
Group 4s1: EvB, EvC, EvD, LaA	Pitch pine	55–65	Pitch pine, shortleaf pine, Virginia pine, oaks.
Group 4w1: MS	Atlantic white cedar.	[1] 45–55	Atlantic white cedar
Group 5s1: LeB	Pitch pine	45–55	Pitch pine, shortleaf pine, Virginia pine.

[1] Information based on best estimates; no curves have been developed for Atlantic white cedar.

plants, whichever is most applicable. For wetland wildlife the rating is based on the ratings shown for wetland food and cover plants and shallow water areas.

Engineering Uses of the Soils [3]

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

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

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

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

[3] DONALD W. HASLEM, State conservation engineer, Soil Conservation Service, helped prepare this section.

management

group because it does not support trees]

Trees for planting	Management concerns				
	Erosion hazard	Equipment restrictions	Seedling mortality	Plant competition	Windthrow hazard
Virginia pine and shortleaf pine.	Slight	Slight	Slight	Moderate	Slight.
Pin oak and sweetgum.	Slight	Severe	Severe	Severe	Severe.
Yellow-poplar	Slight	Slight	Slight	Slight	Slight.
Virginia pine, shortleaf pine, and red oak.	Slight	Slight	Slight	Slight	Slight.
Virginia pine	Slight	Slight to moderate	Moderate	Moderate for conifers and slight for hardwoods.	Slight.
Pitch pine	Slight	Severe	Severe	Severe	Severe.
Sweetgum	Slight	Severe	Severe	Severe	Slight.
Pitch pine, Virginia pine, shortleaf pine.	Slight	Moderate	Severe	Slight	Slight.
Not practical	Slight	Severe	Slight	Severe	Severe.
Pitch pine, Virginia pine, shortleaf pine.	Slight	Moderate	Severe	Slight	Slight.

Most of the information in this section is presented in tables. Table 7 shows several estimated soil properties significant to engineering; table 8 gives interpretations for various engineering uses; and table 9 gives 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 table 8, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science. The Glossary defines many of these terms.

Classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*3*) used by the SCS engineers, Department of Defense, and others, 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, CL–ML.

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 ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are

TABLE 5.—*Yields of upland oak 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	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	--------	--------	--------	--------

gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, along with group index numbers, is shown in table 9, and the estimated classification, without group index numbers, is given in table 7 for all soils mapped in the survey area.

Soil properties significant in enginering

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 kinds of soil in other counties. Following are explanations of some of the columns in table 7.

Depth to a 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 relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic. If the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic; and the liquid limit, from a plastic to a liquid. 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. In table 7, the data for liquid limit and plasticity index are estimates, but in table 9 they are based on the results of tests on soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on basis of 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 plants (*7*).

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the "Glossary." The degree of acidity shown is natural; limed areas are less acid.

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

Interpretations of the soils

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 in other areas nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Cumberland County. They are based on published guidelines (*15*). For topsoil, sand and gravel, and roadfill, only suitability as a source is given, but for other uses, the soil features listed are not to be overlooked in planning, installation, and maintenance of the specified engineering structure.

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

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 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 at a depth of less than 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, nor do they indicate quality of the deposit.

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

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

For embankments soil material is required that is resistant to seepage and piping and has favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are not favorable.

Drainage is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that restrict the movement of water. It is also affected by the 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; texture; content of stones; accumulation 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 water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity of slope and steepness; 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.

The layout and construction of a grassed waterway are affected by such soil properties as texture, depth, and erodibility of the soil material and steepness. Other factors affecting waterways are seepage, 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 in road building when temperatures are below freezing.

Shallow excavations for pipelines, sewerlines, 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, and freedom from flooding or a high water table.

Test data

Table 9 shows engineering test data for some of the major soil series in the survey area. These tests were done at the College of Engineering, Rutgers, The State University (*6, 9*) to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests that determine liquid limit and plastic limit. The mechanical analyses were made by combined sieve and hydrometer methods.

Moisture-density data (compaction) 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.

Land-use Planning

This section is helpful to planners, developers, zoning officials, landowners, and prospective landowners. It indicates the relative suitability of each soil in the county for various community developments. Planners and zoning officials who are interested in comparing the suitability of soils for land-use planning with their capability for use in farming should see the section "Capability grouping."

Table 10 shows the degree of limitation to the various uses of soils in this county. They are expressed as slight, moderate, or severe. For all of them, it is assumed that a good cover of vegetation can be established and maintained. *Slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. *Moderate* means that the limitation can be overcome or modified by planning, by design, or by special maintenance. *Severe* means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

TABLE 6.—*Wildlife*

Soil series and map symbols	Suitability for elements of wildlife habitat		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants
Atsion: Ac	Poor	Poor	Fair
Aura:			
AgA, AgB, ArA, ArB	Fair	Good	Good
AmB	Poor	Fair	Good
Berryland: Bp	Very poor	Poor	Poor
Chillum: ChA, ChB	Good	Good	Fair
Downer:			
DoB, DoC	Good	Good	Good
DrA, DrB	Poor	Fair	Good
Evesboro:			
EvB, EvC, EvD	Poor	Poor	Fair
Fallsington: Fd	Poor	Fair	Fair
Fort Mott: FrA	Poor	Fair	Fair
Hammonton:			
HaA	Poor	Fair	Good
HbA, HbB	Fair	Good	Good
Klej: KmA	Poor	Fair	Fair
Lakehurst: LaA	Poor	Poor	Fair
Lakewood: LeB	Poor	Poor	Fair
Matapeake: MoA, MoB, MoC2	Good	Good	Good
Mattapex:			
MrA	Good	Good	Good
MrB	Good	Good	Good
Muck: MS	Very poor	Very poor	Very poor
Othello: Ot	Poor	Fair	Fair
Pocomoke: Ps	Very poor	Poor	Poor
Sassafras: SgA, SgB, SgC2, SrA, SrB, SrC2	Good	Good	Good
Tidal Marsh: TM	Very poor	Very poor	Very poor
Woodstown:			
WmA	Good	Good	Good
WmB	Good	Good	Good

In the following paragraphs are the uses for which the degree of limitation is given in table 10 and the major soil properties affecting the use.

Foundations of dwellings with basements.—Among the important soil properties affecting foundations of dwellings with basements are slope, drainage, and flood hazard.

Foundations of dwellings without basements.—The dwellings are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the use of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Septic tank absorption fields.—These are subsurface systems of tile or perforated pipe that distribute efflu-

management

Suitability for elements of wildlife habitat—Continued			Suitability for kinds of wildlife		
Hardwood and coniferous trees	Wetland plants	Shallow water areas	Openland	Woodland	Wetland
Fair	Poor	Good	Poor	Fair	Fair.
Fair	Poor	Very poor	Good	Fair	Very poor.
Fair	Poor	Very poor	Fair	Fair	Very poor.
Poor	Poor	Good	Poor	Poor	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Fair	Poor	Very poor	Fair	Fair	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Fair	Good	Fair	Fair	Fair	Fair.
Poor	Poor	Very poor	Fair	Poor	Very poor.
Fair	Poor	Poor	Fair	Fair	Poor.
Fair	Poor	Poor	Good	Fair	Poor.
Poor	Poor	Poor	Fair	Poor	Poor.
Poor	Poor	Fair	Poor	Poor	Poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Very poor	Good	Good	Very poor	Very poor	Fair.
Fair	Good	Good	Fair	Fair	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Very poor	Good	Good	Very poor	Very poor	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.

ent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding (*8*). Slope affects difficulty of layout and construction and the risk of erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sanitary landfill.—This is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period (*13*). Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, risk of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the soil properties in table 10

TABLE 7.—*Estimated soil properties*

[Absence of data indicates the soil is too variable to be rated or that no estimate

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (representative profile)	USDA texture	Classification	
				Unified	AASHTO
	Feet	*Inches*			
Atsion: Ac	0–1	0–19	Sand	SP, SP–SM	A–2, A–3
		19–24	Sand	SP, SP–SM	A–2, A–3
		24–60	Sand	SP, SM, SM–SC	A–2, A–3
Aura: AgA, AgB, AmB, ArA, ArB.	>5	0–12	Sandy loam	SP–SM, SM, SC	A–1, A–2, A–4
		12–24	Sandy clay loam	SM, SC, GM, GC	A–1, A–2, A–4
		24–60	Gravelly sandy clay loam	SM, SC, GM, GC	A–1, A–2, A–4
Berryland: Bp	0	0–13	Sand	SP, SP–SM	A–3, A–2
		13–20	Sand	SP, SP–SM	A–3, A–2
		20–60	Sand	SP, SM, SM-SC	A–2, A–3
Chillum: ChA, ChB	>5	0–10	Silt loam	ML, CL	A–4
		10–30	Silt loam	ML, CL	A–4
		30–60	Gravelly sandy clay loam	SM, SC, GM, GC	A–2, A–4
Downer: DoB, DoC, DrA, DrB.	>4	0–16	Loamy sand	SP–SM, SM, SC	A–2, A–4
		16–28	Sandy loam	SM, SC	A–2, A–4
		28–60	Loamy sand	SP–SM, SM, SM–SC	A–2, A–3
Evesboro: EvB, EvC, EvD.	>5	0–36	Sand	SP, SP–SM	A–2, A–3
		36–60	Sand	SP, SM	A–2, A–3
Fallsington: Fd	0–1	0–12	Sandy loam	SM	A–2, A–4
		12–28	Sandy clay loam	SC, SM, ML, CL	A–2, A–4
		28–60	Sand	SM, SP–SM, SM–SC	A–2, A–3
Fort Mott: FrA	>5	0–26	Loamy sand	SP–SM, SM	A–2
		26–45	Sandy clay loam, sandy loam	SM, SC	A–2, A–4
		45–60	Loamy sand	SP–SM, SM, SM–SC	A–2
Hammonton: HaA, HbA, HbB.	1½–4	0–16	Sandy loam	SM, SM–SC	A–2
		16–24	Sandy loam	SM–SC	A–2, A–4
		24–60	Loamy sand, gravelly sand	SP–SM, SM, SM, SC	A–2, A–3
Klej: KmA	1½–4	0–37	Loamy sand, sand	SP, SM	A–2, A–3
		37–60	Sand	SM, SP, SM–SC	A–2, A–3
Lakehurst: LaA	1½–4	0–40	Sand	SP, SP–SM	A–2, A–3
		40–60	Sand	SP, SM, SM–SC	A–2, A–3
Lakewood: LeB	>5	0–30	Sand	SP, SP–SM	A–2, A–3
		30–60	Sand	SP, SM–SC, SM	A–2, A–3
Matapeake: MoA, MoB, MoC2.	>5	0–8	Silt loam	ML, CL	A–4
		8–34	Silt loam	ML, CL	A–4, A–6
		34–60	Loamy sand	SM, SC, SP–SM	A–2, A–4
Mattapex: MrA, MrB	2–3	0–9	Silt loam	ML, CL	A–4
		9–37	Silt loam	ML, CL	A–4, A–6
		37–60	Fine sandy loam, sandy loam	SM, SC, SP–SM	A–2, A–4
Muck: MS Most properties too variable to be estimated ‘; frequently flooded.	0	0–36	Organic matter	Pt	
		36–60	Sand.		

See footnotes at end of table.

significant in engineering

was made. The symbol > means greater than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
				Percent		*In/hr*	*In/in of soil*	*pH*	
95–100	90–100	50–90	2–12	[1] NL	[2] NP	>6.0	[3] 0.06–0.08	<4.5	Low.
95–100	90–100	50–80	2–12	NL	NP	2.0–6.0	0.08–0.12	4.5–5.0	Low.
95–100	80–100	40–90	2–30	NL–15	NP–7	>6.0	0.04–0.14	4.5–5.5	Low.
70–100	70–100	40–70	10–45	10–25	NP–10	0.2–6.0	0.10–0.18	<4.5–5.0	Low.
60–100	50–100	40–80	20–50	20–45	6–12	0.2–2.0	0.10–0.14	4.5–5.0	Low.
60–100	50–100	40–80	15–50	20–40	5–20	0.2–2.0	0.08–0.12	4.5–5.0	Low.
95–100	90–100	50–90	2–12	NL	NP	>6.0	[3] 0.06–0.08	<4.5	Low.
95–100	90–100	50–90	2–12	NL	NP	2.0–6.0	0.08–0.02	4.5–5.0	Low.
95–100	80–100	40–90	2–35	NL–25	NP–7	2.0–>6.0	0.04–0.14	4.5–5.0	Low.
95–100	95–100	90–100	60–80	20–30	NP–10	0.2–2.0	0.20–0.24	<4.5–5.0	Low.
95–100	95–100	80–100	60–90	20–35	5–15	0.2–2.0	0.18–0.24	4.5–5.0	Low.
60–80	55–80	40–60	20–50	20–50	5–20	0.2–2.0	0.08–0.12	4.5–5.0	Low.
95–100	90–100	50–90	10–40	NL–25	NP–10	2.0–>6.0	0.10–0.16	<4.5	Low.
95–100	90–100	50–90	15–40	10–25	NP–10	2.0–6.0	0.10–0.14	4.5–5.0	Low.
90–100	80–100	40–90	5–30	NL–25	NP–7	2.0–>6.0	0.05–0.10	4.5–5.0	Low.
90–100	85–100	60–90	0–12	NL	NP	>6.0	0.05–0.09	<4.5–5.0	Low.
90–100	85–100	60–90	0–30	NL–20	NP–5	2.0–>6.0	0.07–0.12	4.5–5.0	Low.
95–100	90–100	70–100	20–40	NL–30	NP–15	0.6–2.0	[3] 0.16–0.20	<4.5–5.0	Low.
95–100	90–100	50–100	25–55	20–30	5–15	0.6–2.0	0.14–0.18	4.5–5.0	Low.
90–100	80–100	50–80	10–35	NL–30	NP–7	2.0–>6.0	0.06–0.10	4.5–5.0	Low.
95–100	90–100	80–100	10–20	NL	NP	>6.0	0.05–0.10	<4.5–5.0	Low.
95–100	90–100	80–100	30–45	15–25	NP–10	0.6–6.0	0.12–0.16	4.5–5.0	Low.
90–100	80–100	80–100	5–30	NL–20	NP–7	>6.0	0.05–0.10	4.5–5.0	Low.
95–100	90–100	50–90	15–35	NL–30	NP–5	2.0–>6.0	[3] 0.10–0.16	<4.5	Low.
95–100	90–100	50–90	25–40	15–30	NP–10	2.0–6.0	0.10–0.14	4.5–5.0	Low.
90–100	80–100	70–100	10–30	NL–20	NP–5	2.0–>6.0	0.05–0.10	4.5–5.0	Low.
90–100	85–100	60–90	0–20	NL	NP	>6.0	[3] 0.05–0.09	<4.5–5.0	Low.
90–100	85–100	60–90	0–30	NL–20	NP–7	2.0–>6.0	0.05–0.12	4.5–5.0	Low.
90–100	90–100	50–90	0–12	NL	NP	>6.0	0.05–0.09	<4.5–5.0	Low.
85–100	70–100	50–90	0–30	NL–20	NP–5	>6.0	0.04–0.10	4.5–5.0	Low.
95–100	90–100	50–90	0–12	NL	NP	>6.0	0.05–0.09	<4.5–5.0	Low.
85–100	75–100	40–90	0–30	NL–20	NP–7	>6.0	0.04–0.10	4.5–5.0	Low.
95–100	95–100	80–100	60–80	20–30	NP–10	0.2–2.0	0.20–0.24	<4.5–5.0	Low.
95–100	95–100	90–100	65–90	25–35	5–15	0.2–0.6	0.18–0.22	4.5–5.0	Low.
90–100	70–100	45–100	10–40	NL–30	NP–10	0.2–2.0	0.12–0.18	4.5–5.0	Low.
95–100	95–100	80–100	60–80	20–30	NP–10	0.2–2.0	[3] 0.20–0.24	<4.5–5.0	Low.
95–100	95–100	90–100	65–90	25–35	5–15	0.2–0.6	0.18–0.22	4.5–5.0	Low.
90–100	70–100	45–100	10–40	NL–30	NP–10	0.2–2.0	0.12–0.18	4.5–5.0	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbol	Depth to seasonal high water table	Depth from surface (representative profile)	USDA texture	Classification	
				Unified	AASHTO
	Feet	*Inches*			
Othello: Ot	0–1	0–8	Silt loam	ML, CL	A–4
		8–28	Silt loam	ML, CL	A–4, A–6
		28–60	Fine sandy loam, loamy sand	SM, SC, SP–SM	A–2, A–4
Pocomoke: Ps	0	0–12	Sandy loam	SM, SC	A–2, A–4
		12–27	Sandy loam	SM, SC	A–2, A–4
		27–60	Sand	SP–SM, SM, SM–SC	A–2, A–3, A–4
Sassafras: SgA, SgB, SgC2, SrA, SrB, SrC2.	>5	0–14	Sandy loam	SM, SC	A–2, A–4
		14–40	Sandy clay loam, sandy loam	SM, SC	A–4
		40–60	Loamy sand	SP–SM, SM, SM-SC	A–2
Tidal Marsh: TM Most properties too variable to be estimated; flooded twice daily; if soil drained and oxidized, pH drops as low as 2 where sulfides are present.	0				
Woodstown: WmA, WmB.	2–4	0–8	Sandy loam	SM, SM–SC	A–2, A–4
		8–36	Sandy loam, sandy clay loam	SC, SM	A–2, A–4
		36–60	Loamy sand	SM, SP–SM, SM–SC	A–2, A–3

[1] NL means nonliquid.
[2] NP means nonplastic.

apply only to a depth of about 6 feet, and therefore a limitation of *slight* or *moderate* may not be valid if trenches are much deeper than that. For some soils, reliable predictions can be made to a greater depth, but nevertheless each site should be investigated before it is selected.

Roads and streets.—These roads and streets have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water, and they have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep. The potential frost action was not estimated.

Lawns, landscaping, and golf fairways.—The main factors that affect the degree of limitation for lawns, landscaping, and golf fairways are natural fertility, available water capacity, drainage, and slope.

Athletic fields.—The main soil features that are limitations to the use of soils for athletic fields are slope, natural drainage, and texture.

Picnic areas.—These are attractive natural or landscaped tracts used mainly for preparing meals and eating outdoors. These areas are subject to heavy foot traffic, but most of the vehicular traffic is confined to access roads. The best soils are firm when wet but not dusty when dry; and free of flooding during the season of use; and do not have slopes or stoniness that greatly increases cost of leveling the sites or of building the access roads.

Camp areas.—These are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry.

Paths and trails.—These are used for local and cross country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, and have slopes of *significant in engineering*—Continued

Percentage less than 3 inches passing sieve— No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
				Percent		*In/hr*	*In/in of soil*	*pH*	
95–100	95–100	90–100	60–90	20–40	NP–10	0.6–2.0	[3] 0.22–0.26	<4.5–5.0	Low.
95–100	95–100	90–100	60–90	25–45	5–15	0.2–0.6	0.20–0.24	4.5–5.0	Low.
85–100	80–100	50–100	10–40	NL–30	NP–10	0.2–2.0	0.08–0.12	4.5–5.0	Low.
90–100	90–100	75–90	30–40	NL–30	NP–10	0.6–2.0	[3] 0.14–0.18	<4.5	Low.
90–100	90–100	60–90	20–40	15–30	5–10	0.6–2.0	0.14–0.18	4.5–5.0	Low.
80–100	80–100	50–90	10–40	NL–30	NP–7	2.0–>6.0	0.06–0.12	4.5–5.0	Low.
90–100	80–100	60–100	15–40	NL–30	NP–15	0.6–6.0	0.10–0.16	<4.5–5.0	Low.
85–100	80–100	50–100	35–50	15–40	5–15	0.6–2.0	0.12–0.16	4.5–5.0	Low.
70–100	60–100	30–100	10–35	NL–30	NP–7	0.6–>6.0	0.06–0.12	4.5–5.0	Low.
95–100	90–100	60–100	25–40	NL–15	NP–5	0.6–2.0	[3] 0.12–0.16	<4.5	Low.
95–100	90–100	50–100	25–50	15–30	5–15	0.6–2.0	0.12–0.16	4.5–5.0	Low.
70–100	70–100	30–80	10–35	NL–30	NP–7	2.0–>6.0	0.06–0.10	4.5–5.0	Low.

[3] Additional water is available for plants because the water table is high enough.
[4] Subsidence is severe when the soil is drained.

less than 15 percent. There are few or no rocks or stones on the surface.

Landscaping

In this section is information about some of the trees and shrubs suitable for landscaping homes, schools, and industrial and recreational areas (*14*). In planning, consideration should be given to wind protection, screening of unsightly areas, and the general beauty of neighborhoods.

Trees and shrubs of different species vary widely in suitability to different soils and to site conditions. The soils in the county are placed in four landscape groups, mainly on the basis of the amount of wetness from the seasonal high water table and the available water capacity.

Each of the soils in a specific group has similar suitability for tree and shrub plantings. The landscape planting group of each soil is listed in the "Guide to Mapping Units" at the back of this survey. No landscape planting group has been assigned to Tidal Marsh.

Table 11 lists only some of the plants that are suited to soils in the county. Plants that are severely weakened by disease, insects, or other factors are not included in the list. Many 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.

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.—In this group are well-drained soils that have moderate or high available water capacity. The water table normally is below a depth of 4 feet.

Landscape planting group 2.—All soils in this group are somewhat poorly drained or moderately well drained. They have a seasonal water table that is highest in winter and spring but is moderately deep or deep in summer.

Landscape planting group 3.—All soils in this group are poorly drained or very poorly drained. They have a high water table and may be ponded at some time during the year. They are nearly level and depressional.

Landscape planting group 4.—In this group are excessively drained, very sandy soils that have low available water capacity.

TABLE 8.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Reservoir areas	Embankments
Atsion: Ac	Poor: low fertility; low available water capacity; high water table limits accessibility, except in summer.	Good for sand: high water table limits accessibility. Poor for gravel: small amount in substratum in some areas.	Poor: high water table limits accessibility; SP, SM material.	Rapid permeability in substratum; water table drops 2 to 3 feet in summer.	Low cohesion; fair stability; rapid permeability.
Aura: AgA, AgB, AmB, ArA, ArB.	Poor for AgA and AgB: excess gravel. Poor for AmB: low available water capacity, fertility, and organic matter content; excess sand. Fair for ArA and ArB: moderate amount of gravel.	Unsuitable for sand to a depth of 5 feet, variable below 5 feet; excess fines. Fair for gravel at a depth between 2½ and 5 feet, variable below 5 feet; needs washing.	Fair: SM, SC, GM, and GC material; excess fines.	Moderately slow permeability above pervious substratum.	Good stability and compaction; medium susceptibility to piping.
Berryland: Bp	Poor: low fertility; low available water capacity; high water table limits accessibility; excessive sand content.	Good for sand: high water table. Poor for gravel: small amount in substratum in some areas.	Poor: high water table limits accessibility; SP, SM material.	Rapid permeability in substratum; water table drops 1 foot to 3 feet in summer.	Low cohesion; fair stability; rapid permeability.
Chillum: ChA, ChB	Good	Poor for sand below a depth of 2½ feet: excess fines. Poor for rounded quartzose gravel below a depth of 2½ feet: variable content and thickness of deposit; excess fines; needs washing.	Fair: ML and CL material; moderate shrink-swell.	Pervious substratum.	Fair stability; good to fair compaction characteristics; high susceptibility to piping in upper 30 inches; low below.
Downer: DoB, DoC, DrA, DrB.	Poor for DoB and DoC: low fertility; excess sand. Good for DrA and DrB.	Good for sand below a depth of 2½ feet: may need washing. Poor for gravel: small amount in substratum in some areas.	Good: SP and SM material.	Moderately rapid or rapid permeability in substratum.	Fair stability; pervious substratum; low cohesion.
Evesboro: EvB, EvC, EvD.	Poor: low fertility, available water capacity, and organic-matter content; excess sand.	Good for sand: may need washing. Unsuitable for gravel.	Good: SP and SM material; may need binder.	Rapid permeability	Fair to poor stability; fair to good compaction characteristics; rapid permeability; low cohesion.
Fallsington: Fd	Poor: seasonal water table limits accessibility except in summer; moderate organic-matter content.	Fair for sand below a depth of 2⅓ feet: may need washing; seasonal high water table limits accessibility. Poor for gravel: small amount in substratum in some areas.	Poor: SM and SC material; seasonal high water table limits accessibility.	Rapid permeability in substratum; seasonal high water table.	Fair stability and compaction characteristics; rapid permeability in substratum.

soil properties

Soil features affecting—Continued						
Excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Sidewalls subject to severe collapse; rapid recharge unless underlain by clay.	Seasonal high water table rises to within 1 foot of the surface; rapid permeability; ditchbank subject to collapse.	Needs drainage; low available water capacity; low fertility.	Not needed	Not needed	Seasonal high water table rises to within 1 foot of the surface.	Seasonal high water table rises to within 1 foot of the surface; subject to severe sidewall collapse.
Low water table	Not needed	Moderate to moderately slow intake rate and permeability; moderate available water capacity.	Good stability; erodible.	No adverse features.	Good trafficability.	No adverse features.
Seasonal high water table; rapid recharge.	Seasonal high water table at surface; rapid permeability; ditchbanks subject to collapse.	Needs drainage; low available water capacity when drained; low natural fertility.	Not needed	Not needed	Seasonal high water table at surface.	Seasonal high water table; subject to severe sidewall collapse.
Low water table	Not needed	High available water capacity; moderate intake rate; moderate to moderately slow permeability.	No adverse features.	No adverse features.	No adverse features.	No adverse features.
Low water table	Not needed	Moderate available water capacity; moderately rapid or rapid intake rate.	No adverse features.	No adverse features.	No adverse features.	Subject to moderate sidewall collapse.
Not suitable	Not needed	Low available water capacity; rapid intake rate.	Loose sand easily fills channel.	Not needed; rapid permeability.	No adverse features.	Subject to severe sidewall collapse.
Seasonal high water table within a depth of 1 foot; rapid recharge rate.	Moderate permeability; outlets difficult to obtain in places.	Needs drainage before irrigation; seasonal high water table within a depth of 1 foot; moderate available water capacity.	Not needed	Not needed	Seasonal high water table within a depth of 1 foot.	Subject to severe sidewall collapse.

TABLE 8.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Reservoir areas	Embankments
Fort Mott: FrA	Poor: low fertility and available water capacity in upper 2 feet.	Good for sand below a depth of 3½ feet. Unsuitable for gravel.	Good: SP and SM material.	Rapid permeability in substratum.	Rapid permeability at surface and in substratum.
Hammonton: HaA, HbA, HbB.	Poor for HaA: low fertility; moderate available water capacity; excess sand. Good for HbA and HbB.	Good for sand below a depth of 2 feet. Poor for gravel: limited amount in some areas.	Good: dominantly SP and SM material.	High seepage in substratum in summer.	Pervious surface layer and substratum.
Klej: KmA	Poor: low fertility, available water capacity, and organic-matter content; excess sand.	Good for sand. Unsuitable for gravel.	Good: dominantly SP and SM material; may need binder; seasonal high water table at a depth of 1½ to 4 feet.	High seepage potential; moderately rapid to rapid permeability permits seepage losses in summer.	Fair to poor stability; rapid permeability.
Lakehurst: LaA	Poor: very low fertility; low available water capacity; subject to soil blowing; low organic-matter content; excess sand.	Good for sand: small amount of fines; moderately high water table in winter and early in spring. Unsuitable for gravel.	Good: SP and SP–SM material may need binder.	High seepage potential; rapid permeability throughout.	Fair stability; low cohesion; rapid permeability; medium to high susceptibility to piping; water table may limit accessibility.
Lakewood: LeB	Poor: very low fertility; low available water capacity; subject to soil blowing; low organic-matter content.	Good for sand: few fines. Unsuitable for gravel.	Good: SP or SM material may need binder.	High seepage potential.	Fair stability; low cohesion; rapid permeability; medium to high susceptibility to piping.
Matapeake: MoA, MoB, MoC2.	Good for MoA and MoB. Fair for MoC2: moderate thickness.	Fair for sand below a depth of 3 feet: excess fines. Poor to unsuitable for gravel: low content; location unpredictable; mostly fine size.	Fair: ML and CL or SM and SC material.	Moderately slow permeability.	Fair stability; fair to good compaction characteristics; medium to high susceptibility to piping.
Mattapex: MrA, MrB.	Good	Fair for sand below a depth of 3 feet; excess fines. Poor to unsuitable for gravel below a depth of 3 feet: low content; location unpredictable; mostly fine size.	Fair: ML and CL or SM and SC material.	Moderately slow permeability; seasonal high water table at a depth of 2 to 3 feet.	Fair stability; fair to good compaction characteristics; medium to high susceptibility to piping.

soil properties—Continued

Soil features affecting—Continued						
Excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Not suitable	Not needed	Low available water capacity in upper 2 feet; rapid intake rate.	Loose sand easily fills channel.	Normally not needed.	No adverse features.	Subject to moderate sidewall collapse.
Seasonal high water table at a depth of 1½ to 4 feet in winter and spring, drops below a depth of 5 feet in summer.	Moderate permeability in surface layer and subsoil; rapid permeability in substratum.	Moderate available water capacity; moderately rapid intake rate.	Not needed	No adverse features.	Seasonal high water table at a depth of 1½ to 4 feet.	Seasonal high water table at a depth of 1½ to 4 feet in winter, drops below a depth of 5 feet in summer; subject to moderate sidewall collapse.
Low water table in summer.	Seasonal high water table at a depth of 1½ to 4 feet; rapid permeability; ditch walls collapse easily.	Low available water capacity; rapid intake rate.	Not needed	Normally not needed.	Seasonal high water table at a depth of 1½ to 4 feet.	Seasonal high water table at a depth of 1½ to 4 feet; subject to severe sidewall collapse.
Low water table in summer.	Rapid permeability; ditch walls collapse easily.	Low available water capacity; very low fertility; rapid intake rate.	Loose sand easily fills channels.	Very low fertility; low available water capacity.	Seasonal high water table at a depth of 1½ to 4 feet.	Seasonal high water table at a depth of 1½ to 4 feet in winter and spring, drops below a depth of 5 feet in summer; subject to severe sidewall collapse.
Unsuitable	Not needed	Low available water capacity; very low fertility; rapid intake rate.	Loose sand easily fills channels.	Very low fertility; low available water capacity.	Loose sand subject to blowing.	Subject to severe sidewall collapse.
Low water table	Generally not needed; small depressed areas may need surface drainage.	High available water capacity; moderate to moderately slow intake rate.	No adverse features.	No adverse features.	Fair trafficability.	Subject to slight sidewall collapse.
Low water table in summer.	Moderately slow permeability; seasonal high water table at a depth of 2 to 3 feet.	High available water capacity; moderate to moderately slow intake rate.	Seasonal high water table at a depth of 2 to 3 feet.	Seep spots; seasonal high water table.	Seasonal high water table at a depth of 2 to 3 feet.	Seasonal high water table at a depth of 2 to 3 feet; subject to moderate sidewall collapse.

TABLE 8.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Road fill	Reservoir areas	Embankments
Muck: MS	Poor: high water table limits accessibility; high organic-matter content.	Unsuitable: high water table limits accessibility.	Poor: high water table limits accessibility; organic material is unstable.	Constantly high water table.	High water limits accessibility; organic material is unstable; high organic-matter content.
Othello: Ot	Poor: seasonal high water table limits accessibility except in summer; moderate organic-matter content.	Fair for sand below a depth of 3½ feet: excess fines. Poor for gravel below a depth of 3½ feet: low content; location unpredictable; mostly fine size.	Fair: SM and SC material to a depth of 3 feet; SM material below 3 feet.	Moderately slow permeability; seasonal water table rises to within 1 foot of the surface.	Fair stability; fair to good compaction characteristics; moderate to high susceptibility to piping.
Pocomoke: Ps	Poor: seasonal high water table limits accessibility, except in summer; high organic-matter content.	Poor: high water table limits accessibility; high sand content below a depth of 2½ feet; small amount of gravel in some areas.	Poor: SM and SC material; seasonal high water table limits accessibility.	Seasonal water table at surface, except in summer when it is at a depth of nearly 2 feet.	Good stability and compaction characteristics in surface layer and in subsoil; rapid permeability in substratum; low cohesion.
Sassafras: SgA, SgB, SgC2, SrA, SrB, SrC2.	Good for SrA, SrB, and SrC2. Poor for SgA, SgB, and SgC2: excess gravel.	Good for sand below a depth of 3½ feet. Poor for gravel below a depth of 3½ feet: small supply; high proportion is fine, rounded, and quartzose.	Fair: mostly SM and SC material; dominantly more than 30 percent fines.	Moderate permeability.	Good stability and compaction characteristics in surface layer and in subsoil; porous substratum.
Tidal Marsh: TM	Poor: subject to daily flooding; soil becomes more acid upon drying.	Unsuitable: daily tidal flooding.	Unsuitable: excess mineral and organic-matter content; daily tidal flooding.	Variable mineral and organic-matter content; tidal flooding twice daily; subject to high storm tides.	Excess organic-matter content; poor stability.
Woodstown: WmA, WmB.	Good	Good for sand below a depth of 3 feet; seasonal water table limits accessibility in winter and spring. Poor for gravel: limited amount; occurrence unpredictable; high proportion is less than ½ inch in diameter.	Fair: SM, SC, and SP–SM material; dominantly more than 30 percent fines.	Seasonal high water table at a depth of 2 to 4 feet; permeability in substratum may permit seepage losses.	Good stability and compaction characteristics in surface layer and subsoil; porous substratum.

soil properties—Continued

Soil features affecting—Continued						
Excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading	Shallow excavations
Sidewalls subject to severe collapse.	Outlets normally difficult to obtain; constantly high water table.	Not needed	Not needed	Not needed	Water table at surface; low bearing capacity.	High water table; rapid recharge rate.
Rapid recharge rate.	Moderately slow permeability in subsoil; moderate in substratum.	Drainage needed; high available water capacity; moderately slow intake rate.	Not needed	Not needed	Seasonal high water table rises to within 1 foot of the surface; coarse texture below 3½ feet.	Seasonal high water table rises to within 1 foot of the surface; moderate sidewall collapse.
Rapid recharge rate; sidewalls subject to severe collapse.	Outlets difficult to obtain; moderate permeability in surface layer and in subsoil; moderately rapid permeability in substratum.	Needs drainage before irrigation; moderate available water capacity; water table near a depth of nearly 2 feet in summer.	Not needed	Not needed	Seasonal water table at surface.	Seasonal water table at surface; subject to severe sidewall collapse.
Low water table	Not needed	High or moderate available water capacity; moderate intake rate; excess gravel in SgA, SgB, and SgC2.	No adverse features.	No adverse features.	No adverse features.	Subject to slight sidewall collapse.
Subject to daily tidal flooding and high storm tides.	Daily tidal flooding; dike construction difficult; soil becomes more acid upon drying; subject to high storm tides.	Not needed	Not needed	Not needed	Not needed	Tidal flooding twice daily; subject to high storm tides.
Low water table in summer.	Moderate permeability in surface layer and in subsoil; moderately rapid in substratum.	High available water capacity; moderate intake rate and permeability; water table below a depth of 5 feet in summer.	No adverse features.	No adverse features.	Seasonal high water table at a depth of 2 to 4 feet.	Seasonal high water table at a depth of 2 to 4 feet; subject to moderate sidewall collapse.

TABLE 9.—*Engineering*

[Tests made by Engineering Department, Rutgers, The State University.

Soils	Sampling site			Depth	Percentage passing sieve—		
	Site number	Latitude	Longitude		¾-inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)
				Inches			
Aura loamy sand: Nonmodal, subsurface abnormally coarse textured.	9	39°27′32″	74°56′25″	0–8	100	92	85
				8–26	100	90	69
				26–50	99	92	83
Chillum silt loam: Nonmodal, silt content slightly low in subsoil.	45	39°29′13″	74°18′13″	0–8	100	99	98
				8–30	99	98	98
				30–62	97	91	89
Evesboro sand:							
Nonmodal, gravel content higher than normal in subsurface horizon.	13	39°21′0″	74°57′25″	0–36	100	100	99
				36–84	100	75	65
Modal	48	39°29′21″	75°14′39″	0–3	100	100	100
				3–22	100	100	100
				22–36	100	100	99
				36–48	90	82	79
				48–72	97	96	94
Fort Mott loamy sand:							
Modal	18	39°20′18″	75°33′35″	0–8	100	99	98
				8–24	100	100	99
				24–36	100	100	100
				36–84	100	100	100
Modal	20	39°28′50″	79°19′42″	0–24	98	93	91
				24–60	100	98	97
				60–132	100	100	100
Hammonton sandy loam:							
Nonmodal, gravel content higher than normal in the substratum.	29	39°13′57″	74°55′2″	0–6	100	96	93
				6–30	100	98	95
				30–58	87	69	61
				58–76	100	97	96
Nonmodal, clay content slightly below normal in the subsoil.	30	39°16′8″	75°3′46″	0–12	100	99	98
				12–26	99	94	91
				26–50	98	88	80
Klej loamy sand: Modal	38	39°23′38″	75°5′43″	0–8	100	99	98
				8–18	99	96	94
				18–30	100	94	90
				30–52	97	89	84
Lakewood sand: Nonmodal, surface horizon finer than normal.	16	39°22′59″	75°1′26″	0–6	100	100	98
				6–24	100	100	98
				24–48	100	99	98
				48–70	100	97	97
				70–84	100	99	99
Matapeake silt loam: Modal	46	39°31′23″	75°15′19″	0–10	100	100	98
				10–44	100	100	100
				44–56	96	92	92
Mattapex silt loam:							
Nonmodal, silt content too low	42	39°25′1″	72°21′58″	0–6	100	100	100
				6–20	100	100	99
				20–60	100	100	99
Nonmodal, silt content too low	43	39°23′40″	75°23′15″	0–8	100	98	95
				8–30	100	98	97
				30–48	100	97	95
Othello silt loam: Modal	22	39°26′11″	75°23′11″	0–10	100	100	100
				10–28	100	100	100
				28–50	100	100	99

See footnotes at end of table.

test data

Absence of data indicates the determination was not made]

Percentage passing sieve—cont'd		Hydrometer analysis [1]		Liquid limit [2]	Plasticity index [3]	Maximum density [4]	Optimum moisture content [4]	Classification		
								AASHTO		
No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05–0.005 mm	0.005 mm					Group	Group index	Unified
		Percent	*Percent*	*Percent*		*Lb/cu ft*	*Percent*			
44	19	---	---	[5] NL	[6] NP	---	---	A-1-b	0	SM
25	10	---	---	NL	NP	124	10	A-1-b	0	SP-SM
43	27	4	24	42	16	120	13	A-2-7	1	[7] SM-SC
93	83	---	---	29	7	---	---	A-4	8	CL-ML
96	87	49	25	28	8	---	---	A-4	8	CL-ML
57	45	23	19	36	13	---	---	A-6	3	SM-SC
56	4	---	---	NL	NP	---	---	A-3	0	SP
25	8	---	---	NL	NP	125	10	A-1-b	0	SP-SM
90	8	---	---	NL	NP	---	---	A-3	0	SP-SM
89	8	---	---	NL	NP	104	13	A-3	0	SP-SM
91	7	---	---	NL	NP	---	---	A-3	0	SP-SM
63	5	---	---	NL	NP	---	---	A-3	0	SP-SM
84	10	---	---	NL	NP	109	12	A-3	0	SP-SM
88	14	---	---	NL	NP	---	---	A-2-4	0	SM
88	14	---	---	NL	NP	112	11	A-2-4	0	SM
95	18	---	---	NL	NP	117	10	A-2-4	0	SM
98	5	---	---	NL	NP	100	16	A-3	0	SP-SM
83	16	---	---	NL	NP	---	---	A-2-4	0	SM
85	23	---	---	NL	NP	114	12	A-2-4	0	SM
98	1	---	---	NL	NP	98	15	A-3	0	SP
73	26	---	---	NL	NP	---	---	A-2-4	0	SM
79	37	---	---	18	5	---	---	A-4	1	SM-SC
42	7	---	---	NL	NP	---	---	A-1-b	0	SP-SM
65	19	---	---	NL	NP	---	---	A-2-4	0	SM
73	19	---	---	NL	NP	---	---	A-2-4	0	SM
71	20	---	---	NL	NP	125	10	A-2-4	0	SM
67	17	---	---	NL	NP	121	9	A-2-4	0	SM
75	14	---	---	NL	NP	---	---	A-2-4	0	SM
72	13	---	---	NL	NP	---	---	A-2-4	0	SM
67	14	---	---	NL	NP	---	---	A-2-4	0	SM
57	13	---	---	NL	NP	---	---	A-2-4	0	SM
68	13	---	---	NL	NP	---	---	A-2-4	0	SM
62	3	---	---	NL	NP	---	---	A-3	0	SP
76	8	---	---	NL	NP	---	---	A-3	0	SP-SM
78	3	---	---	NL	NP	---	---	A-3	0	SP
60	1	---	---	NL	NP	---	---	A-3	0	SP
95	89	---	---	27	6	---	---	A-4	8	CL-ML
98	92	57	29	27	6	111	16	A-4	8	CL-ML
87	43	26	16	22	7	116	13	A-4	2	SM-SC
88	51	---	---	NL	NP	---	---	A-4	3	ML
89	48	---	---	NL	NP	---	---	A-4	3	SM
90	50	---	---	18	4	---	---	A-4	3	SM-SC
85	47	---	---	18	1	---	---	A-4	3	SM
87	54	32	19	22	7	---	---	A-4	4	CL-ML
75	6	---	---	NL	NP	---	---	A-3	0	SP-SM
91	75	---	---	32	7	---	---	A-4	8	CL-ML
92	84	49	31	26	6	108	18	A-4	8	CL-ML
80	58	---	---	20	3	115	13	A-4	5	ML

TABLE 9.—*Engineering*

Soils	Sampling site			Depth	Percentage passing sieve—		
	Site number	Latitude	Longitude		¾-inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)
				Inches			
Sassafras sandy loam: Modal	37	39°24′18″	75°6′24″	0–8 8–24 24–48	100 100 86	98 99 63	95 98 56
Woodstown sandy loam: Modal	29	39°13′57″	74°55′2″	0–6 6–30 30–58 58–76	100 100 87 100	96 98 69 97	93 95 61 96
Modal	31	39°22′14″	75°15′9″	0–12 12–30 30–44 44–60 60–70	100 100 100 100 100	100 100 93 90 79	98 100 87 80 72

[1] Standard Method AASHTO Designation T 88–49 (*2*).

[2] Standard Method AASHTO Designation T 89–49.

[3] Standard Method AASHTO Designation T 91–49.

[4] Standard Method AASHTO Designation T 99–49.

Formation and Classification of the Soils

This section describes the factors of soil formation as they exist in Cumberland County, the development of soil horizons, and the classification of the soils of the county according to the current classification system.

Factors of Soil Formation

Soils form through interaction of five major factors: parent material, climate, relief, plant and animal life, and time. The relative influence of each factor varies from place to place. Local variations are due mainly to differences in kinds of parent material or drainage. In each place the soil properties reflect the dominance of one or more of the above factors.

Parent material

All soils of Cumberland County formed in unconsolidated geologic material, which is many feet thick (*5*). The most extensive is the Cohansey Formation. It underlies all of the county, but it is buried by a thin layer of more recent deposits in many places. It consists mainly of quartz sand, and in places it has lenses or thin strata of light-colored clay or gravel. Another is the generally more gravelly and clayey Bridgeton Formation, which occurs in many parts of the county. It consists of reddish surficial deposits that cap the hills and upland areas. This deposit was once nearly continuous but has been eroded so that it remains mostly as isolated remnants on summits. In the Shiloh, Roadstown, and Deerfield areas the sandy or gravelly deposits are overlain by a mantle of silt loam or loam. In many low areas, finer textured material that washed from uplands has been redeposited. Near Stow Creek and Vineland, the underlying clay beds have slow internal drainage, and have extensive areas of moderately well drained or somewhat poorly drained soils.

Plant and animal life

Micro-organisms, plants, and many higher animals influence soil formation. They add organic matter to the soils. Higher plants tend to offset leaching by feeding on nutrients within the rooting zone and depositing them on the surface in the form of leaves, twigs, and dead plants. Micro-organisms hasten the decay of organic matter, and when they die, add to the organic residue. Many animals, such as crawling insects, moles, and worms, chew up plant remains and mix them into the soil. They improve aeration and permeability by burrowing into the soil.

In the process of decay many organic substances are released, such as humic acids, which accelerate the weathering of mineral grains and the leaching of nutrients.

In areas of Cumberland County where pine trees and associated plants and micro-organisms have dominated the biological community for a long time the soils have a bleached horizon. In this county, frequent burning has resulted in a native plant cover of pine forest. In these frequently burned areas are Lakewood, Lakehurst, and Atsion soils.

Climate and relief

In Cumberland County climate and relief are so *test data*—Continued

Percentage passing sieve—cont'd		Hydrometer analysis [1]		Liquid limit [2]	Plasticity index [3]	Maximum density [4]	Optimum moisture content [4]	Classification		
								AASHTO		
No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05–0.005 mm	0.005 mm					Group	Group index	Unified
		Percent	*Percent*	*Percent*		*Lb/cu ft*	*Percent*			
73	45	----------	----------	21	5	----------	----------	A–4	2	SM–SC
84	57	30	25	25	8	117	13	A–4	4	CL
43	24	11	12	25	8	124	10	A–2–4	0	SC
73	26	----------	----------	NL	NP	----------	----------	A–2–4	0	SM
79	37	----------	----------	18	5	----------	----------	A–4	1	SM–SC
42	7	----------	----------	NL	NP	----------	----------	A–1–b	0	SP–SM
65	19	----------	----------	NL	NP	----------	----------	A–2–4	0	SM
69	28	----------	----------	NL	NP	----------	----------	A–2–4	0	SM
68	40	19	19	21	8	----------	----------	A–4	1	SC
61	19	----------	----------	NL	NP	----------	----------	A–2–4	0	SM
19	2	----------	----------	NL	NP	----------	----------	A–1–b	0	SP
37	1	----------	----------	NL	NP	----------	----------	A–1–b	0	SP

[5] NL means nonliquid.

[6] NP means nonplastic.

[7] The Soil Conservation Service and the Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points from the A–line are to be given a borderline classification. Examples of borderline classification obtained by this use are SM–SC and CL–ML.

interrelated that they are discussed together. The climatic changes during and after the Ice Age had considerable effect on the soils. Glacial melt water caused much erosion and mixing of soil material. High winds deposited a mantle of silt loam or loam in the northwestern part of the county.

For extensive periods while the soils were forming, soils in low areas were saturated or covered with water. In these soils, the dark color of the surface layer is the result of the accumulation of organic matter, and the subsoil is gray because of poor aeration. The soils on uplands are generally better drained. Their strong-brown and reddish colors indicate that aeration is adequate and that they have iron oxides.

The degree and kind of weathering that has taken place in the Bridgeton Formation indicates that there were periods when the climate was warmer than today. Soil series are placed in natural drainage classes in table 12.

Time

The formation of soils requires a long time. Imperceptible changes are taking place continuously, but the cumulative effect of these changes is noticeable only after hundreds, perhaps thousands, of years.

The geologic materials exposed in Cumberland County range from recent to several million years old, but most of the soils are less than a million years old. The oldest soils are those that formed in the remnants of the Bridgeton Formation, which caps the hills. These soils are deeply weathered and have distinct horizons. On uplands other soils that are younger also have well-developed horizons. Extending inland from the coast at an elevation of less than 50 feet is a system of terraces that range from 12,000 to 80,000 years in age. On these terraces the soils have less profile formation. Along the streams in low areas the soils are forming in comparatively recent deposits, and have less profile development than older soils.

Development of Soil Horizons

In most places soil formation begins as weathering of rock. On the Coastal Plains, this process took place before the marine or melt-water deposits were laid down; consequently, chemical weathering and clay mineral formation are more important than this process. Processes that commonly take place in soils of the Coastal Plain are freezing and thawing, wetting and drying, heating and cooling, and shrinking and swelling. They are largely responsible for breaking pebbles and grains into smaller particles and for developing soil structure.

On the Coastal Plain, soil formation is mostly the result of an accumulation of organic residues in the surface horizons; the leaching of the products of weathering and decay; the chemical weathering of primary minerals and formation of secondary or clay minerals; and the translocation of silicate minerals, silt particles, and probably complexes of humus and iron or aluminum oxide from one horizon to another (*15*). In most soils several or all of these processes are operating at the same time.

Soils that have formed as a result of man's activity have the least accumulation of organic matter in the surface layer. Sandy soils, such as the Evesboro, Klej, Lakewood, and Lakehurst soils, have an accumulation

TABLE 10.—*Soil limitations*

Soil series and map symbols	Limitations of the soils for—			
	Foundations of dwellings—		Septic tank absorption fields	Sanitary landfill
	With basements	Without basements		
Atsion: Ac	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.
Aura: AgA, AgB, ArA, ArB	Slight	Slight	Moderate: moderately slow to moderate permeability in subsoil; deep excavation to permeable material is needed in most places.	Slight
AmB	Slight	Slight	Moderate: moderately slow to moderate permeability in subsoil; deep excavation to permeable material is needed in most places.	Slight
Berryland: Bp	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Chillum: ChA, ChB	Slight	Slight	Moderate: moderately slow permeability at a depth of 30 inches, may require deep trenching.	Slight
Downer: DoB, DoC	Slight	Slight	Slight [1]	Severe: small amount of filter material; moderately rapid to rapid permeability in substratum.
DrA, DrB	Slight	Slight	Slight [1]	Severe: small amount of filter material; moderately rapid to rapid permeability in substratum.
Evesboro: EvB, EvC	Slight	Slight	Slight [1]	Severe: insufficient fines for filtering; rapid permeability permits ground water pollution.
EvD	Moderate: slope; erosion hazard.	Moderate: slope; erosion hazard.	Moderate: slope [1].	Severe: insufficient fines for filtering; rapid permeability permits ground water pollution.

See footnote at end of table.

for community development

Limitations of the soils for—Continued					
Roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic areas	Camp areas	Paths and trails
Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot; low fertility; low available water capacity.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.
Moderate: subgrade more than 30 percent fines.	Slight	Slight for ArA. Moderate for AgA, AgB, and ArB: moderate gravel content; gentle slopes in AgB and ArB.	Slight	Slight	Slight.
Moderate: subgrade more than 30 percent fines.	Moderate: high sand content.	Moderate: gentle slopes; dust hazard.	Moderate: dust hazard.	Moderate: dust hazard.	Moderate: dust hazard.
Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface; low fertility; low available water capacity when drained.	Severe: seasonal high water table at surface; low fertility; low available water capacity when drained.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.
Moderate: subgrade is more than 30 percent fines.	Slight	Slight for ChA. Moderate for ChB: slope.	Slight	Slight	Slight.
Moderate: subgrade is more than 30 percent fines.	Moderate: moderate available water capacity.	Severe: moderate available water capacity; high sand content; strong slope in DoC.	Moderate: moderate available water capacity; dust hazard.	Moderate: dust hazard; poor trafficability.	Moderate: dust hazard; poor trafficability.
Moderate: subgrade is more than 30 percent fines.	Slight	Slight for DrA. Moderate for DrB: slope.	Slight	Slight	Slight.
Slight	Severe: low fertility; low available water capacity; high sand content.	Severe: poor trafficability; low available water capacity; low fertility; high sand content.	Severe: poor trafficability; low available water capacity; severe dust hazard.	Severe: severe dust hazard; poor trafficability.	Severe: severe dust hazard; poor trafficability.
Moderate: slope	Severe: low fertility; low available water capacity.	Severe: poor trafficability; low available water capacity.	Severe: poor trafficability; low available water capacity.	Severe: severe dust hazard; poor trafficability.	Severe: severe dust hazard; poor trafficability.

TABLE 10.—*Soil limitations for*

Soil series and map symbols	Limitations of the soils for—			
	Foundations of dwellings—		Septic tank absorption fields	Sanitary landfill
	With basements	Without basements		
Fallsington: Fd	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.
Fort Mott: FrA	Slight	Slight	Slight [1]	Severe: small amount of filter material; rapid permeability in substratum permits ground water pollution.
Hammonton:				
HaA	Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Slight: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: moderately well drained; needs drainage or filling.	Severe: seasonal high water table at a depth of 1½ to 4 feet; low amount of filtering material; ground water pollution hazard.
HbA, HbB	Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Slight: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: moderately well drained; needs deep drainage or filling.	Severe: seasonal high water table at a depth of 1½ to 4 feet; low amount of filtering material; ground water pollution hazard.
Klej: KmA	Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Slight: seasonal high water table at a depth of 1½ to 4 feet.	Moderate: moderately well drained; needs drainage or filling.	Severe: seasonal high water table at a depth of 1½ to 4 feet; lack of filter material and rapid permeability permits ground water pollution.
Lakehurst: LaA	Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Slight: seasonal high water table at a depth of 1½ to 4 feet.	Moderate [1]: moderately well drained; deep drainage needed.	Severe: seasonal high water table at a depth of 1½ to 4 feet; rapid permeability permits ground water pollution.
Lakewood: LeB	Slight	Slight	Slight [1]	Severe: insufficient fines for filtering; rapid permeability permits ground water pollution.
Matapeake:				
MoA, MoB	Slight	Slight	Slight	Slight: insufficient fines for filtering in places.
MoC2	Slight	Slight	Slight	Slight: insufficient fines for filtering in places.

See footnote at end of table.

community development—Continued

Limitations of the soils for—Continued					
Roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic areas	Camp areas	Paths and trails
Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.	Severe: seasonal high water table within a depth of 1 foot.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.
Slight	Severe: low fertility; low available water capacity in upper 2 feet; low organic-matter content.	Severe: severe dust hazard; low available water capacity in upper 2 feet; low fertility.	Severe: severe dust hazard; low available water capacity in upper 2 feet.	Severe: severe dust hazard; poor trafficability.	Severe: severe dust hazard; poor trafficability.
Moderate: seasonal high water table at a depth of 1½ to 4 feet; subgrade is more than 30 percent fines.	Moderate: excess sand.	Moderate: seasonal high water table at a depth of 1½ to 4 feet; drainage needed.	Moderate: moderate dust hazard.	Moderate: moderate dust hazard; poor trafficability.	Moderate: moderate dust hazard; moderate trafficability.
Moderate: seasonal high water table at a depth of 1½ to 4 feet; subgrade is more than 30 percent fines.	Slight: seasonal water table at a depth of 1½ to 4 feet.	Moderate: seasonal high water table at a depth of 1½ to 4 feet; drainage needed.	Slight: water table at a depth of more than 20 inches during season of use.	Slight: water table at a depth of more than 20 inches during season of use.	Slight: water table at a depth of more than 20 inches during season of use.
Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Severe: low natural fertility; low available water capacity; low organic-matter content.	Severe: poor trafficability; severe dust hazard; low available water capacity; low natural fertility.	Severe: poor trafficability; low available water capacity.	Severe: poor trafficability; severe dust hazard.	Moderate: severe dust hazard; poor trafficability.
Moderate: seasonal high water table at a depth of 1½ to 4 feet.	Severe: very low fertility; low available water capacity; low organic-matter content; poor trafficability.	Severe: severe dust hazard; poor trafficability.	Severe: severe dust hazard; poor trafficability.	Severe: severe dust hazard; poor trafficability.	Severe: severe dust hazard; poor trafficability.
Slight	Severe: very low fertility; low available water capacity; poor trafficability.	Severe: low available water capacity; very low fertility; severe dust hazard.	Severe: loose sand; dust hazard; soil blowing hazard.	Severe: severe dust hazard; poor trafficability.	Severe: severe dust hazard; poor trafficability.
Moderate: subgrade is more than 30 percent fines.	Slight	Slight for MoA. Moderate for MoB: slope.	Slight	Slight	Slight.
Moderate: subgrade is more than 30 percent fines.	Slight	Severe: slope	Slight	Slight	Slight.

TABLE 10.—*Soil limitations for*

Soil series and map symbols	Limitations of the soils for—			
	Foundations of dwellings—		Septic tank absorption fields	Sanitary landfill
	With basements	Without basements		
Mattapex: MrA, MrB	Moderate: moderately high seasonal water table.	Slight: moderately high seasonal water table.	Severe: moderately well drained; needs deep drainage.	Severe: moderately high seasonal water table; ground water pollution hazard.
Muck: MS	Severe: seasonal high water table at surface; flood hazard.	Severe: seasonal high water table at surface; flood hazard.	Severe: seasonal high water table at surface; flood hazard.	Severe: seasonal high water table at surface; flood hazard.
Othello: Ot	Severe: seasonal high water table perched within a depth of 1 foot.	Severe: seasonal high water table perched within a depth of 1 foot.	Severe: seasonal high water table perched within a depth of 1 foot.	Severe: seasonal high water table perched within a depth of 1 foot.
Pocomoke: Ps	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.
Sassafras: SgA, SgB, SrA, SrB	Slight	Slight	Slight [1]	Severe: permeability of substratum may permit ground water pollution.
SgC2, SrC2	Slight	Slight	Moderate [1]: strong slopes.	Severe: permeability of substratum may permit ground water pollution.
Tidal Marsh: TM	Severe: daily tidal flooding and extreme storm tides.	Severe: daily tidal flooding and extreme storm tides.	Severe: tidal flooding twice daily.	Severe: tidal flooding twice daily.
Woodstown: WmA, WmB	Moderate: seasonal high water table at a depth of 2 to 4 feet.	Slight: seasonal high water table at a depth of 2 to 4 feet.	Moderate: moderately well drained; needs deep drainage or filling.	Severe: seasonal high water table at a depth of 2 to 4 feet; low amount of filtering material.

[1] Pollution of ground water is a risk.

of organic matter in the surface layer that is less than 1 percent. Sassafras and other loamy, well-drained soils are 1 to 4 percent organic matter. Pocomoke, Berryland, and other very poorly drained soils are 5 to 10 percent organic matter in the surface layer.

Except for Tidal Marsh, leaching of carbonates has been so severe in all soils that they are naturally extremely acid or very strongly acid. Heavy liming of the fields has changed the reaction to a depth of 3 to 4 feet in these soils.

Translocation of the clay minerals from one layer to another occurs in Downer and Sassafras soils, and they consist of 3 to 10 percent more clay in the subsoil than in either the surface layer or the underlying layers.

Various chemical changes and iron transfer are common to many soils of Cumberland County. The effect of oxidation and iron transfer are probably most striking in the Lakehurst soils, which have a strongly bleached, gray surface layer and a yellowish-brown subsoil. In places, the Bh horizon contains organic matter and possibly iron.

Iron is transferred in wet soils where iron is segregated in the mottles. Iron concretions are common in *community development*—Continued

Limitations of the soils for—Continued					
Roads and streets	Lawns, landscaping, and golf fairways	Athletic fields	Picnic areas	Camp areas	Paths and trails
Moderate: moderately high seasonal water table; more than 30 percent fines.	Slight	Moderate: water table at a depth of more than 20 inches during season of use.	Slight: water table at a depth of more than 20 inches during season of use.	Slight: water table at a depth of more than 20 inches during season of use.	Slight: water table at a depth of more than 20 inches during season of use.
Severe: seasonal high water table at surface; flood hazard.	Severe: seasonal high water table at surface; flood hazard.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: water table at a depth of less than 20 inches for a month or more during season of use.
Severe: seasonal high water table perched within a depth of 1 foot.	Severe: seasonal high water table perched within a depth of 1 foot.	Severe: seasonal high water table perched within a depth of 1 foot.	Severe: water table at surface for a month or more during season of use.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches for a month or more during season of use.
Severe: seasonal high water table at surface.	Severe: seasonal high water table at surface.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.	Severe: water table at a depth of less than 20 inches during season of use.
Moderate: soil contains more than 30 percent fines.	Slight for SrA and SrB. Moderate for SgA and SgB: moderate gravel content.	Slight for SrA. Moderate for SgA, SgB, and SrB: gravel content moderate in SgA and SgB; slope in SgB and SrB.	Slight	Slight	Slight.
Moderate: more than 30 percent fines.	Slight	Severe: strong slopes.	Slight	Slight	Slight.
Severe: tidal flooding twice daily and extreme storm tides.	Severe: tidal flooding twice daily and extreme storm tides.	Severe: daily tidal flooding and extreme storm tides.	Severe: tidal flooding twice daily and extreme storm tides.	Severe: tidal flooding twice daily and extreme storm tides.	Severe: tidal flooding twice daily and extreme storm tides.
Moderate: content of fines more than 30 percent in most places.	Moderate: seasonal high water table at a depth of 2 to 4 feet.	Moderate: seasonal high water table at a depth of 2 to 4 feet; WmB has slope limitation.	Slight: water table at a depth of more than 20 inches during season of use.	Slight: water table at a depth of more than 20 inches during season of use.	Slight: water table at a depth of more than 20 inches during season of use.

Lakehurst, Atsion, and Berryland soils. Iron is reduced in soils that are wet for long periods. Most of these soils are gray because the iron is reduced instead of oxidized. Examples are Fallsington and Pocomoke soils, which have a gray subsoil.

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 woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

TABLE 11.—*Landscape*

Landscape planting groups and map symbols	Deciduous plants		
	Kind and height, in feet, of large and medium trees that have—		
	Rapid growth	Moderate growth	Slow growth
Group 1: Well-drained soils that have high or moderate available water capacity. AgA, AgB, AmB, ArA, ArB, ChA, ChB, DoB, DoC, DrA, DrB, MoA, MoB, MoC2, SgA, SgB, SgC2, SrA, SrB, SrC2.	White ash (50+), cutleaf European birch (50), American linden (50+), mimosa (25–40), American mountain ash (25–50), northern red oak (50+), Bradford pear (40–50), silverbell (50+), sweetgum (50+), yellow-poplar (50–100), yellowwood (50+), zelkova (50+), and katsura (50–75).	Green ash (40–60), European beech (50+), gray birch (15–25), flowering crabapple (15–25), crapemyrtle (20–35), ginkgo (50+), golden chaintree (30), black gum (25–50), red-haw hawthorn (20–30), thornless honeylocust (40–70), American hornbeam (25–35), red horsechestnut (30–40), Japanese pagoda tree (50+), kalopanax (50+), sweetbay magnolia (15–25), Norway maple (40–80), named varieties of Norway maple (15–70), red maple (40–80), sugar maple (60–75), pin oak (50+), scarlet oak (50+), shingle oak (75+), southern red oak (50+), turkey oak (75+), willow oak (50+), plum and cherry (15–40), and shadbush (20–35).	American beech (50+), flowering dogwood (25), golden raintree (20–40), European hornbeam (50+), ironwood (20–50), littleleaf linden (30), and white oak (50+).
Group 2: Moderately well drained or somewhat poorly drained soils that have a seasonal high water table. HaA, HbA, HbB, KmA, LaA, MrA, MrB, WmA, WmB.	White ash (50+), cutleaf European birch (50), Katsura (50–75), American linden (50+), mimosa (25–40), American mountain-ash (25–50), northern red oak (50+), Bradford pear (40–50), sweetgum (50+), and yellow-poplar (50–100).	Green ash (40–60), European beech (50+), gray birch (15–25), crapemyrtle (20–35), black gum (25–50), thornless honeylocust (40–70), American hornbeam (25–35), red horsechestnut (30–40), Japanese pagoda tree (50+), kalopanax (50+), European larch (50+), sweetbay magnolia (15–25), Norway maple (40–80), named varieties of Norway maple (15–70), red maple (40–80), sugar maple (60–75), pin oak (50+), scarlet oak (50+), shingle oak (75+), southern red oak (50+), turkey oak (75+), willow oak (50+), and shadbush (20–35).	American beech (50+), flowering dogwood (25), ironwood (20–50), littleleaf linden (30), and white oak (50+).
Group 3: Poorly drained or very poorly drained soils that have a high water table for more than 6 months. Ac, Bp, Fd, MS, Ot, Ps.	Sweetgum (50+)	Blackgum (25–50), European larch (50+), sweetbay magnolia (15–25), red maple (40–80), pin oak (50+), and willow oak (50+).	White oak (50+)
Group 4: Excessively drained, droughty, sandy soils that have low available water capacity. EvB, EvC, EvD, FrA, LeB.	Mimosa (25–40), zelkova (50+).	Gray birch (15–25), American hornbeam (25–35), and turkey oak (75+).	Ironwood (20–50)

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*16*). 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 order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measureable. The properties are chosen so that the soils of similar genesis, or mode of origin, are grouped. In table 13 the soil series of Cumberland County are placed in four categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized in the current classification system. Of these, only Entisols, Histosols, Spodosols, and Ultisols are in Cumberland County. 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).

plantings

Deciduous plants—cont'd	Coniferous plants			
Kind and height, in feet, of small trees and shrubs	Kind and height, in feet, of trees that have—			Kind and height, in feet, of shrubs
	Rapid growth	Moderate growth	Slow growth	
Arrowwood (10–15), flame azalea (10–15), bayberry (6–10), blackhaw (15–20), coralberry (2–6), highbush cranberry (10–15), redosier dogwood (10), Laland firethorn (10–20), forsythia (10–15), Franklin tree (15–20), hawthorn (12–20), amur honeysuckle (10–15), Tatarian honeysuckle (10–15), maples (12–25), autumn-olive (10–15), amur privet (15–20), winterberry (10), and white fringetree (12–15).	Glossy privet (30–40)	Cedar of Lebanon (50–80+), eastern redcedar (30+), cryptomeria (80–100+), white fir (50–100), eastern hemlock (50–90), southern magnolia (50+), Austrian pine (50+), white pine (50–100), Norway spruce (50+), and white spruce (50+).	Northern white-cedar (50+), oriental white cedar ((50+), atlas cedar (50+), California incense cedar (50–90), American holly (30–50), and Colorado blue spruce (50+).	Azalea (5–10), Chinese holly (10), Japanese holly (variable height), juniper (variable height), mountain-laurel (5–15), mugo pine (10), rhododendron (10–15), and Japanese yew (variable height).
Arrowwood (10–15), bayberry (6–10), blackhaw (15–20), coralberry (2–6), high-bush cranberry (10–15), redosier dogwood (10), maple (12–25), winterberry (10), and white fringetree (12–15).	Glossy privet (30–40)	Eastern redcedar (30+), eastern hemlock (50–90), Austrian pine (50+), white pine (50–100), Norway spruce (50+), and white spruce (50+).	Northern white–cedar (50+), oriental white cedar (50+), and American holly (30–50).	Juniper (variable height), mountain laurel (5–15), and rhododendron (10–15).
Arrowwood (10–15), redosier dogwood (10), winterberry (10), and white fringetree (12–15).		White spruce (50+)		
Autumn-olive (10–15)		Austrian pine (50+) and white pine (50–100).		

SUBORDER. Each order is divided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *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 have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Umbraquults (*Umbr,* meaning thick dark colored

TABLE 12.—*Soil series arranged according to subsoil texture and natural drainage*

Primary subsoil texture	Soil series in natural drainage classes					
	Excessively drained	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
Sand or loamy sand:						
Bleached horizon more than 6 inches thick	Lakewood		Lakehurst		Atsion	Berryland.
Bleached horizon less than 6 inches thick	Evesboro		Klej			
Sandy loam:						
Surface layer of loamy sand as much as 20 inches thick or sandy loam.		Downer	Hammonton	Hammonton	Fallsington	Pocomoke.
Sandy clay loam or sandy loam:						
Surface layer of loamy sand more than 20 inches thick.		Fort Mott				
Surface layer of sandy loam; brownish, grayish, or mottled friable subsoil.		Sassafras	Woodstown		Fallsington	
Surface layer of sandy loam or loamy sand less than 20 inches thick; reddish, firm subsoil.		Aura				
Silty clay loam or silt loam:						
Depth to firm, reddish, gravelly substratum is 20 to 30 inches.		Chillum				
Depth to sandy loam substratum is more than 30 inches.		Matapeake	Mattapex		Othello	
Mixed mineral material or muck in upper 20 inches:						
Mostly mineral material						Tidal Marsh.
Mostly organic material						Muck.

TABLE 13.—*Classification of the soils*

Series	Family	Subgroup	Order
Atsion	Sandy, siliceous, mesic	Aeric Haplaquods	Spodosols.
Aura	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Berryland	Sandy, siliceous, mesic	Typic Haplaquods	Spodosols.
Chillum	Fine-silty, mixed, mesic	Typic Hapludults	Ultisols.
Downer	Coarse-loamy, siliceous, mesic	Typic Hapludults	Ultisols.
Evesboro	Mesic, coated	Typic Quartzipsamments	Entisols.
Fallsington	Fine-loamy, siliceous, mesic	Typic Ochraquults	Ultisols.
Fort Mott	Loamy, siliceous, mesic	Arenic Hapludults	Ultisols.
Hammonton	Coarse-loamy, siliceous, mesic	Aquic Hapludults	Ultisols.
Klej	Mesic, coated	Aquic Quartzipsamments	Entisols.
Lakehurst	Mesic, coated	Haplaquodic Quartzipsamments	Entisols.
Lakewood	Mesic, coated	Spodic Quartzipsamments	Entisols.
Matapeake	Fine-silty, mixed, mesic	Typic Hapludults	Ultisols.
Mattapex	Fine-silty, mixed, mesic	Aquic Hapludults	Ultisols.
Muck [1]			Histosols.
Othello	Fine-silty, mixed, mesic	Typic Ochraquults	Ultisols.
Pocomoke	Coarse-loamy, siliceous, thermic	Typic Umbraquults	Ultisols.
Sassafras	Fine-loamy, siliceous, mesic	Typic Hapludults	Ultisols.
Tidal Marsh [1]			Histosols and Entisols.
Woodstown	Fine-loamy, siliceous, mesic	Aquic Hapludults	Ultisols.

[1] This is a broadly defined unit. It represents soils of several families and subgroups.

surface soil, *aqu*, for wetness or water, and *Ult*, from Ultisols).

SUBGROUP. Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Umbraquults (a typical Umbraquult).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used to differentiate families. An example is the coarse-loamy, siliceous, thermic family of Typic Umbraquults.

SERIES. Soil series are separated within a family. Each series is a collection of individual soils having essentially uniform properties and sequences of horizons or layers within a defined depth. An example is the Pocomoke series.

General Nature of the County

Farm acreage in the county was as high as 40 percent in 1940 but had decreased to about 30 percent by 1969. Farms decreased in number from 1,035 in 1964 to 733 in 1969, but as the number decreased the size increased. In 1969, the average size of a farm was 130 acres; about 67,000 acres was in crops, and of this acreage more than 20,000 was irrigated.

The main crop is vegetables that are grown mainly for freezing. The main vegetables are snap beans, onions, and cabbage, but many others are grown.

In 1967 the woodland totaled 139,000 acres, or about 45 percent of the county. Most of this was hardwood forest, but there are also pine forests in the county. Most of the extensive woodland is not considered a part of farms.

TABLE 14.—*Temperature and precipitation data*

[All data from Millville]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average	One year in 10 will have—		Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
			Maximum temperature higher than—	Minimum temperature lower than—		Less than—	More than—		
	°F	°F	°F	°F	*Inches*	*Inches*	*Inches*	*Number*	*Inches*
January	46	27	55	6	2.9	0.7	4.8	6	4
February	44	25	59	9	2.8	1.6	4.2	4	4
March	51	31	68	20	3.8	2.0	5.7	2	2
April	62	40	82	30	3.1	1.3	5.7	0	0
May	73	51	88	39	3.2	.9	5.9	0	0
June	82	60	92	50	3.1	.7	5.3	0	0
July	87	66	96	58	3.9	.9	7.7	0	0
August	85	64	91	53	4.4	1.4	9.3	0	0
September	77	56	88	45	3.1	.6	6.8	0	0
October	69	47	81	32	2.7	.6	5.0	0	0
November	56	35	68	24	3.5	1.3	5.9	(1)	4
December	46	27	59	13	3.6	1.4	6.2	1	3
Year	65	44	[2] 97	[3] 2	40.1	32.8	56.5	12	4

[1] Less than half a day.
[2] Average annual highest temperature.
[3] Average annual lowest temperature.

Climate [4]

Cumberland County has a humid temperate climate moderated by the Delaware Bay and the Atlantic Ocean. Table 14 gives temperature and precipitation data, and table 15 gives probabilities of low temperatures in spring and fall.

Summer temperatures do not exceed 100° F for long periods but they are frequently in the middle or upper 90's. Winter temperatures generally are not below 5° for long periods. The ground is normally not frozen throughout the winter.

The average annual precipitation is 40 to 44 inches, and the monthly averages in table 14 indicate that precipitation is well distributed. In nearly every year there are periods when there is not enough rainfall for high-value crops, but in recent years the irrigated acreage has increased. Rainfall is heaviest in June and July. Much of the rainfall in summer comes as thunderstorms. The largest amount of rainfall recorded in a 24-hour period is 9.99 inches. In winter, the rainfall frequently warms the soils enough to thaw them, but heavy rainfall on partly thawed soils is highly erosive. Hailstones are not frequent but, at times, are destructive to high-value crops.

Winds affect crop production in the county. Most of the wind blows from the northwest. The critical period for soil blowing is November to April. On the average, duration and velocity of the wind are greatest in March. By that time, cover crops have been plowed into the fields that are to be used for early crops. Sand blown by high winds damages young corn and other unprotected plants. High winds also remove organic matter, which is a valuable part of the very sandy soils.

The length of the growing season in the county is about 193 days. The average date of the last killing frost in spring is about April 15, and that of the first in fall is October 25. Probabilities for the last damaging cold temperature in spring and the first in fall are listed in table 15.

[4] DONALD V. DUNLAP, former State climatologist, ESSA, U.S. Department of Commerce.

TABLE 15.—*Probabilities of low temperatures in spring and fall*

[All data from Shiloh]

Season and probability	Dates for given probability and temperatures				
	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 17	March 28	April 8	April 20	May 1
2 years in 10 later than	March 12	March 22	April 1	April 13	April 26
5 years in 10 later than	February 26	March 6	March 19	March 30	April 15
Fall:					
1 year in 10 earlier than	November 26	November 18	November 8	October 24	October 11
2 years in 10 earlier than	December 2	November 23	November 13	October 29	October 15
5 years in 10 earlier than	December 14	December 4	November 25	November 9	October 25

Geology

Among the geologic formations that are at the surface in Cumberland County are the Kirkwood Formation, Cohansey Sand, Bridgeton Formation, and Cape May Formation (*5*). All the formations are made up of unconsolidated deposits of sand, gravel, silt, and clay. The Kirkwood Formation and Cohansey Sand are of Tertiary Age, but the Bridgeton Formation and Cape May Formation, which are relatively shallow, are of Quaternary age. Sand and gravel are mined from the Bridgeton, Cape May, and Cohansey Formations, and most of the water for industrial and urban uses comes from the Kirkwood and Cohansey Formations.

Water Supply

In Cumberland County, the use of water is highly seasonal, mainly because increasing amounts are needed for irrigation and for the food-processing industries. The amounts of water withdrawn are larger than those withdrawn in nearby Salem and Cape May Counties. In 1964 seasonal use per day ranged from 27 million gallons in March to 145 million gallons in August, but the average per day was 51 million gallons, of which 4.9 million gallons was ground water. In 1964 the total amount of water used per day was 10.6 million gallons for public supply, 19.0 million gallons for suburban, rural, residential, institutional, farm, and commercial uses.

The two important aquifers that supply most of the water are the lower Kirkwood aquifer and the Cohansey-Kirkwood aquifer. Most wells obtain water from the lower Kirkwood aquifer where the yield is less than 50 gallons per minute but could be as much as 400 gallons per minute. The depth of these wells ranges from 200 to 370 feet. The Cohansey-Kirkwood aquifer is the shallowest and most important source of ground water in the county, but it is highly susceptible to surface contamination. It generally yields large amounts of water (300 to 1,200 gallons per minute) from wells that are less than 180 feet deep. The water is characterized by a low content of dissolved solids (63 milligrams per liter, median), low hardness (21 milligrams per liter, median), and a low pH value (5.5 pH, median).

As computed for Cumberland County, water gains per day are 1,050 million gallons received as precipitation, 142 million gallons from surface water inflow, but negligible ground-water inflow. Water losses per day are 685 million gallons through evapotranspiration, 370 million gallons through surface water outflow, and 137 million gallons through ground water outflow.

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Glossary

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.

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.

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.

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 available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and 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 porly 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.

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.

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.

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.

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

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

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

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.

Substratum. Technically, the part of the soil below the solum.

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."

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. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Described on page	Capability unit	Woodland group	Landscape planting group
Ac	Atsion sand	9	Vw-26	3w1	3
AgA	Aura gravelly sandy loam, 0 to 2 percent slopes	10	IIs-9	3o2	1
AgB	Aura gravelly sandy loam, 2 to 5 percent slopes	10	IIs-9	3o2	1
AmB	Aura loamy sand, 0 to 5 percent slopes	10	IIIs-10	3o2	1
ArA	Aura sandy loam, 0 to 2 percent slopes	11	IIs-9	3o2	1
ArB	Aura sandy loam, 2 to 5 percent slopes	11	IIs-9	3o2	1
Bp	Berryland sand	12	Vw-26	3w1	3
ChA	Chillum silt loam, 0 to 2 percent slopes	12	I-4	3o1	1
ChB	Chillum silt loam, 2 to 5 percent slopes	12	IIe-4	3o1	1
DoB	Downer loamy sand, 0 to 5 percent slopes	13	IIs-6	3o2	1
DoC	Downer loamy sand, 5 to 10 percent slopes	14	IIIe-6	3o2	1
DrA	Downer sandy loam, 0 to 2 percent slopes	14	I-5	3o2	1
DrB	Downer sandy loam, 2 to 5 percent slopes	14	IIe-5	3o2	1
EvB	Evesboro sand, 0 to 5 percent slopes	16	VIIs-8	4s1	4
EvC	Evesboro sand, 5 to 10 percent slopes	16	VIIs-8	4s1	4
EvD	Evesboro sand, 10 to 20 percent slopes	16	VIIs-8	4s1	4
Fd	Fallsington sandy loam	17	IIIw-21	2w1	3
FrA	Fort Mott loamy sand, 0 to 5 percent slopes	18	IIIs-7	3o2	4
HaA	Hammonton loamy sand, 0 to 5 percent slopes	18	IIw-15	2o1	2
HbA	Hammonton sandy loam, 0 to 2 percent slopes	18	IIw-14	2o1	2
HbB	Hammonton sandy loam, 2 to 5 percent slopes	18	IIw-14	2o1	2
KmA	Klej loamy sand, 0 to 3 percent slopes	20	IIIw-16	3s1	2
LaA	Lakehurst sand, 0 to 3 percent slopes	20	IVw-17	4s1	2
LeB	Lakewood sand, 0 to 5 percent slopes	21	VIIs-8	5s1	4
MoA	Matapeake silt loam, 0 to 2 percent slopes	22	I-4	3o1	1
MoB	Matapeake silt loam, 2 to 5 percent slopes	22	IIe-4	3o1	1
MoC2	Matapeake silt loam, 5 to 10 percent slopes, eroded	22	IIIe-4	3o1	1
MrA	Mattapex silt loam, 0 to 2 percent slopes	23	IIw-13	3o1	2
MrB	Mattapex silt loam, 2 to 5 percent slopes	23	IIw-13	3o1	2
MS	Muck	23	VIIw-30	4w1	3
Ot	Othello silt loam	24	IIIw-20	3w2	3
Ps	Pocomoke sandy loam	25	IIIw-24	2w1	3
SgA	Sassafras gravelly sandy loam, 0 to 2 percent slopes	25	I-5	3o2	1
SgB	Sassafras gravelly sandy loam, 2 to 5 percent slopes	25	IIe-5	3o2	1
SgC2	Sassafras gravelly sandy loam, 5 to 10 percent slopes, eroded	26	IIIe-5	3o2	1
SrA	Sassafras sandy loam, 0 to 2 percent slopes	26	I-5	3o2	1
SrB	Sassafras sandy loam, 2 to 5 percent slopes	26	IIe-5	3o2	1
SrC2	Sassafras sandy loam, 5 to 10 percent slopes, eroded	26	IIIe-5	3o2	1
TM	Tidal Marsh	26	VIIIw-29	---	---
WmA	Woodstown sandy loam, 0 to 2 percent slopes	27	IIw-14	2o1	2
WmB	Woodstown sandy loam, 2 to 5 percent slopes	28	IIw-14	2o1	2

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