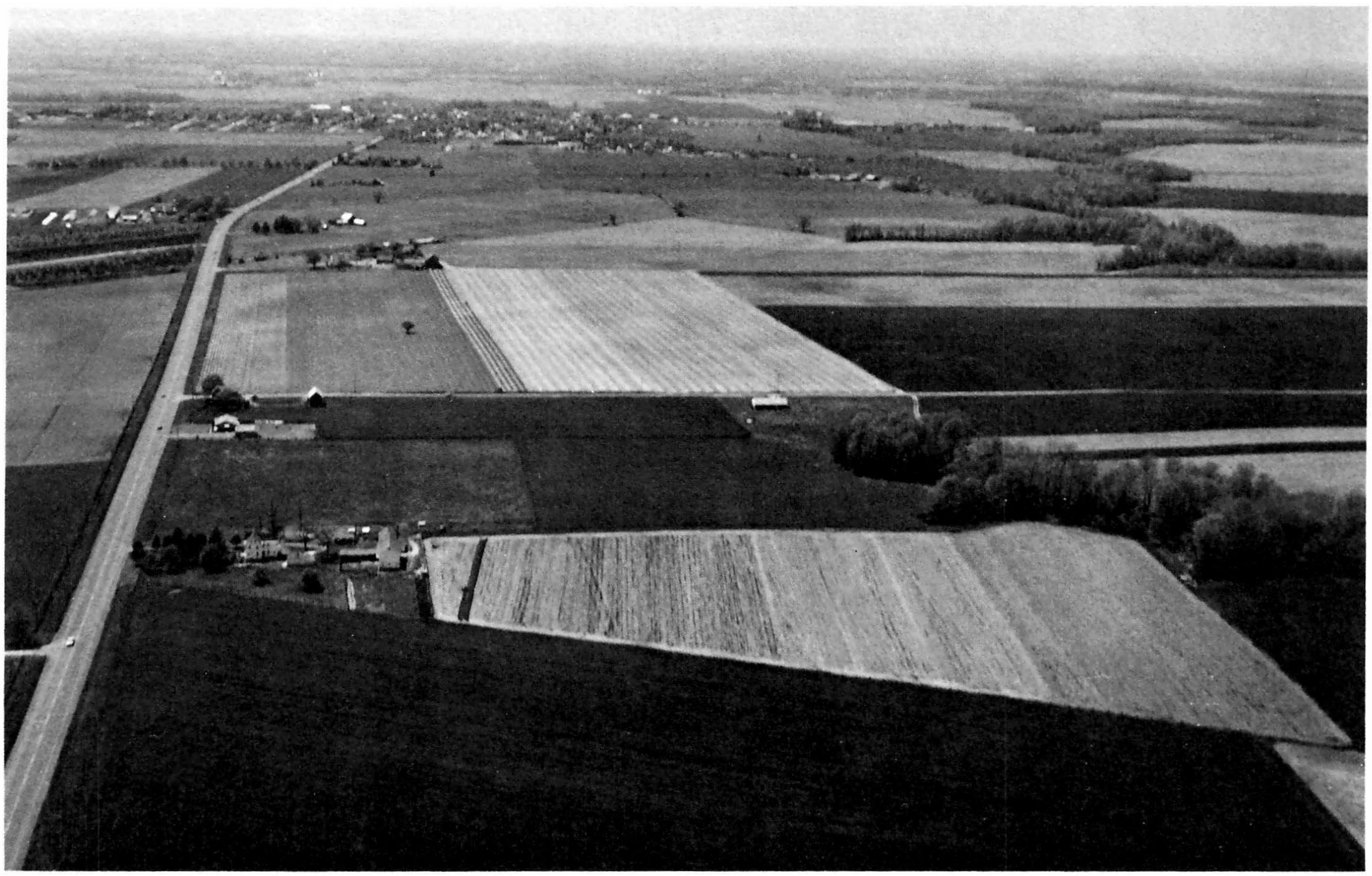
Issued October 1970

SOIL SURVEY

New Castle County, Delaware



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

Major fieldwork for this soil survey was done in the period 1943–65. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1965. This survey was made cooperatively by the Soil Conservation Service and the Delaware Agricultural Experiment Station. It is part of the technical assistance furnished to the New Castle Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

THIS SURVEY of New Castle County 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 agriculture, industry, and recreation.

Locating Soils

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

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

Finding and Using Information

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

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

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

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

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

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

Community planners and others can read about the soil properties that affect the choice of sites for homes, industrial buildings, schools, and parks in the section "Nonfarm Uses of Soils."

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

Newcomers in New Castle County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

Cover picture: **View of Matapeake-Sassafras soil association (6) showing Middletown in the background. U.S. Highway No. 301 on left.**

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SOIL SURVEY OF NEW CASTLE COUNTY, DELAWARE

BY EARLE D. MATTHEWS AND OSCAR L. LAVOIE, SOIL CONSERVATION SERVICE

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH DELAWARE AGRICULTURAL EXPERIMENT STATION

NEW CASTLE COUNTY is the northernmost county in Delaware (fig. 1). It has a land area of 279,680 acres, or 437 square miles. Wilmington, the county seat and the largest city in the State, is on the Delaware River in the northeastern part of the county. Other important towns are Delaware City, Middletown, Newark, New Castle, and Odessa.

The Chesapeake and Delaware Canal divides the county. The part that is south of the canal is used mostly for farming, but north of the canal an increasingly large acreage is being diverted to residential, commercial, industrial, and other nonfarm uses. In the Piedmont Plateau, or the acreage north of the area that extends northeastward from Newark to Wilmington and then northeastward from Wilmington to Carpenter, the soils are sloping to hilly and are eroded or are susceptible to erosion. In the Coastal Plain, or the southern part of the county, the soils are more nearly level, and some of them require drainage.

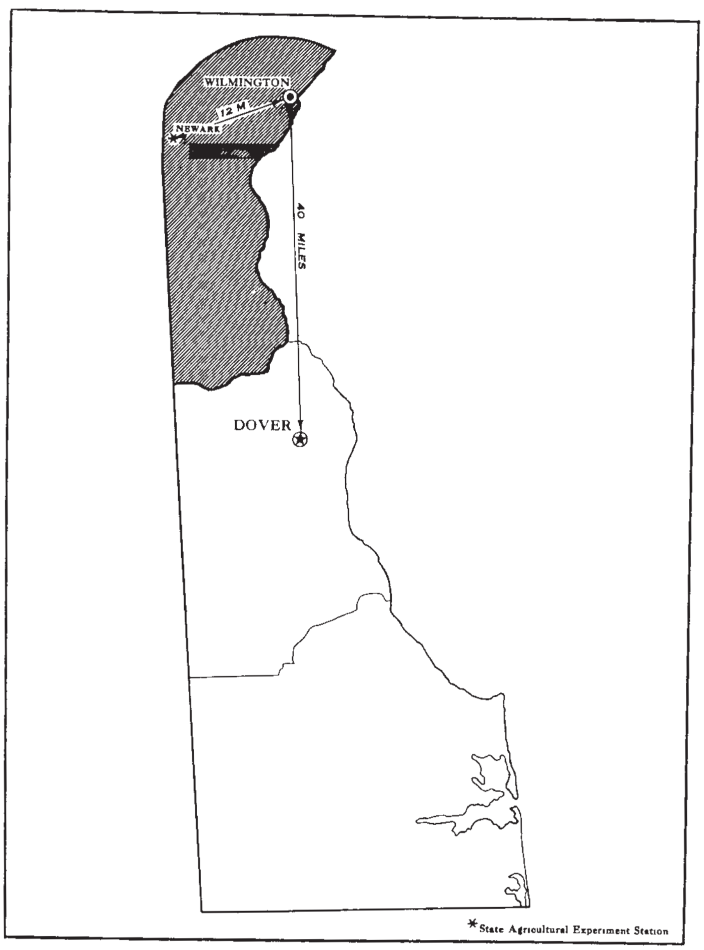

Figure 1.—**Location of New Castle County in Delaware.**

The chief sources of farm income, in order of their importance, are livestock and livestock products, dairy products, poultry and poultry products, field crops, and truck crops. Corn is the most extensive crop, but wheat, soybeans, and barley also are grown. Important truck crops are sweet corn, Irish potatoes, green peas, lima beans, tomatoes, and asparagus. Fruit orchards are important locally.

Local markets are readily available for marketing farm products. Major markets within a radius of about 100 miles or less are Philadelphia, Pa.; Baltimore, Md.; Washington, D.C.; and New York, N.Y.

How This Survey Was Made

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

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

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

Soils of one series can differ somewhat in texture of the surface soil 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 (*8*).[1] The name of a soil phase indicates a feature that affects management. For example, Chester loam, 0 to 3 percent slopes, is one of several phases within the Chester 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 woodland, buildings, field borders, trees, and other details that greatly help in drawing soil boundaries accurately. The soil map in the back of this survey 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 management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of New Castle County; the soil complex and the undifferentiated group.

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

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the survey, there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the soil map may be made up of only one of the dominant soils, or of two or more. The name of the undifferentiated group consists of the names of the dominant soils, joined by "and." Glenelg and Manor loams, 3 to 8 percent slopes, moderately eroded, is an example.

In most areas surveyed there are areas where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These areas are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Mixed alluvial land and Tidal marsh are examples of two land types in New Castle County.

[1] Italic numbers in parentheses refer to Literature Cited, p 95.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are 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 soils. Yields under defined management are estimated for all the soils.

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 a way that it is readily useful to different groups of readers, among them farmers, managers of woodland, engineers, and homeowners.

On the basis of the 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, and 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 New Castle County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The 13 soil associations in New Castle County are described in the following pages.

1. Glenelg-Manor-Chester Association

Nearly level to steep, well-drained, medium-textured soils formed over micaceous crystalline rocks; on uplands

This association is in one large area in the northern and northwestern parts of the county. It consists mainly of gently sloping to moderately sloping soils. On the bottom lands and crests, however, the soils are nearly level, and in some areas above streams they are steep. This association occupies about 15 percent of the county.

Glenelg soils make up about 43 percent of the association; Manor soils, about 28 percent; Chester soils, about 14 percent; and minor soils, the remaining 15 percent.

The major soils in this association are deep, well drained, and micaceous (fig. 2). The Glenelg soils have a subsoil of silt loam and silty clay loam that generally extends to a depth of not more than 36 inches. The Chester

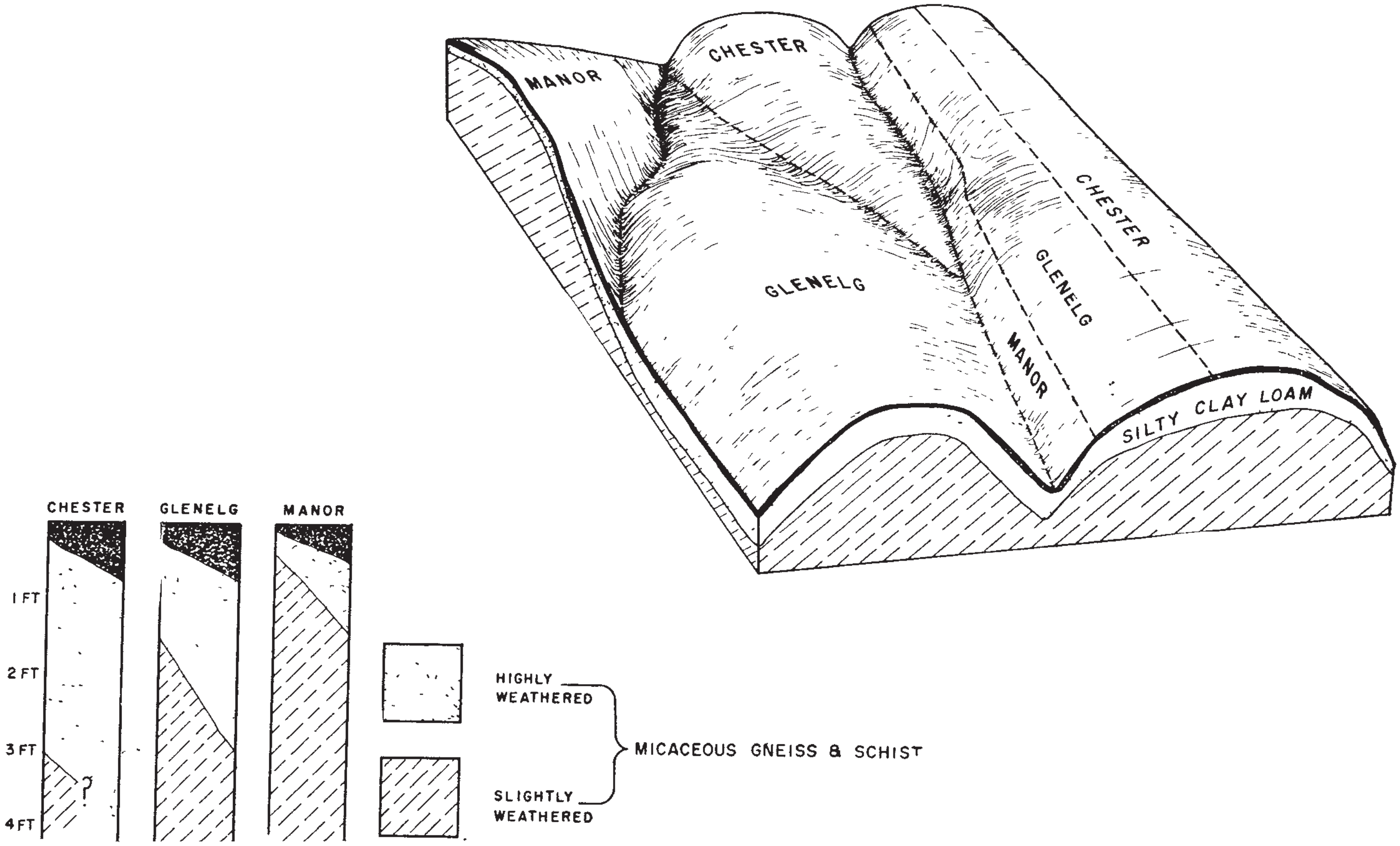

Figure 2.—**Typical pattern of the major soils in the Glenelg-Manor-Chester soil association.**

soils have a subsoil of clay loam and silt loam that generally extends to a depth of more than 36 inches. The Glenelg and Chester soils are more micaceous in their underlying material than in the material above it. The Manor soils are highly micaceous. They generally are fairly uniform loam throughout the profile; the subsoil is not finer textured than the surface layer.

The most important minor soils in this association are in the Glenville, Codorus, and Hatboro series. The Glenville soils occur mainly around the head of drainageways and at the base of slopes. They contain a brittle fragipan and are moderately well drained to somewhat poorly drained. The Codorus soils are moderately well drained, and the Hatboro soils are poorly drained. Both kinds of soils occur mainly on flood plains and are susceptible to flooding. Some areas are on foot slopes.

Figure 3 shows how an area of this association is used. Farming is intensive in many places. Much of the farming is on the contour, and row crops are alternated with strips of hay or other close-growing crops. Many of the farms raise some livestock, and others specialize in producing milk, beef, or other animal products. Large areas are in hay and pasture. Forage plants grow well on the soils of this association. In many places the soils are too steep to be cultivated regularly. The steep soils are more suitable for use as woodland, for pasture, for orchards, or for parks and wildlife areas.

The major soils of this association provide good building sites, though slope is a limitation in places. In most places excavation is not difficult and is not limited by wetness. The soils generally have only slight to moderate limitations to use for sewage disposal by septic tanks. Care should be taken, however, not to place filter fields on steep soils or on wet soils of the flood plains.

2. Neshaminy-Aldino-Watchung Association

Level to steep, well drained, moderately well drained, and poorly drained, medium-textured soils formed over dark-colored gabbroic rocks; on uplands

This association occupies an area in the northern part of the county and a smaller area in the western part. The soils are mainly gently sloping to moderately sloping, but they range from level to steep (fig. 4). This association makes up about 3 percent of the county.

Neshaminy soils make up about 38 percent of the association; Aldino soils, about 29 percent; Watchung soils, about 18 percent; and minor soils, the remaining 15 percent.

The Neshaminy soils are level to steep, deep, and well drained. They are very stony in places. They have a silty clay loam subsoil and are underlain by bedrock at a depth of 6 to 10 feet. The Aldino and Watchung soils are level to gently sloping. Aldino soils are moderately well drained, have a brittle fragipan in the lower part of the subsoil, and are underlain by bedrock at a depth of 4 to 6 feet. The Watchung soils are poorly drained. Their sub-

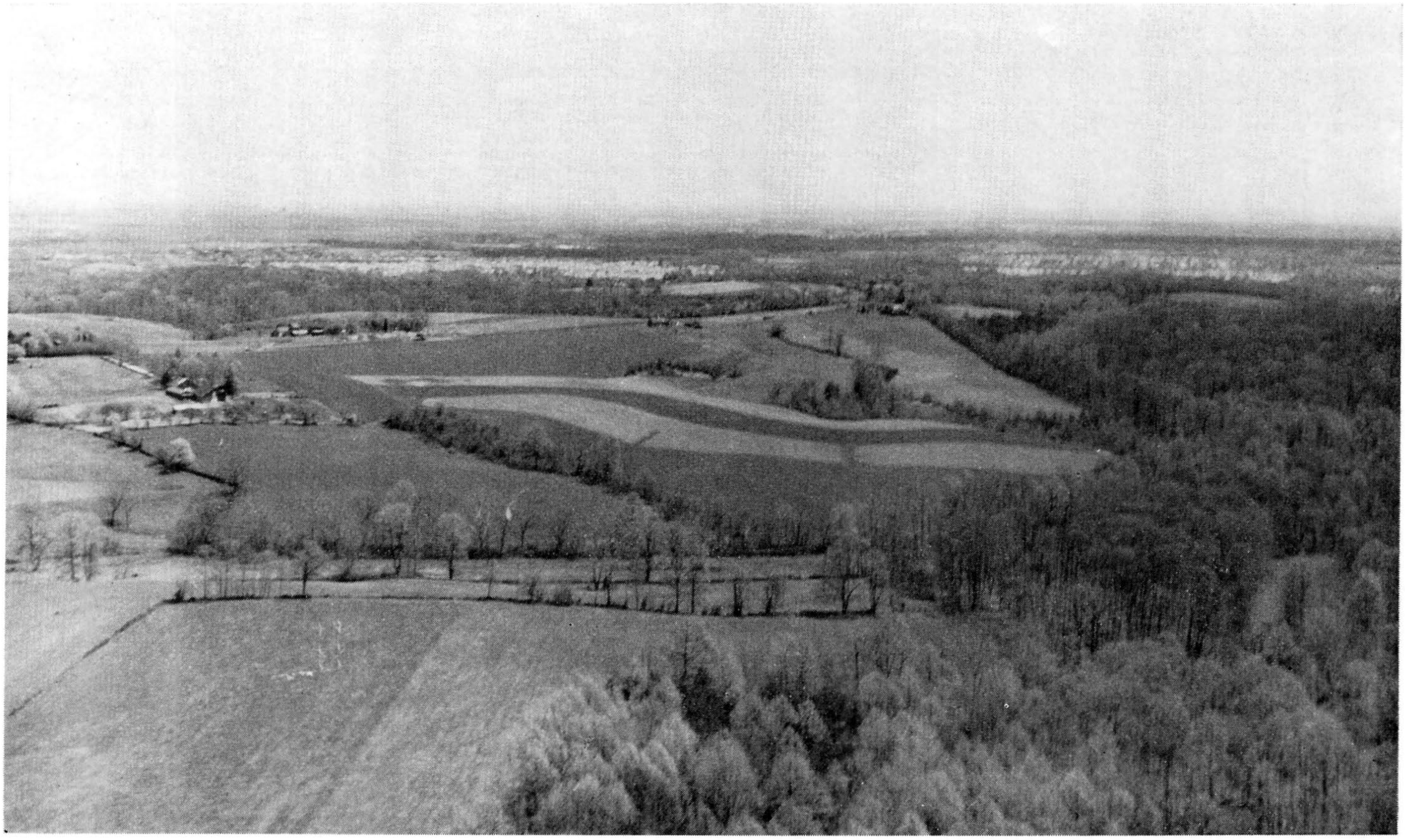

***Figure 3.*—Land use in the Glenelg-Manor-Chester soil association. Grassland is at left, woodland at right, and stripfarming at the center.**

soil is rich in clay, and bedrock is at a depth of 5 to 10 feet. Watchung soils are very stony in places.

The most important minor soils in this association are in the Talleyville, Montalto, Calvert, Codorus, and Hatboro series. Talleyville and Montalto soils are deep and well drained, and they commonly occur closely with the Neshaminy soils. The Calvert soils are poorly drained and commonly occur closely with the Watchung soils. The moderately well drained Codorus and the poorly drained Hatboro soils are on flood plains.

***Figure 4.*—A wooded area in the Neshaminy-Aldino-Watchung soil association. The loose rocks are on Watchung very stony silt loam.**

Intensive farming is practiced chiefly on the Neshaminy soils. The Aldino and Watchung soils have impeded drainage and are seasonally wet. Some drainage is needed where the Aldino soils are cultivated. Because they are wet, stony, or both, the Watchung soils are hardly ever used for cultivated crops. They can be used for pasture.

The Neshaminy soils make good building sites, but excavating into the bedrock may be difficult. The filter fields of septic tanks should be large on the Neshaminy soils. Filter fields do not function properly on the Aldino soils during wet periods and usually do not function at all on the Watchung soils.

3. Neshaminy-Talleyville-Urban Land Association

Level to moderately sloping, well-drained, medium-textured soils, relatively undisturbed to severely disturbed; formed over dark-colored gabbroic rocks; on uplands

This association occurs as a single area in the northern part of the county. It includes a large part of the city of Wilmington. The soils are level to moderately sloping. This association makes up about 5 percent of the county.

Deep, well-drained Neshaminy and Talleyville soils make up about 65 percent of this association. The remaining 35 percent consists of Made land in areas that were Aldino, Montalto, and Watchung soils before they were severely disturbed by man.

The soils in about one-fourth of this association are relatively undisturbed and are still farmed in some areas. In about one-half of the association, the soils have been disturbed in community development, but not to the extent that they cannot be identified. The rest of the association is Made land, which consists of areas in which the soils have been severely cut, graded, or artificially filled.

Most of this association is not farmed. The main limitations to use are those related to community development. In many areas of minor soils, wetness and drainage are the chief concerns. The depth of excavations in this association depends on the depth to bedrock and the hardness of this rock. In the relatively undisturbed areas of Neshaminy and Talleyville soils, depth to bedrock ranges from 6 to 10 feet or more and the bedrock is extremely hard.

4. Elsinboro-Delanco-Urban Land Association

Level to gently sloping, well drained and moderately well drained, medium-textured soils, relatively undisturbed to severely disturbed; formed in old alluvium on stream terraces

This association consists of old alluvial terraces along Clay Creek and its tributaries. It extends along both sides of State Route 2 from Newark (fig. 5) northeastward to Prices Corners. The soils range from level to gently sloping. This association occupies about 3 percent of the county.

The Elsinboro soils make up about 42 percent of the association; Delanco soils, about 28 percent; Urban land, about 20 percent; and minor soils the remaining 10 percent. In much of the association the Elsinboro and Delanco soils and Urban land are closely intermingled.

In about one-half of this association, the soils are relatively undisturbed and are still farmed in some areas. The soils in about one-third of the association have been disturbed during community development, but not to the extent that they cannot be identified. The rest of the association is made up of Made land, in which the soils have been severely cut and graded or artificially filled.

The Elsinboro soils are well drained and occur on terraces, benches, and low bluffs. The Delanco soils are moderately well drained and occur on terraces.

Among the minor soils in this association are the moderately well drained Codorus soils and the poorly drained Hatboro soils on flood plains and the poorly drained Kinkora soils on terraces.

Except for nurseries, home gardens, and other small areas, this association is not farmed. The main limitations to use that should be considered are those related to community development. Where relatively undisturbed, the Elsinboro soils have few limitations to farming or to nonfarm uses, but drainage is a concern on the seasonally wet Delanco soils.

5. Sassafras-Fallsington-Matapeake Association

Level to gently rolling, well-drained and poorly drained, moderately coarse textured and medium-textured soils on uplands

This association occupies a broad area that extends northeastward from the Maryland State line almost to the city of Wilmington. Slopes range from 0 to 15 percent. This association makes up about 12 percent of the county.

The Sassafras soils make up about 25 percent of the association; Fallsington soils, about 25 percent; Matapeake soils, about 25 percent; and minor soils, the remaining 25 percent.

The Sassafras and Matapeake soils are well drained, and the Fallsington soils are poorly drained. The Sassafras soils have a sandy loam surface layer and a sandy clay loam subsoil. The Fallsington soils have a loam or sandy loam surface layer and a sandy clay loam subsoil. The Matapeake soils have a silt loam surface layer and a silt loam and silty clay loam subsoil. All of these major soils are underlain by sandy material.

Among the minor soils in this association are the poorly drained Elkton and Othello soils and the moderately well drained Woodstown soils.

Farming is still important on the soils of this association, though community development is considerable, particularly near Wilmington and Newark. In most places the Sassafras and Matapeake soils have only slight or moderate limitations to farming and to nonfarm uses. Because Fallsington soils are generally wet, they have moderate or severe limitations for most uses. If drained, Fallsington soils generally are more suitable for farming than for community development.

6. Matapeake-Sassafras Association

Nearly level to steep, well-drained, medium-textured and moderately coarse textured soils on uplands

This association occupies a large area that extends from New Castle southwestward through the central part of the county to the Maryland State line in the southwestern part. The soils are mainly nearly level, but they range from nearly level to steep. This association makes up about 27 percent of the county.

Matapeake soils make up about 68 percent of this association; Sassafras soils, about 17 percent; and minor soils, the remaining 15 percent.

The Matapeake and Sassafras soils are deep and well drained. The Matapeake soils have a silt loam surface layer and a silty clay loam subsoil. The Sassafras soils have a sandy loam surface layer and a sandy loam and sandy clay loam subsoil.

Among the minor soils in this association are the moderately well drained Woodstown, the poorly drained Fallsington, and the very poorly drained Johnston soils. Johnston soils are susceptible to flooding.

Farming is both intensive and extensive in this association. The potential for farming the soils in this association generally is better than that of any other in the county. Except for the slope and the hazard of erosion in some areas, the major soils have few limitations for farming and for most nonfarm uses. Only in the northeastern part of

Figure 5.—**Elsinboro-Delanco-Urban land soil association, looking northeastward from an airplane above Newark. The ridge in the background is the Piedmont uplands of the county.**

the association is there much residential and industrial expansion, though limitations to this expansion are only slight or moderate.

7. Matapeake-Sassafras-Urban Land Association

Level to gently sloping, well-drained, medium-textured and moderately coarse textured soils, relatively undisturbed to severely disturbed; on uplands

This association occupies an area between New Castle and Wilmington. It consists mainly of well-drained, level to gently sloping soils. This association makes up about 2 percent of the county.

Matapeake soils make up about 67 percent of the association, and Sassafras soils and Urban land, the remaining 33 percent.

In this association the soils are relatively undisturbed in about 10 percent of the acreage. In about 75 percent of the association there has been some cutting, filling, and grading, but not so much that the soils cannot be identified. The remaining 15 percent of the association has been so altered by man that it is called Made land.

The soils in this association are no longer cultivated, except for home gardens and other small areas. In most places limitations to use of soils for community development are slight to moderate. The Matapeake soils, however, have severe limitations for septic tank filter fields. The chief concern is controlling erosion on sloping soils where water concentrates because of man's activity.

8. Fallsington-Sassafras-Woodstown Association

Undulating, poorly drained to well-drained, medium-textured and moderately coarse textured soils on uplands

This association is in a single area in the extreme southwestern corner of the county. Here the undulating soils are marked by small sinks and by depressions that are locally called whale wallows. Between the depressions the soils are mainly nearly level, but they are more strongly sloping in a few places. This association makes up about 7 percent of the county.

Fallsington soils make up about 25 percent of the association; Sassafras soils, about 25 percent; Woodstown soils, about 25 percent; and minor soils, the remaining 25 percent.

The Fallsington soils are poorly drained, the Sassafras are well drained, and the Woodstown are moderately well drained. The Fallsington and Woodstown soils have a sandy clay loam subsoil, and the Sassafras soils have a sandy loam and sandy clay subsoil. Figure 6 shows the major soils and their underlying material.

In some areas of this association farming is intensive, but many areas of poorly drained and very poorly drained soils remain wooded and are only partly farmed. Except on the well-drained Sassafras soils, drainage improvement is the greatest need. Because they are wet in many areas, and because of their location, the soils of this association generally are not used for nonfarm purposes.

9. Sassafras-Fallsington Association

Nearly level to gently sloping, well-drained and poorly drained, moderately coarse textured and medium-textured soils on uplands

This association is in a single area in the southern part of the county. It consists mainly of nearly level, smooth soils. Slopes are more than 5 percent in only a few areas. This association makes up about 8 percent of the county.

Sassafras soils make up about 50 percent of the association; Fallsington soils, about 35 percent; and minor soils, the remaining 15 percent.

The Sassafras soils are well drained and have a sandy loam and sandy clay loam subsoil. The poorly drained Fallsington soils have a sandy clay loam subsoil.

Among the minor soils in this association are the somewhat excessively drained Rumford, the moderately well drained Woodstown, the very poorly drained Pocomoke, and the well drained Collington soils.

In this association the soils are dominantly sandy loams and are low in natural fertility, but crops on them respond well to good management. Drainage is needed on the Fallsington soils. The Sassafras soils have few limitations to nonfarm uses, but limitations are moderate or severe for most of the other soils.

10. Keyport-Elkton Association

Nearly level to gently sloping, moderately well drained and poorly drained, medium-textured soils on uplands

This association occurs in an area south of Delaware City and in a larger area near Taylors Bridge, in the southeastern corner of the county. The soils are mainly nearly level, but in a few areas they are gently sloping. Long, smooth slopes are dominant. This association makes up about 4 percent of the county.

Keyport soils make up about 43 percent of the association; Elkton soils, about 42 percent; and minor soils, the remaining 15 percent.

The Keyport and Elkton soils have a subsoil of silty clay loam and silty clay through which water moves very slowly (fig. 7). Keyport soils are moderately well drained and have a yellowish-brown subsoil that is mottled with light gray in the lower part. The poorly drained Elkton soils have a light-gray or gray subsoil mottled with yellowish brown.

The minor soils in this association are the well drained Sassafras and Matapeake, the moderately well drained Mattapex, and the very poorly drained Bayboro soils.

For all uses the chief limitation of these soils is the impeded or poor drainage caused partly by the subsoil rich in clay. Because tile does not function well in the Keyport or Elkton soils, ditches should be used for drainage. Intensive drainage practices are needed on the more nearly level Keyport soils before many kinds of crops can by grown. For hay or pasture the practices may be less intensive. On the Elkton soils some farmers grade the soil between closely spaced ditches. The more sloping Keyport soils are subject to erosion. For practically all nonfarm uses, the Keyport soils have moderate to severe limitations and the Elkton soils have severe limitations. On the Keyport and Elkton soils, limitations are severe for disposal of sewage effluent from septic tanks.

11. Aldino-Keyport-Mattapex-Urban Land Association

Level to gently sloping, moderately well drained, medium-textured soils, relatively undisturbed to severely disturbed; on uplands

This association is in the northeastern part of the county. The largest area extends from a point southwest of the city of Wilmington, through part of the city, and then northward along the Delaware River to the Pennsylvania State line. Small but important areas are near New Castle and on Pea Patch Island in the Delaware River. The soils are level to gently sloping. This association makes up about 4 percent of the county.

Aldino soils make up about 30 percent of the association; Keyport soils, about 24 percent; Mattapex soils, about 20 percent; Urban land, about 18 percent; and minor soils, the remaining 8 percent.

The Aldino, Keyport, and Mattapex soils are moderately well drained, and, in most places, have a silt loam surface layer. The Aldino soils are dominant in the area north of Wilmington, and Keyport soils, in the area south of Wilmington.

Among the minor soils in this association are the poorly drained Othello and Fallsington soils. These soils occur in the more southern areas of the association, mainly on Pea Patch Island. A few small areas of Tidal marsh are along the Delaware River in the northern part of the association.

In practically all of the association, the soils have been altered or disturbed, mainly by filling during commercial and industrial development. In most places, the fill is less

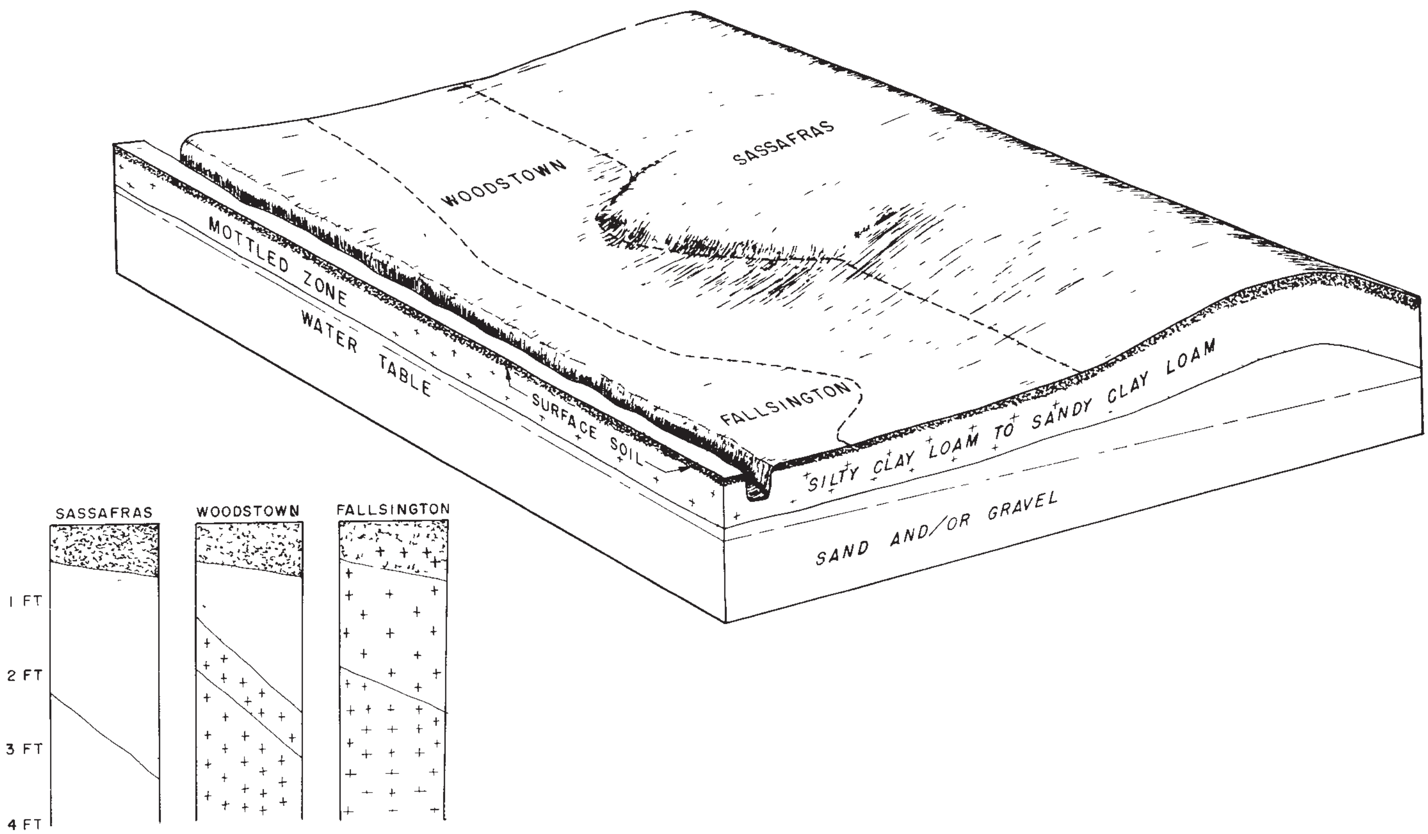

Figure 6.—**Major soils in the Fallsington-Sassafras-Woodstown soil association. The crosses represent the zone of mottling.**

than 18 inches thick and the soils can still be identified. A few areas, mostly in the southern part of the association, have not been disturbed and filled. These areas are of Othello soils. A few other areas throughout the association have been filled with material more than 18 inches thick and are called Made land.

Inadequate drainage was the main reason for filling the soils of this association. On most industrial and commercial sites, drainage by tile or ditches is still necessary so as to control the water level and, in places, to control salinity.

Farming is not important in the Aldino-Keyport-Mattapex-Urban land association.

12. Tidal Marsh Association

Marshy areas bordering the Delaware River and short tidal streams

This association occurs mostly along the Delaware River between Wilmington and the Kent County line. It is in an almost continuous strip that protrudes inland along many of the short tidal streams. The association makes up 8 percent of the county.

Almost all of this association is at sea level. The water table is at or above the surface during normal high tides, but the entire association is subject to flooding during storms and at unusually high tides. These floodwaters range from highly saline along the Delaware River to brackish in the upper reaches of the tidal streams.

Marsh vegetation covers most of this association. Tidal marsh cannot be used for crops or pasture, but it is used for wildlife and for some recreational purposes. Some areas that border the Delaware River have been filled for industrial development.

13. Urban Land Association

Areas used for streets, sidewalks, and buildings and other areas where cutting and filling have been extensive

This association occurs in a single area that includes much of the city of Wilmington and extends westward almost to Prices Corners. It consists of land used for buildings, streets, and sidewalks and of areas where soil material has been removed or the soil has been covered by fill material. Fills are commonly several feet thick. This association makes up about 2 percent of the county.

Most of this association is well drained or moderately well drained. Natural conditions are so obscured that the boundary between the rock of the Piedmont and old sediments of the Coastal Plain cannot be accurately established. In the northern part of the association, however, various kinds of bedrock are within 4 to 10 feet of the surface, except where fills are exceptionally thick. In the southern part of the association, sediments are old and thick and bedrock is at a depth of more than 10 feet.

Except for a few nurseries and home gardens, Urban land association is not farmed.

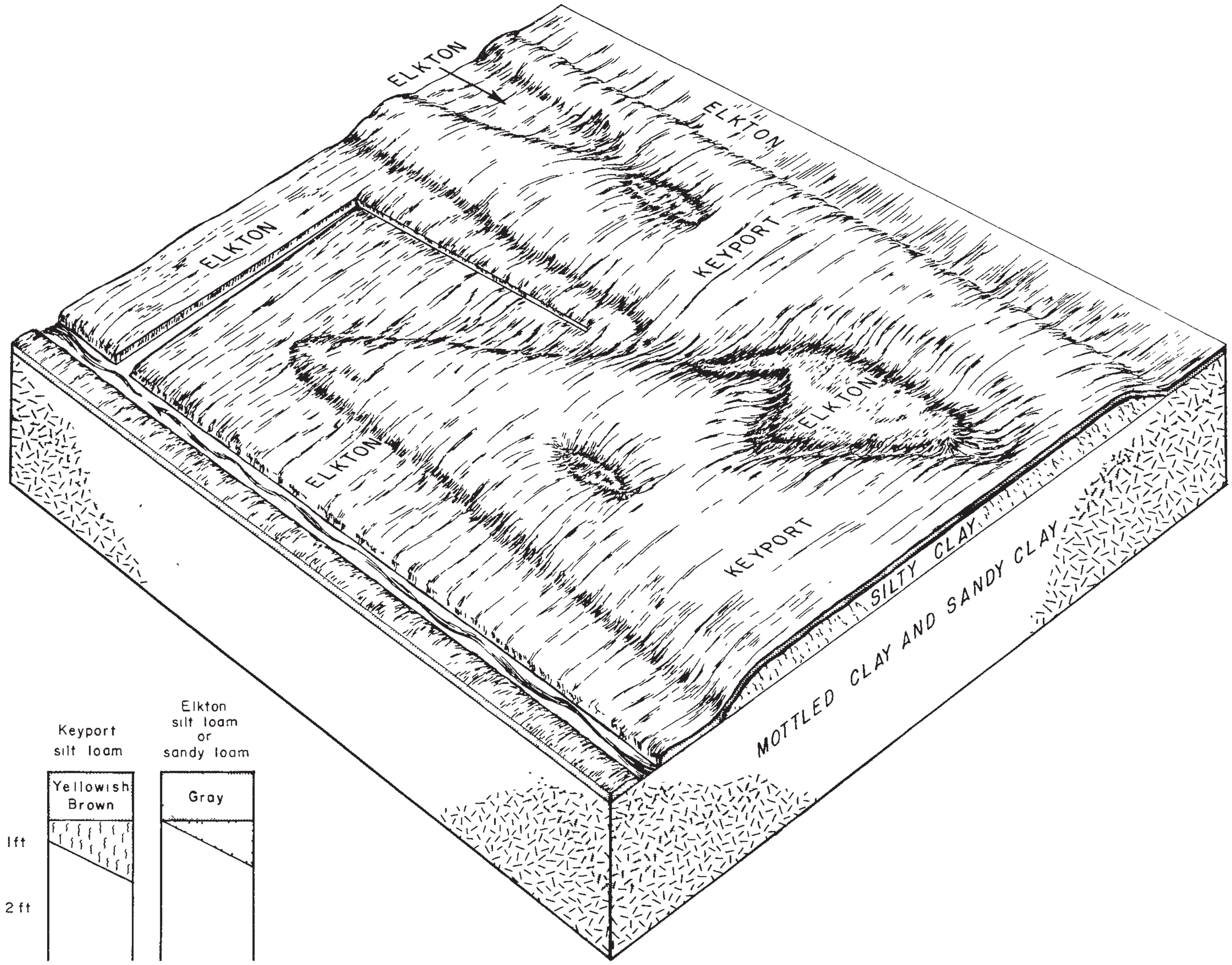

Figure 7.—**Major soils in the Keyport-Elkton soil association.**

Descriptions of the Soils

This section describes the soil series and mapping units in New Castle County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series and then the mapping units in the series. Thus, to get full information on any one mapping unit, it is necessary to read the description of the unit and also the description of the soil series to which it belongs. The description of a soil series mentions features that apply to all the soils in the series. Differences among the soils of one series are pointed out in the descriptions of the individual soils or are indicated in the soil name. Unless otherwise stated, the descriptions of all mapping units in this section are for moist soils. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. For example, Mixed alluvial land is a miscellaneous land type and does not belong to a soil series; nevertheless, it is listed in alphabetic order along with the series.

An essential part of each soil series is the description of the soil profile, the sequence of layers beginning at the surface and continuing downward to the depth beyond which roots of most plants do not penetrate. Each soil series contains a short description of a typical soil profile and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and the woodland suitability group in which the mapping unit has been placed. The pages on which each capability unit and each woodland group are described can be found by

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

Soil	Acres	Percent
Aldino silt loam, 0 to 3 percent slopes	2,037	0.7
Aldino silt loam, 3 to 8 percent slopes, moderately eroded	819	.3
Aldino-Keyport-Mattapex-Urban land complex	8,575	3.1
Bayboro silt loam	453	.2
Butlertown silt loam, 0 to 2 percent slopes	475	.2
Butlertown silt loam, 2 to 5 percent slopes, moderately eroded	791	.3
Butlertown silt loam, 5 to 10 percent slopes, moderately eroded	188	.1
Chester loam, 0 to 3 percent slopes	1,401	.5
Chester loam, 3 to 8 percent slopes, moderately eroded	5,983	2.1
Chester loam, 8 to 15 percent slopes, moderately eroded	1,597	.6
Chester loam, 8 to 15 percent slopes, severely eroded	907	.3
Chester loam, 15 to 25 percent slopes, moderately eroded	586	.2
Chester loam, 15 to 25 percent slopes, severely eroded	398	.1
Codorus silt loam	1,830	.7
Collington fine sandy loam, 2 to 5 percent slopes, moderately eroded	115	(1)
Collington fine sandy loam, 5 to 10 percent slopes, severely eroded	158	(1)
Collington fine sandy loam, 10 to 25 percent slopes, severely eroded	141	(1)
Comus silt loam	453	.2
Delanco silt loam, 0 to 3 percent slopes	547	.2
Delanco silt loam, 3 to 8 percent slopes, moderately eroded	542	.2
Elioak silt loam, 3 to 8 percent slopes, moderately eroded	280	.1
Elioak silty clay loam, 8 to 15 percent slopes, severely eroded	127	(1)
Elioak silty clay loam, 15 to 25 percent slopes, severely eroded	125	(1)
Elkton sandy loam, 0 to 2 percent slopes	694	.2
Elkton silt loam, 0 to 2 percent slopes	8,437	3.0
Elkton silt loam, 2 to 5 percent slopes	614	.2
Elsinboro silt loam, 3 to 8 percent slopes, moderately eroded	1,557	.6
Elsinboro silt loam, 8 to 15 percent slopes, moderately eroded	165	(1)
Elsinboro-Delanco-Urban land complex, 0 to 8 percent slopes	2,805	1.0
Fallsington sandy loam	10,063	3.6
Fallsington loam	16,129	5.8
Glenelg and Manor loams, 3 to 8 percent slopes, moderately eroded	7,576	2.7
Glenelg and Manor loams, 8 to 15 percent slopes, moderately eroded	7,921	2.8
Glenelg and Manor loams, 8 to 15 percent slopes, severely eroded	1,239	.4
Glenelg and Manor loams, 15 to 25 percent slopes, moderately eroded	3,960	1.4
Glenelg and Manor loams, 15 to 25 percent slopes, severely eroded	2,748	1.0
Glenelg and Manor loams, 25 to 45 percent slopes	1,994	.7
Glenville silt loam, 0 to 3 percent slopes	761	.3
Glenville silt loam, 3 to 8 percent slopes, moderately eroded	2,218	.8
Gravel pits and Quarries	788	.3
Hatboro silt loam	2,406	.9
Hatboro silt loam, local alluvium, 0 to 3 percent slopes	652	.2
Hatboro silt loam, local alluvium, 3 to 12 percent slopes	340	.1
Johnston loam	1,516	.5
Keyport silt loam, 0 to 2 percent slopes	2,982	1.1
Keyport silt loam, 2 to 5 percent slopes, moderately eroded	9,330	3.3
Keyport silt loam, 5 to 10 percent slopes, moderately eroded	874	.3
Keyport silty clay loam, 5 to 10 percent slopes, severely eroded	770	.3
Kinkora silt loam, 0 to 3 percent slopes	554	.2
Kinkora silt loam, 3 to 8 percent slopes	135	(1)
Made land and Urban land	9,178	3.3
Manor-Glenelg-Chester-Urban land complex, 0 to 8 percent slopes	1,229	.4
Matapeake silt loam, 0 to 2 percent slopes	9,642	3.4
Matapeake silt loam, 2 to 5 percent slopes, moderately eroded	45,436	16.2
Matapeake silt loam, 5 to 10 percent slopes, moderately eroded	4,084	1.5
Matapeake silt loam, 5 to 10 percent slopes, severely eroded	4,079	1.5
Matapeake silt loam, 10 to 15 percent slopes, moderately eroded	458	.2
Matapeake silt loam, 10 to 15 percent slopes, severely eroded	2,009	.7
Matapeake silt loam, silty substratum, 0 to 2 percent slopes	273	(1)
Matapeake silt loam, silty substratum, 2 to 5 percent slopes, moderately eroded	1,341	.5
Matapeake silt loam, silty substratum, 5 to 10 percent slopes, moderately eroded	214	(1)
Matapeake-Sassafras-Urban land complex, 0 to 5 percent slopes	5,303	1.9
Mattapex silt loam, 0 to 2 percent slopes	2,117	.8
Mattapex silt loam, 2 to 5 percent slopes, moderately eroded	1,062	.4
Mattapex silt loam, 5 to 10 percent slopes, moderately eroded	203	(1)
Mattapex silt loam, 5 to 10 percent slopes, severely eroded	197	(1)
Mixed alluvial land	3,702	1.3
Neshaminy and Montalto silt loams, 0 to 3 percent slopes	364	.1
Neshaminy and Montalto silt loams, 3 to 8 percent slopes, moderately eroded	2,689	1.0
Neshaminy and Montalto silt loams, 8 to 15 percent slopes, moderately eroded	568	.2
Neshaminy and Montalto silty clay loams, 8 to 15 percent slopes, severely eroded	145	(1)
Neshaminy and Montalto silty clay loams, 15 to 25 percent slopes, severely eroded	187	(1)
Neshaminy and Talleyville very stony silt loams, 3 to 35 percent slopes	684	.2
Neshaminy-Talleyville-Urban land complex, 0 to 8 percent slopes	8,399	3.0
Neshaminy-Talleyville-Urban land complex, 8 to 25 percent slopes	383	.1
Othello silt loam	3,928	1.4
Othello-Fallsington-Urban land complex	4,766	1.7
Pocomoke loam	1,161	.4
Rumford loamy sand, 2 to 5 percent slopes, moderately eroded	739	.3
Rumford loamy sand, 5 to 10 percent slopes, moderately eroded	232	(1)
Sassafras sandy loam, 0 to 2 percent slopes	280	.1
Sassafras sandy loam, 2 to 5 percent slopes, moderately eroded	4,415	1.6
Sassafras sandy loam, 5 to 10 percent slopes, moderately eroded	1,791	.6
Sassafras sandy loam, 5 to 10 percent slopes, severely eroded	1,381	.5
Sassafras sandy loam, 10 to 15 percent slopes, moderately eroded	421	.2
Sassafras sandy loam, 10 to 15 percent slopes, severely eroded	510	.2
Sassafras and Matapeake soils, 15 to 30 percent slopes	935	.3

See footnote at end of table.

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

Soil	Acres	Percent	Soil	Acres	Percent
Silty and clayey land, gently sloping	140	(1)	Watchung and Calvert silt loams, 3 to 8 percent slopes	290	0.1
Silty and clayey land, sloping	202	(1)	Woodstown sandy loam, 0 to 2 percent slopes	731	.3
Silty and clayey land, steep	237	(1)	Woodstown sandy loam, 2 to 5 percent slopes, moderately eroded	1,044	.4
Talleyville silt loam, 2 to 5 percent slopes, moderately eroded	2,510	0.9	Woodstown loam, 0 to 2 percent slopes	3,374	1.2
Talleyville silt loam, 5 to 10 percent slopes, moderately eroded	156	(1)	Woodstown loam, 2 to 5 percent slopes, moderately eroded	3,415	1.2
Tidal marsh	23,242	8.3	Total	279,680	100.0
Watchung very stony silt loam	106	(1)			
Watchung and Calvert silt loams, 0 to 3 percent slopes	1,972	.7			

[1] Less than 0.1 percent.

referring to the "Guide to Mapping Units" at the back of this soil survey.

Many terms used in the soil descriptions and other sections of this survey are defined in the Glossary at the back of this soil survey and in the "Soil Survey Manual" (*8*).

Aldino Series

The Aldino series consists of moderately well drained soils that occur on uplands in the northern part of the county. These soils developed in a thin silty mantle and underlying material that weathered mainly from serpentine. The principal native vegetation is oaks and hickory.

In a typical profile the surface layer is brown or dark-brown silt loam about 8 inches thick. The subsoil, about 28 inches thick, is yellowish-brown silty clay loam in the upper part. The lower part is a fragipan of light brownish-gray silt loam that is very dense, firm, and brittle. Water moves slowly or very slowly through this layer. Below the fragipan is disintegrated rock material overlying hard rock.

The Aldino soils are not difficult to work at a favorable content of moisture, but they tend to be wet in spring and are slow to warm. Planting is frequently delayed. Artificial drainage, particularly in the more nearly level areas, may be needed for some crops. These soils generally are fairly easy to drain with tile lines or ditches, though neither should be installed below the top of the fragipan. Although available moisture capacity is high in the Aldino soils, water does not readily penetrate the fragipan and drying is faster than for more permeable soils. The Aldino soils are well supplied with magnesium, but they may contain little calcium and other plant nutrients. Impeded drainage and a seasonal perched water table limit the use of these soils, and erosion is a hazard in the more sloping areas.

Profile of Aldino silt loam, 0 to 3 percent slopes, in an idle field, along County Route 200, about 1 mile north of Claymont:

Ap—0 to 8 inches, brown or dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable, slightly sticky; roots common; medium acid; clear, wavy boundary; horizon 6 to 9 inches thick

B2t—8 to 19 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; friable or firm, sticky and plastic; roots few to common; distinct, discontinuous clay films of yellowish brown (10YR 5/6 to 5/8); strongly acid; clear, smooth boundary; horizon 10 to 13 inches thick.

IIBx—19 to 36 inches, light brownish-gray (10YR 6/2) heavy silt loam; appears massive but has medium platy cleavage; firm and brittle, slightly sticky and slightly plastic; prominent, dark yellowish-brown (10YR 4/4) clay coats and flows; 2 to 5 percent of horizon is highly weathered, black rock fragments; very strongly acid; clear, wavy boundary; horizon 10 to 20 inches thick

IIC—36 to 48 inches +, silt loam saprolite that is mainly variegated yellowish brown (10YR 5/8) to strong brown (7.5YR 5/8) but is about 40 percent gray or light gray (10YR 6/1); firm, slightly sticky, laminar or foliar; few nearly black, partly weathered rock fragments; very strongly acid.

The surface layer, or, in cultivated areas, the plow layer ranges from almost pure silt to silt loam. The B2t horizon contains more clay than the Bx horizon. The C horizon is loam in some places The Bx and C horizons contain fragments of partly weathered serpentine in some places, but the A and B2t horizons generally are free of coarse fragments The solum ranges from about 28 to 40 inches in thickness, and depth to bedrock is 4 to 6 feet

Except for some mottles and variegations, the entire profile is commonly 10YR or 2.5Y in hue, but it is 5Y in some horizons. In undisturbed areas the A1 horizon is very thin and has a value of 3 or 4 and a chroma of 1 or 2. The A2 horizon in undisturbed areas ranges from 7 to 12 inches in thickness and is 4 or 5 in value and 2 or 3 in chroma Because the A1 horizon is so thin, the plow layer has the same color range as the A2 horizon The B2t horizon is at least 10 inches thick. It is 5 or 6 in value and 4 or lower in chroma. This horizon is not gray and does not show other evidence of wetness The matrix of the Bx horizon is 5 or 6 in value and 2 to 4 in chroma Where the chroma is 3 or 4, mottles have a chroma of 2 or lower. In some places, particularly where the hue is 7.5YR, mottles may have a high chroma. The C horizon varies more in color than the B horizon. Grayness in the C horizon is caused by restricted aeration, is inherent from the disintegrated rock material, or both. Reaction ranges from medium acid to very strongly acid, but acidity generally decreases with depth Base saturation in the lower part of the C horizon is more than 35 percent

In this county soils other than the Aldino that contain a fragipan in the lower part of the subsoil are in the Butlertown, Calvert, and Glenville series. The Aldino soils are moderately well drained but developed from the same kind of material as did the poorly drained Calvert soils The fragipan in the Aldino soils is generally more dense and compact than that of the Butlertown soils, and the Butlertown soils are deeper to bedrock Aldino soils are somewhat better drained than the highly micaceous Glenville soils and contain more bases.

Aldino silt loam, 0 to 3 percent slopes (AdA).—The surface layer of this soil is mostly silt. In most places little soil has been lost through erosion, but a few acres have been somewhat damaged. This soil has the profile described as typical for the series.

In rainy periods or when snow melts, this soil is saturated quickly because water does not run off readily. The soil remains wet for fairly long periods. Drainage can be improved by digging shallow ditches or by laying tile lines. Bedding also helps to remove excess water from cropland. Where the slope is appreciable, graded rows improve surface drainage. In many places, diversion terraces may be used to intercept water that might otherwise accumulate. (Capability unit IIw-3; woodland suitability group 12)

Aldino silt loam, 3 to 8 percent slopes, moderately eroded (AdB2).—This soil is more sloping than Aldino silt loam, 0 to 3 percent slopes, and has lost a large part of its surface layer in most areas. The fragipan, therefore, is a little nearer the surface. Although this soil is seasonally wet and slow to warm up in spring, the greatest hazard is erosion, particularly if the soil is already wet when rains are heavy. Included with this soil in mapping are some scattered spots where the subsoil is partly exposed and some small areas that have slopes of slightly more than 8 percent.

Drainage ditches are required in some areas of cropland, but diversion terraces that collect and dispose of excess water normally are more needed. (Capability unit IIe-13; woodland suitability group 12)

Aldino-Keyport-Mattapex-Urban land complex (Am).—This mapping unit is extensive and highly important in some parts of the county that are not farmed. Most of it occurs north of Wilmington between U.S. Highway No. 202 and the Delaware River. It consists of level to gently sloping Aldino, Keyport, and Mattapex soils that have been used for residential or other community purposes. The soil series can be recognized, but the soils have been disturbed so much that it is impractical to separate them on the soil map.

The three kinds of soils originally occurred in about equal proportions, but at least 50 percent of the complex has been covered with as much as 18 inches of borrow material or other fill, or has had as much as two-thirds of the original soil profile removed by cutting. About 20 to 25 percent of the complex has been covered with more than 18 inches of fill, or the soil profile has been almost entirely cut away. The remaining 30 to 35 percent of the complex has been relatively undisturbed. A profile typical for the Aldino, Keyport, and Mattapex soils is described for their respective series.

The fill materials used to cover the soils vary in texture but most commonly are silty. These materials are generally well suited to lawn grasses, ornamental shrubs, and other plants.

Except where fill materials are deep, seasonal wetness and a high water table limit suitability of this mapping unit for building sites, septic tanks, and other residential and community uses. Suitability of filled areas must be determined for each site. (Capability unit and woodland suitability group not assigned)

Bayboro Series

The Bayboro series consists of very poorly drained soils that occur in upland depressions in the southern, or Coastal Plain, part of the county. These soils developed in old deposits of clay or silty clay. The principal native vegetation is water-tolerant hardwoods, including oaks, gums, and swamp maple.

In a typical profile the surface layer is very dark brown silt loam in the upper 6 inches and black silty clay loam in the lower 10 inches. The subsoil is 14 inches thick, and it is sticky and very plastic when wet. It consists of gray silty clay that is mottled with yellowish brown and strong brown. The underlying material is gray silty clay mottled with strong brown.

The Bayboro soils are difficult to work if they are too wet or too dry. They are hard when dry but are sticky and cloddy if worked when wet. Use of heavy equipment is considerably limited when the soils are even a little too wet.

Normally, these soils are wet late in spring, and the water table is near the surface. Where natural or artificial outlets are lacking, the Bayboro soils are commonly ponded for fairly long periods. Drainage is difficult because water moves very slowly through these soils, particularly through the subsoil. Ditches are generally more suitable for drainage than tile lines because tile lines do not work well when laid in the clayey subsoil. Probably the Bayboro soils are the last ones in the county to be ready for cultivation in spring. Most areas are not cropped, except those included as parts of larger fields. Although the available moisture capacity is high, cropping is severely limited by very poor drainage and the fluctuating water table.

Profile of Bayboro silt loam, in an idle field about 2 miles west of Clayton, on County Route 47:

Ap—0 to 6 inches, very dark brown (10YR 2/2) heavy silt loam; weak, coarse, granular structure; friable, sticky and slightly plastic, roots abundant; very strongly acid, clear, wavy boundary; horizon 5 to 10 inches thick

A1—6 to 16 inches, black (10YR 2/1) light silty clay loam; moderate, coarse, granular structure and medium subangular blocky structure; firm, sticky and plastic; roots common, very strongly acid, clear, wavy boundary; horizon 8 to 10 inches thick.

B2tg—16 to 30 inches, gray (N 5/0) silty clay; common, fine and medium, distinct mottles of yellowish brown (10YR 5/4) and prominent mottles of strong brown (7.5YR 5/6); weak, medium, blocky structure; very few roots; firm, sticky and very plastic; thin but distinct clay coatings: extremely acid; gradual, wavy boundary; horizon 12 to 20 inches thick.

Cg—30 to 42 inches +, gray (N 5/0) silty clay, common, medium, prominent mottles of strong brown (7.5YR 5/6); structureless (massive); very firm, sticky and plastic; no roots; extremely acid.

The combined thickness of the Ap and A1 horizons is as much as 20 inches in some places. The Bt horizon is clay or silty clay. In most places the C horizon is clay or silty clay, but it may contain some thin lenses of sandy material and is stratified in places. Normally, no pebbles or other coarse fragments occur in the profile, but a few may occur in the C horizon. The solum generally ranges between 25 and 40 inches in thickness. Bedrock is at a great depth.

In undisturbed areas the A horizon generally is black, but the Ap horizon is very dark gray or very dark brown in a hue of 10YR The Bt horizon has the same hue The matrix of the Bt horizon is 5 to 7 in value and 0 to 2 in chroma. Mottles in the B2t horizon are 10YR in hue or redder, 5 to 7 in value, and 4 to 8 in chroma The percentage of mottles ranges from less than 10 to more than 50. The C horizon has about the same range in color as the Bt horizon. Structure in the Bt horizon ranges from weak to moderate and is mostly blocky, but in places it tends to be prismatic. The Bt horizon is sticky to very sticky and plastic to very plastic. Unlimed, these soils are strongly acid to extremely acid, and their acidity commonly increase with depth

The Bayboro soils are similar to the Pocomoke soils in natural drainage, but they are much less sandy throughout. Consequently, water moves much less readily through the Bayboro soils than through the Pocomoke soils, which are much easier to drain and to work Bayboro soils have a thick, dark surface layer like that of the Johnston soils, which occur on flood plains, but the fine-textured subsoil of the Bayboro soils is lacking in the Johnston soils The Bayboro soils formed in the same kind of fine sediments as the Elkton and Keyport soils. The Bayboro soils are more poorly drained than the Elkton soils. They are poorer drained than the Keyport soils, which are moderately well drained and have a yellowish-brown clayey subsoil that is mottled with gray in the lower part.

Bayboro silt loam (Ba).—Most of this soil is practically level and slightly depressional, but slopes are a little more than 2 percent in a few areas, particularly at the base of better drained slopes or on the rims of depressions.

Using the soil for crops is severely limited by poor drainage and the high water table. (Capability unit IIIw–9; woodland suitability group 7)

Butlertown Series

The Butlertown series consists of moderately well drained soils that are level to moderately sloping. These soils occur on uplands of the Coastal Plain, where they developed in silty to very fine sandy old sediments. The Butlertown soils are not well aerated for at least a part of the year. The native vegetation is mixed upland hardwoods, mostly oaks.

In a typical profile the surface layer is brown or dark-brown silt loam about 12 inches thick. The subsoil is about 40 inches thick. It is yellowish-brown silt loam or light silty clay loam in the upper part. The lower part is a fragipan of yellowish-red silt loam mottled with grayish brown. Water moves slowly through this layer. Below the fragipan is stratified material consisting of very fine sandy loam and silt loam.

The Butlertown soils have a surface layer that is crumbly and easy to work at a favorable content of moisture, but they tend to be somewhat wet in spring and are slow to warm. Planting of crops that are normally planted very early is sometimes slightly delayed in spring. Artificial drainage may be needed for early crops, particularly in the more nearly level areas. Where drainage is needed, the soils generally are fairly easy to drain with tile lines. Although the available moisture capacity is high, impeded drainage and seasonal wetness limit the use of these soils. Also, erosion is a hazard in sloping areas.

Profile of Butlertown silt loam, 0 to 2 percent slopes, in a cultivated field about 3 miles northwest of Delaware City, at the intersection of County Routes 46 and 378:

Ap—0 to 12 inches, brown or dark-brown (10YR 4/3) silt loam; weak, medium and coarse, granular structure; friable; many roots; medium acid (limed); clear, smooth boundary; horizon 8 to 12 inches thick

B1—12 to 22 inches, yellowish-brown (10YR 5/6) heavy silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; roots common, strongly acid; gradual, smooth boundary, horizon 8 to 10 inches thick

B2t—22 to 38 inches, yellowish-brown (10YR 5/6) light silty clay loam; weak to moderate, medium, subangular blocky structure; friable, sticky and plastic; few roots; some discontinuous clay coats; strongly acid; clear, smooth boundary; horizon 12 to 18 inches thick.

Bx—38 to 52 inches, yellowish-red (5YR 5/6) silt loam; many, medium, distinct mottles of grayish brown (10YR 5/2); weak to moderate, thin, platy structure; firm and brittle, slightly sticky and slightly plastic; dark grayish-brown (10YR 4/2) coatings of clay or silt; strongly acid; clear, smooth boundary; horizon 12 to 16 inches thick

C—52 to 60 inches +, variegated yellowish-brown and yellowish-red (10YR 5/4 and 5YR 5/8) very fine sandy loam; structureless (massive) to stratified; very friable; no roots, strongly acid.

In places the A horizon is almost pure silt The C horizon ranges from silt to very fine sand This horizon may include pockets of fine sand, and generally it is stratified. The C horizon normally contains no coarse fragments, but in places there are a few, fine, smooth pebbles. The thickness of the solum ranges from about 40 to 56 inches, and depth to the Bx horizon, or fragipan, ranges from about 30 to 38 inches Bedrock is at a great depth

In undisturbed areas the A1 horizon is thin and the A2 horizon is 4 to 8 inches thick The A1 horizon is generally dark gray (10YR 4/1). The Ap, or A2, horizon has a value of 4 to 6 and a chroma of 2 to 4 The B2t horizon has a value of 5 and a chroma of 6 to 8 In most areas the B2t horizon and the Bx horizon have a hue of 10YR or 7 5YR, but in places the hue of the Bx horizon includes 5YR. In the Bx horizon the matrix has a value of 5 or 6 and a chroma of 3 to 6, the mottles have a chroma of 1 or 2. In places the C horizon is not variegated and contains mottles of low chroma In unlimed areas the soils are medium acid to very strongly acid, and their acidity generally increases with depth

The Butlertown soils have a fragipan like that in the Aldino soils, but they are not so high in plant nutrients, particularly calcium, magnesium, and other bases The fragipan in the Butlertown soils is generally less dense and compact than that in the Aldino soils, and the Butlertown soils are deeper to bedrock than those soils The Butlertown soils are somewhat less wet than the Glenville soils, which are only about 5 to 10 feet deep to bedrock. In this county soils other than the Butlertown that formed in silty materials are the well drained Matapeake, the moderately well drained Mattapax, and the poorly drained Othello.

Butlertown silt loam, 0 to 2 percent slopes (BuA).—Most of this level soil occurs in areas that are surrounded by the Matapeake soils. This soil has the profile described as typical for the series.

There is almost no hazard of erosion, but internal drainage is slow, and planting is delayed in spring when the soil is wet. The main concern of management is the removal of seasonally excess water from the part of the soil above the fragipan. (Capability unit IIw–1; woodland suitability group 7)

Butlertown silt loam, 2 to 5 percent slopes, moderately eroded (BuB2).—This soil is more susceptible to erosion than Butlertown silt loam, 0 to 2 percent slopes. A significant amount of the original surface layer has been lost in most fields.

Stripcropping and diversion terraces help to control erosion. Strips should be graded, and waterways used for disposing of excess water should be kept in sod. Improved drainage is less necessary on this soil than on the Butlertown silt loam, 0 to 2 percent slopes, though a few ditches or tile lines may be needed in some areas. (Capability unit IIe–16; woodland suitability group 7)

Butlertown silt loam, 5 to 10 percent slopes, moderately eroded (BuC2).—This soil has lost a large amount of its original surface layer through erosion, but it is not severely damaged or limited in use. For continued safe use, however, practices are needed for controlling erosion. Care should be taken in collecting and disposing of excess water. (Capability unit IIIe–16; woodland suitability group 10)

Calvert Series

In the Calvert series are poorly drained soils that occur on upland flats and depressions on the Piedmont Plateau in the northern part of the county. These soils formed in material that weathered mainly from serpentine or similar rocks. The principal native vegetation is mixed wetland hardwoods, mostly oaks.

A typical profile has a black surface layer about 1 inch thick and a gray subsurface layer about 6 inches thick, both of silt loam that is slightly sticky when wet. The subsoil is about 23 inches thick. This layer is gray or light-gray heavy silt loam in the upper part. The lower part is a fragipan of gray light silty clay loam that is mottled with yellowish brown and strong brown. Below the fragipan is disintegrated rock material overlying hard rock.

The Calvert soils are usually difficult to work because they are so wet for long periods and are hard and cloddy in the plow layer when dry. Water moves through them very slowly, and they are quite difficult to drain, mainly because they have an impermeable fragipan in the subsoil. Although these soils have high available moisture capacity and are well supplied with nutrients, seasonal wetness and difficulty of drainage limit their use for crops. These soils are severely limited for most nonfarm uses as well. Some fields are used for grazing, but many areas are idle or still in trees.

In New Castle County the Calvert soils are not mapped separately. They were mapped only with the Watchung soils in undifferentiated units. For descriptions of these units, see the Watchung series.

Profile of a Calvert silt loam, in a cleared, but undisturbed, field just east of Brandywine:

A1—0 to 1 inch, black (5Y 2/2) silt loam; weak, fine, granular structure, friable, slightly sticky; roots plentiful; strongly acid; abrupt, smooth boundary; horizon 1 to 3 inches thick.

A2g—1 to 7 inches, gray (10YR 5/1) silt loam; weak, fine, granular structure that tends to be platy; friable, slightly sticky and slightly plastic; roots common; strongly acid, clear, wavy boundary; horizon 4 to 8 inches thick.

B2tg—7 to 18 inches, gray or light-gray (10YR 6/1) heavy silt loam; common, medium, prominent mottles of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6); moderate, medium, subangular blocky structure; friable to firm, sticky and slightly plastic, very few roots; some thin, indistinct clay coatings; strongly acid, clear, smooth boundary; horizon 9 to 12 inches thick.

Bx—18 to 30 inches, gray (10YR 5/1) light silty clay loam, common, medium, prominent mottles of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6); weak, coarse, prismatic structure and medium platy structure; firm to very firm, brittle, sticky and plastic; no roots; distinct coatings on prisms, strongly acid; gradual, wavy boundary; horizon 10 to 15 inches thick.

IICg—30 to 48 inches +, gray (10YR 5/1) silt loam; common coarse, prominent mottles of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6); structureless (massive); firm, sticky and slightly plastic; no roots; some mica flakes and fragments of rock; strongly acid to medium acid.

The B2t and Bx horizons generally are silty clay loam, but they may be heavy silt loam or silty clay in some parts. The average clay content of these horizons is less than 35 percent. The IICg horizon ranges from silt loam to silty clay; it contains mica flakes and rock fragments from the underlying rock. The fragipan or Bx horizon is generally distinct, but grades to faint in places where the texture is finer than silty clay loam. The solum ranges from 24 to 38 inches in thickness. Depth to hard rock normally is 4 to 6 feet. In a few areas, colluvial stones occur on or near the surface.

Color of the A horizon ranges from 10YR in hue to neutral. The A1 horizon ranges from gray or olive gray to black. The Ap, or A2, horizon has a value of 4 or 5 and a chroma of 0 to 2 or 3 in a few places. The matrix of the B and C horizons is 10YR to 5Y in hue, 4 to 6 in value, and 1 or 2 in chroma. Mottles in the B and C horizons are 5Y to 5YR in hue, 4 or 5 in value, and 3 to 8 in chroma. The C horizon has a slightly greenish tinge in some places, and it is generally less acid than the solum.

Other poorly drained soils in this county are the Elkton, Fallsington, Hatboro, Kinkora, Othello, and Watchung, but none of these has a fragipan in the lower part of the subsoil. The Calvert soils contain a fragipan like the Aldino soils, and they developed in the same kind of material as those soils, but the Calvert soils are more poorly drained and more difficult to work. Calvert soils occur closely with the Watchung soils, which have a finer textured, more clayey subsoil but lack a fragipan.

Chester Series

The Chester series consist of deep, nearly level to fairly steep, well-drained soils. These soils occur mostly on the summits and upper slopes of the rolling uplands in the Piedmont Plateau. They are mature soils that developed in materials weathered in place from crystalline rock. The native vegetation consists of mixed hardwoods, mostly oaks.

In a typical profile the plow layer is dark grayish-brown loam that is about 8 inches thick. The subsoil, about 37 inches thick, is dark yellowish-brown heavy loam or silt loam in the upper part, strong-brown clay loam in the middle part, and strong-brown loam or silt loam in the lower part. It is underlain by highly micaceous, disintegrated rock material overlying hard rock.

The Chester soils are easily worked at a favorable content of moisture. They warm up readily in spring and have high available moisture capacity, and they are suited to nearly all uses. Erosion is a hazard in sloping areas.

Profile of Chester loam, 0 to 3 percent slopes, in a cultivated field on the north side of County Route 53, about one-half mile west of Milford Crossroads:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; roots abundant; medium acid (limed); clear, smooth boundary, horizon 6 to 8 inches thick.

B1—8 to 18 inches, dark yellowish-brown (10YR 4/4) heavy loam or silt loam; moderate, medium, subangular blocky structure; friable to firm, sticky and slightly plastic; roots common; strongly acid: gradual, wavy boundary; horizon 4 to 10 inches thick.

B2t—18 to 28 inches, strong-brown (7.5YR 5/6) clay loam; moderate, medium, subangular blocky structure; friable to firm, sticky and plastic; few roots; thin, continuous clay coatings; mica flakes common; strongly acid, gradual, wavy boundary; horizon 8 to 10 inches thick.

B3—28 to 45 inches, strong-brown (7.5YR 5/6) loam or silt loam, weak, fine to coarse, blocky structure; friable, slightly sticky; no roots; abundant mica flakes; strongly acid; gradual, wavy boundary; horizon 10 to 17 inches thick.

C—45 to 60 inches +, loam or fine sandy loam that is highly variegated, micaceous saprolite and schistose; very friable; slightly sticky; no roots; very strongly acid.

The A horizon is loam that is very near silt loam. The B1 horizon is heavy loam, silt loam, or light silty clay loam. In most places the B2t horizon is light silty clay loam, but in some places it is heavy loam, heavy silt loam, or clay loam. The average clay content in the B2t horizon is between 18 and 35 percent. Normally, the B3 horizon is coarser textured than the B2t horizon, but its texture is finer than that of the C horizon Fragments of schist or gneiss or angular pebbles of quartzite are scattered throughout the profile but only in small amounts. The solum ranges from about 28 to 45 inches in thickness, and depth to bedrock is 5 to 10 feet or more

In undisturbed areas the A1 horizon is 1 to 3 inches thick and the A2 horizon is 6 to 12 inches thick The A1 horizon generally ranges from 10YR to 5YR in hue; it has a value of 3 and a chroma of 1 or 2 The Ap, or A2, horizon generally has a hue of 10YR or 7.5YR, a value of 4, and a chroma of 2 to 4. In the B2t horizon the hue ranges from 10YR to 5YR, the value is 4 or 5, and the chroma is 6 to 8. The C horizon normally is highly variegated, but in places one color is dominant. Unless these soils have been limed, they are strongly acid to very strongly acid Acidity commonly increases with depth.

The Chester soils are similar to the Elioak, Elsinboro, Glenelg, Glenville, Manor, Rumford, and Talleyville soils in morphology. The Glenelg and Elsinboro soils, however, are more similar to the Chester soils in characteristics The Chester soils have a thicker solum than the Glenelg soils. The Chester soils most closely resemble the Elsinboro soils, but their structure is stronger and their horizons are more distinct. Chester soils have a more clayey Bt horizon than the Elsinboro soils; they are generally less micaceous in the solum than those soils, and they lack the waterworn coarse fragments and stratification.

Chester loam, 0 to 3 percent slopes (ChA).—Most of this soil occurs on broad, nearly flat ridgetops. A profile of this soil is described as typical for the series.

Included in mapping are a few gravelly areas, which are indicated by symbol on the soil map. Also included are a few spots where the subsoil is slightly redder and stickier than normal for the Chester series.

This soil is well suited to all crops commonly grown in the county. It is nearly level, and its use for cultivated crops is not limited. (Capability unit I–4; woodland suitability group 4)

Chester loam, 3 to 8 percent slopes, moderately eroded (ChB2).—This soil, the most extensive in the Chester series, has lost a large part of the original surface layer in most areas. Included with this soil in mapping are a few severely eroded spots, some gravelly spots, and some local areas in which the subsoil is redder and stickier than normal.

Under good management, this soil can be kept in regular cultivation. Farming operations should be on the contour, if possible, and runoff should be carefully removed through sodded waterways. (Capability unit IIe–4; woodland suitability group 4)

Chester loam, 8 to 15 percent slopes, moderately eroded (ChC2).—This soil is more strongly sloping than Chester loam, 0 to 3 percent slopes, and it has lost part of its original surface layer through erosion. In some places a few shallow gullies have been cut.

Included with this soil in mapping are a few gravelly spots. Also included are a few small areas where the subsoil is redder and stickier than normal.

Because erosion is a severe hazard, intensive practices are needed if this soil is cultivated regularly. (Capability unit IIIe–4; woodland suitability group 4)

Chester loam, 8 to 15 percent slopes, severely eroded (ChC3).—This soil has lost most of its original surface layer through erosion. The present plow layer is a mixture of the original surface layer and a part of the subsoil; generally it is browner or redder, stickier, and somewhat more difficult to till than that of less eroded Chester soils. Gullies have been cut in places, and some of them are fairly deep.

Included with this soil in mapping are a few spots in which the subsoil is redder and stickier than normal.

This severely eroded soil should not be cultivated regularly. If it is used for crops, very intensive practices are needed that control soil and water losses. (Capability unit IVe–3; woodland suitability group 4)

Chester loam, 15 to 25 percent slopes, moderately eroded (ChD2).—Most of this soil remains in trees. If the wooded areas were cleared and not protected, they would be subject to severe erosion.

Included with this soil in mapping are a few small areas that are somewhat gravelly. Also included are a few spots where shallow gullies have been cut into the subsoil.

This soil should be kept in hay, pasture, sodded orchards, or other close-growing vegetation most of the time. If cultivated crops are grown, very intensive measures are needed for controlling soil losses. (Capability unit IVe–3; woodland suitability group 4)

Chester loam, 15 to 25 percent slopes, severely eroded (ChD3).—This soil is somewhat thinner in the surface layer and subsoil and is shallower to bedrock than less eroded Chester soils. Practically all of the original surface layer is gone, and in many places a large part of the subsoil has been washed away. Gullies are few to common; some of them have been cut almost to bedrock. The present plow layer consists mainly of subsoil material and is stickier, more difficult to work, and more easily eroded than the surface layer of other Chester soils. Included with this soil in mapping are a few gravelly areas.

This Chester soil is not suited to cultivated crops, but it can be safely used for hay, pasture, or sodded orchards. (Capability unit VIe–2; woodland suitability group 4)

Codorus Series

The Codorus series consists of moderately well drained soils on flood plains, mainly in the Piedmont Plateau. Some areas extend along the major streams into the northern part of the Coastal Plain. The fluctuating water table is seasonally very high, and the soils are subject to flooding at irregular intervals. The native vegetation is mixed hardwoods that are tolerant of excess moisture.

In a typical profile the surface layer is dark yellowish-brown silt loam about 11 inches thick. The subsoil is about 23 inches thick. This layer is dark-brown loam or silt loam in the upper part, dark yellowish-brown silt loam mottled with dark grayish-brown in the middle part, and dark grayish-brown silty clay loam in the lower part. Below the subsoil is silty clay loam or silt loam that includes a few thin layers of slightly sandy material. Mica flakes are common throughout the profile, especially in the underlying material.

The Codorus soils are fairly easy to work at a favorable content of moisture, but they are usually wet in spring and are fairly slow to warm. Also, they are subject to flooding, especially in spring. For these reasons, plowing and planting are frequently delayed. Artificial drainage benefits most crops, and it helps to lengthen the period of grazing on pasture. These soils generally are fairly easy to drain if outlets for tile systems or ditches are adequate. The available moisture capacity is high, and water moves through the soil readily, but not rapidly. Drainage is desirable, chiefly because it lowers the water table quickly enough in spring for cultivation. Drainage can be improved more easily in fields that are protected from flooding and from excess water running off higher lying soils.

Profile of Codorus silt loam, in a pasture on County Route 258, about 1 mile east of Ashland:

Ap—0 to 11 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, granular structure; friable slightly sticky; roots abundant; strongly acid; clear, wavy boundary; horizon 10 to 12 inches thick

B1—11 to 15 inches, dark-brown (10YR 3/3 grading toward 7.5YR 4/4) loam or silt loam; weak, medium, granular structure; friable, slightly sticky; roots plentiful; common mica flakes; strongly acid; clear, wavy boundary; horizon 3 to 6 inches thick

B2—15 to 24 inches, dark yellowish-brown (10YR 3/4) silt loam; few, medium, faint mottles of dark grayish brown (10YR 4/2); weak, medium, granular structure; friable, slightly sticky and slightly plastic; very few roots; considerable fine mica; very strongly acid; clear, wavy boundary; horizon 7 to 12 inches thick.

B3g—24 to 34 inches, dark grayish-brown (2.5Y 4/2) light silty clay loam; weak, medium, granular structure and very weak, coarse, blocky structure; friable to firm, sticky and plastic; no roots; considerable fine mica very strongly acid; clear, wavy boundary; horizon 8 to 20 inches thick

Cg—34 to 52 inches +, dark grayish-brown (2.5Y 4/2) light silty clay loam or silt loam; few thin strata of slightly more sandy material; massive; friable to firm, slightly sticky; highly micaceous; very strongly acid.

The B horizon ranges from loam to light silty clay loam but is silt loam in most places The B3 and C horizons may contain pockets or thin strata of coarser textured material In places a IIC horizon occurs below a depth of 40 inches; this horizon consists of almost any kind of water-deposited material and commonly contains many waterworn pebbles Pebbles occur throughout the profile, but are only abundant in the IIC horizon The depth to the gleyed B3g horizon is between 20 and 30 inches Depth to the C horizon is commonly greater than that shown in the typical profile. Bedrock occurs at a depth of 6 to 20 feet or more

In some places the A horizon is grayer than that described, especially if it is undisturbed The Ap horizon is 10YR or 2.5Y in hue, 3 or 4 in value, and 2 to 4 in chroma In most places the B1 and B2 horizons have a hue of 10YR or 2.5Y, but in places the hue is 7.5YR, value is 3 to 5, and chroma is 3 or 4. The B3g horizon is 2.5Y or 5Y in hue, 4 to 6 in value, and 1, 2, or rarely higher in chroma Where the chroma of the matrix is 2 or higher, mottles have a chroma of 0, 1, or 2 There may or may not be mottles of high chroma in the B2, B3, and C horizons Unlimed soils are medium acid to very strongly acid, and acidity increases with depth

The Codorus soils occur on the same flood plains as the well-drained Comus soils and the poorly drained Hatboro soils No other soils in the county are similar to the Codorus soils in drainage and susceptibility to flooding

Codorus silt loam (Co).—This soil generally is nearly level and has a smooth surface, but in some areas it is gently sloping, and in others it has a somewhat irregular or wavy surface that shows the outlines of old stream channels. Although the soil is rather extensive in the northern part of the county, it normally occurs in fairly narrow strips.

This soil is suited to many kinds of crops and is used chiefly for corn, hay, and pasture. Impeded drainage is the main limitation in areas that are protected from damaging floodwater. Where the risk of flooding is severe, cropping is strongly limited and improved pasture is the most intensive use. In places where flooding is a very severe hazard, use is limited chiefly to woodland or unimproved pasture. (Capability unit IIw-7; woodland suitability group 9)

Collington Series

In the Collington series are deep, gently sloping to moderately steep, well-drained soils. These soils developed on uplands in old marine sediments that contain moderate amounts of glauconite, or greensand. This glauconite accounts for the somewhat olive-colored subsoil that is characteristic of the Collington soils. Practically all areas have been cleared for farmland (fig. 8), though the native vegetation is mixed hardwoods, mainly oaks.

In a typical profile the plow layer is brown or dark-brown fine sandy loam about 8 inches thick. The next layer is about 7 inches thick, and it is dark yellowish-brown fine sandy loam. The subsoil, about 17 inches thick, is olive-brown fine sandy clay loam that shows visible grains of greensand. It is underlain by olive-colored, sandier material containing a considerable amount of greensand.

The Collington soils are easy to work, and they warm up rapidly in spring. They have moderate to fairly high available moisture capacity, and they are suited to nearly all uses, but erosion is a hazard in the more sloping areas.

Profile of Collington fine sandy loam, 2 to 5 percent slopes, moderately eroded, in a cultivated field on County Route 420, about 1 mile west of Port Penn:

Ap—0 to 8 inches, brown or dark-brown (10YR 4/3) fine sandy loam; weak, fine, granular structure; friable; roots abundant; strongly acid; clear, wavy boundary; horizon 8 to 10 inches thick

A2—8 to 15 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; very weak, fine, granular structure; very friable; roots plentiful; strongly acid; clear, wavy boundary; horizon 5 to 9 inches thick

B2t—15 to 32 inches, olive-brown (2.5Y 4/4) fine sandy clay loam; moderate, medium, subangular blocky structure; friable to firm, sticky and slightly plastic; roots common; some faint clay coatings; common grains of glauconite; strongly acid; clear, wavy boundary; horizon 15 to 21 inches thick

C—32 to 50 inches +, olive (5Y 4/3) light sandy loam or loamy sand; structureless (single grain); loose; no roots; 20 to 30 percent glauconite; very strongly acid

The B horizon is generally fine sandy loam, but in places it is clay loam; the average clay content is between 25 and 35 percent The C horizon ranges from light loamy sand to sandy loam, though in places it includes thin strata of clayey material. Coarse fragments generally are lacking, but there may be a few fine, smooth pebbles. In uneroded fields the solum is about 28 to 40 inches thick Where the soils have been severely eroded, the solum is generally thinner. Bedrock is at a great depth.

Hue throughout the profile ranges from 2.5Y to 7.5YR. A thin, dark A1 horizon occurs in undisturbed areas. In the rest of the solum, the value is 3 or 4, and chroma is 3, 4, or rarely 2 Glauconite gives the B and C horizons an olive to greenish tinge. The C horizon commonly has the same color range as the solum, but it may have some variegations with a chroma of more than 4 Unlimed fields are strongly acid to extremely acid, and acidity increases with depth.

Soils in the county similar to the Collington soils are those of the Matapeake, Montalto, Neshaminy, and Sassafras series. None of these soils has been significantly influenced by glauconite, and none is tinged with olive to greenish colors like the Collington soils. Collington soils most nearly resemble the Sassafras soils, but they have been influenced more by greensand and are generally less bright and red in the subsoil The solum of Collington soils is fine sandy loam and fine sandy clay loam, whereas that of the Matapeake soils is dominantly

Figure 8.—**A cultivated field of the Collington soils near Odessa. In the foreground is Collington fine sandy loam, 5 to 10 percent slopes, severely eroded. The light-colored areas are Collington fine sandy loam, 2 to 5 percent slopes, moderately eroded. In the background is Collington fine sandy loam, 10 to 25 percent slopes, severely eroded.**

silt loam and silty clay loam. The subsoil of the Collington soils is not so red as that of Montalto and Neshaminy soils, and it is sandier and less clayey Collington soils are deeper to bedrock than the Neshaminy and Montalto soils.

Collington fine sandy loam, 2 to 5 percent slopes, moderately eroded (CsB2).—Most areas of this soil have already lost a part of the original surface layer, and a few shallow gullies have been cut. This soil has the profile described as typical for the series.

This soil is well suited to most of the common crops, and it is among the soils better suited to farming in the southern part of the county. It is well drained, and its capacity for holding available moisture and nutrients is good. The risk of water erosion is moderate. Practices are needed that include contour stripcropping and winter cover crops. (Capability unit IIe–5; woodland suitability group 5)

Collington fine sandy loam, 5 to 10 percent slopes, severely eroded (CsC3).—This soil has generally lost most of its original surface layer through erosion, and in places the subsoil is exposed. A few shallow gullies have been cut. The plow layer has an olive to greenish tint and is stickier than the original surface layer.

Included with this soil in mapping are a few small areas where little or no erosion has occurred.

This soil is poorly suited to most cultivated crops, but it can be used for grazing, woodland, or other kinds of less intensive farming. (Capability unit IVe–5; woodland suitability group 18)

Collington fine sandy loam, 10 to 25 percent slopes, severely eroded (CsD3).—This soil has lost all or nearly all of its original surface layer through erosion, and the plow layer consists almost entirely of subsoil material. Shallow gullies and a few deep ones have been cut.

This soil is no longer safe for cultivation, and it should be protected by vegetative cover at all times. Suitable cover includes some kinds of hay, well-managed pasture, sodded orchards, or new plantings of trees where the soil surface is well protected. (Capability unit VIe–2; woodland suitability group 18)

Comus Series

The Comus series consists of well-drained soils on flood plains that lie on the Piedmont Plateau and extend along some of the major streams into the fringe of the Coastal Plain. The water table is usually well below the surface, but flooding is a hazard at irregular intervals. The native vegetation consists mostly of oaks and other hardwoods, but many areas have been cleared.

In a typical profile the surface layer is dark grayish-brown silt loam about 7 inches thick. The subsoil, about 35 inches thick, is brown or dark-brown silt loam in the upper part. In the lower part it is strong-brown silty clay loam. Underlying the subsoil is strong-brown fine sandy loam that is made up of stratified material. Mica flakes are common throughout the profile.

The Comus soils are fairly easy to work. Because they are well drained, they can be worked early in spring. Artificial drainage is not needed, but in some places plowing and planting should be delayed in spring until all danger of flooding is past. Also, runoff from higher areas needs to be diverted. The Comus soils have high available moisture capacity, and water moves through them readily. Crops respond well if lime and fertilizer are added. These soils are commonly used for hay and pasture, but corn and other crops grow well.

Profile of Comus silt loam, in an idle field on County Route 352, about 1 mile north of Ogletown:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable, slightly sticky; roots plentiful; strongly acid; clear, wavy boundary; horizon 4 to 7 inches thick

B21—7 to 35 inches, brown or dark-brown (7.5YR 4/4) silt loam; weak, fine, granular and moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; roots common in upper part; some fine mica flakes; very strongly acid; gradual, wavy boundary; horizon 21 to 30 inches thick.

B22—35 to 42 inches, strong-brown (7 5YR 5/6) light silty clay loam; weak, medium, subangular blocky structure; friable to firm, sticky and slightly plastic; no roots; mica flakes common; very strongly acid; abrupt, wavy boundary; horizon 5 to 9 inches thick.

IIC—42 to 50 inches +, strong-brown (7 5YR 5/6) fine sandy loam; stratified; friable; micaceous; very strongly acid.

The B2 horizon is loam, silt loam, or light silty clay loam, but differences in texture in this horizon are the result of stratification, not the internal movement of clay The IIC horizon is of any texture markedly different from the horizon above it In some places a C horizon occurs between the B22 and the IIC horizons within a depth of 5 feet; in such places the C horizon is silt loam or silty clay loam Mica flakes are generally evident throughout. Waterworn pebbles may occur in any horizon, but these are most common in the IIC horizon The solum ranges from about 30 to 42 inches in thickness, and bedrock occurs at a depth of 6 to 20 feet or more

Hue is 10YR or 7 5YR throughout the profile. In undisturbed areas, the A1 horizon is 2 to 4 inches thick; its value is mostly 3 and chroma is 1 or 2 In the Ap horizon, the value is 4 or 5 and chroma is 2 or 3. The B horizon has a value of 4 or 5 and a chroma of 4 or 6 The IIC horizon generally resembles the B22 horizon in color. Mottles are lacking in most places, but there may be some faint mottles having a low chroma at depths below about 40 inches

The Comus soils occur on the flood plains with the moderately well drained Codorus soils and the poorly drained, usually very wet Hatboro soils No other soils in the county are similar to the Comus in drainage and susceptibility to flooding.

Comus silt loam (Cu).—This soil is nearly level in most places, but it is gently sloping or moderately sloping in small areas. Except for the hazard of flooding, the soil has no limitations that affect its use. It is used mainly for hay crops, pasture, corn, and trees. Winter grain crops may be damaged by floodwater in spring. (Capability unit I-6; woodland suitability group 9)

Delanco Series

The Delanco series consists of moderately well drained soils on terraces along some of the major streams in the northern part of the county. These soils developed in material that washed from soils on uplands of the Piedmont Plateau. The native vegetation consists of mixed hardwoods, mostly oaks.

In a typical profile the surface layer is dark grayish-brown silt loam about 7 inches thick. The subsoil, about 30 inches thick, is yellowish-brown silt loam in the uppermost 5 inches, is yellowish-brown and strong-brown silty clay loam in the middle part, and is yellowish-red silt loam in the lower part. This layer is mottled with grayish brown between the depths of 23 and 36 inches. The underlying material is yellowish-red very fine sandy loam mottled with light brownish gray. This layer contains some waterworn pebbles and is micaceous.

The Delanco soils are fairly easy to work at a favorable content of moisture, but they tend to be wet in spring and are fairly slow to warm. Planting is sometimes delayed, and artificial drainage may be needed for some crops. The soils generally are fairly easy to drain. Their available moisture capacity is high.

Profile of Delanco silt loam, 0 to 3 percent slopes, in a cultivated area at Harmony Hills:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable, slightly sticky and slightly plastic; roots abundant; strongly acid; clear, smooth boundary; horizon 5 to 8 inches thick

B1—7 to 11 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic, roots plentiful; strongly acid; gradual, wavy boundary; horizon 3 to 8 inches thick

B21t—11 to 23 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure, friable, sticky and plastic; few roots; thin, discontinuous clay coats; some variegation with a higher chroma in lower 6 inches; mica flakes common; strongly acid; clear, smooth boundary; horizon 10 to 14 inches thick.

B22t—23 to 32 inches, strong-brown (7 5YR 5/6) silty clay loam; many, medium, distinct mottles of grayish brown (10YR 5/2); moderate, medium, subangular blocky structure, friable to firm, sticky and plastic; very few roots; some discontinuous clay coatings; mica flakes common; strongly acid; clear, smooth boundary; horizon 8 to 12 inches thick.

B3—32 to 36 inches, yellowish-red (5YR 4/8) heavy silt loam; many, coarse, prominent mottles of grayish-brown (10YR 5/2); moderate, coarse, subangular blocky structure, firm, slightly sticky and slightly plastic; no roots; many mica flakes; very strongly acid; clear, smooth boundary; horizon 0 to 8 inches thick.

C—36 to 50 inches +, yellowish-red (5YR 5/8) very fine sandy loam; many, coarse, prominent mottles of light brownish gray (10YR 6/2); structureless (massive); firm, slightly sticky and slightly plastic; some fine, waterworn gravel; abundant mica flakes; very strongly acid.

The B horizon is fine sandy clay loam or clay loam in some places The average clay content of the B horizon is less than 35 percent. Waterworn pebbles or cobblestones can occur in any part of the profile, but they are most common in the lower horizons. The solum ranges from about 28 to 42 inches in thickness, and depth to nonconforming bedrock is 6 to 20 feet or more.

In undisturbed areas these soils have a thin, dark-gray A1 horizon and a somewhat thicker A2 horizon. The Ap horizon ranges from 10YR to 2.5Y in hue; it is 4 or 5 in value and generally is 2 in chroma In undisturbed areas the A2 horizon ranges from 10YR to 2.5Y in hue, is 5 or 6 in value, and generally is 4 in chroma. The B2t horizon is 10YR or 7.5YR in hue, 4 to 7 in value, and 6, 8, or 4 in chroma In some places the B22t, B3, and C horizons contain so many grayish mottles that the horizon appears to be gleyed with some high-chroma mottling The C horizon and the B3 horizon, where it is present, vary in color, are friable to firm, and are moderately to highly micaceous These horizons have a hue of 5YR and a high chroma in many places In unlimed areas, reaction is strongly acid to very strongly acid; the acidity increases with depth.

The Delanco soils are similar to the Aldino, Butlertown, Keyport, Mattapex, and Woodstown soils in natural drainage. Delanco soils are much deeper to hard rock than Aldino soils and they lack the fragipan that occurs in the Aldino and Butlertown soils The Delanco soils are less silty than the Mattapex soils, are less clayey than the Keyport soils, and are less sandy than the Woodstown soils. Commonly, on the same terraces as the Delanco soils are the well-drained Elsinboro and the poorly drained Kinkora soils

Delanco silt loam, 0 to 3 percent slopes (DeA)—This soil has the profile described as typical for the series. The soil is so nearly level that it commonly stays wet for long periods, and improving drainage is the chief concern. Corn grown for silage generally does better than crops planted earlier. Because the soil is wet in winter, alfalfa and other perennial crops may be damaged by frost heaving. Runoff is slow, and erosion is only a slight hazard. (Capability unit IIw–1; woodland suitability group 7).

Delanco silt loam, 3 to 8 percent slopes, moderately eroded (DeB2).—This soil is more sloping than Delanco silt loam, 0 to 3 percent slopes, and it is not so wet for such long periods. Generally, erosion is a greater hazard than wetness. For some uses, however, artificial drainage is needed in some places.

Included with this soil in mapping are a few scattered areas that have slopes of slightly more than 8 percent and some spots where the subsoil is exposed or where shallow gullies have formed. (Capability unit IIe–16; woodland suitability group 7)

Elioak Series

The Elioak series consists of very deep, well-drained, gently sloping to steep soils that occur on uplands of the Piedmont Plateau. These soils generally occupy upper slopes or summits of hills. They developed in material that weathered in place from highly micaceous, crystalline rock. The native vegetation is mixed hardwoods, mainly oaks.

In a typical profile the surface layer is brown or dark-brown silt loam about 7 inches thick. The subsoil, about 35 inches thick, is yellowish-red silty clay loam in the upper part. The lower part is yellowish-red and red silty clay that is sticky and plastic and contains fine mica flakes. The subsoil is underlain by variegated yellowish-red and yellowish-brown, disintegrated rock material that is highly micaceous and feels slick or greasy.

Except in severely eroded areas, the Elioak soils are fairly easy to work. In severely eroded areas, however, subsoil material has been turned up through normal tillage, and the plow layer is very sticky, even if only a little wet, and is difficult to work at any moisture content. The Elioak soils warm fairly early in spring, in time for normal farming operations. They have high available moisture capacity. Slope and the hazard of erosion are the main limitations.

Profile of Elioak silt loam, 3 to 8 percent slopes, moderately eroded, in a cultivated field along County Route 324, about one-half mile east of Pleasant Hill:

Ap—0 to 7 inches, brown or dark-brown (7.5YR 4/4) silt loam; moderate, medium, granular structure; friable, slightly sticky; roots abundant; strongly acid; clear, smooth boundary, horizon 5 to 8 inches thick.

B1—7 to 12 inches, yellowish-red (5YR 4/8) silty clay loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; roots plentiful; strongly acid; clear, wavy boundary; horizon 4 to 8 inches thick.

B21t—12 to 30 inches, yellowish-red (5YR 4/8) silty clay; moderate, medium, subangular blocky structure; friable to firm, sticky and plastic; roots common; continuous clay coatings; fine mica flakes; strongly acid; clear, wavy boundary; horizon 15 to 20 inches thick.

B22t—30 to 42 inches, red (2.5YR 4/6) silty clay; moderate, medium, subangular blocky structure; firm, sticky and plastic; no roots; continuous clay coats; fine mica flakes; strongly acid; clear, wavy boundary; horizon 10 to 12 inches thick

C—42 to 54 inches +, variegated yellowish-red (5YR 4/6 and 4/8) and yellowish-brown (10YR 5/8) saprolite of fine sandy loam texture; very friable to loose; highly micaceous; strongly acid.

In New Castle County the Ap horizon normally is silt loam, but it is silty clay loam in severely eroded areas The B2t horizon is heavy silty clay loam, heavy clay loam, or silty clay. The C horizon ranges from fine sandy loam to silt loam Some fragments of mica schist commonly occur in the lower part of the solum and in the C horizon Angular pebbles of quartzite may be present in any part of the profile, but generally not in large amounts In uneroded areas the solum ranges from about 40 to nearly 60 inches in thickness. The depth to bedrock is 6 to 10 feet or more

The A horizon ranges from 10YR to 5YR in hue In undisturbed areas there is an A1 horizon 3 to 4 inches thick and an A2 horizon 4 to 8 inches thick. The A1 horizon generally has a value of 3 and a chroma of 2 or 3 The A2 horizon has a value of 4 or 5 and a chroma normally of 4 Except in severely eroded areas, the Ap horizon has a value of 4 or 5 and a chroma of 2, 3, or 4 In severely eroded areas the plow layer is generally 5YR 4/4 to 5/6 The B2t horizon centers on a hue of 2.5YR but, in some places it is 5YR, and in other places it approaches 10R In this horizon value is seldom higher than 4, and chroma is 6 or 8 In some places the C horizon has a single hue, generally 5YR or 2.5YR, but in other places the horizon is variegated and has hues between 10YR and 10R The value in the C horizon commonly is 4 or 5 and chroma ranges from 2 to 8. Variegation in the C horizon is inherent: it is not the result of wetness In unlimed areas reaction is strongly acid to extremely acid, and in most places acidity increases with depth.

The Elioak soils are similar to the Chester, Elsinboro, Glenelg, Rumford, and Talleyville soils in drainage and morphology The Elioak soils have a redder and finer textured subsoil than the Chester, Elsinboro, Glenelg, and Rumford soils Unlike the Talleyville soils, they lack a thick mantle of silty material over the red clay subsoil. The Elioak soils are similar to the Montalto soils in color and texture Elioak soils, however, are strongly acid to extremely acid, and Montalto soils are medium acid to strongly acid; generally, acidity increases with depth in the Elioak soils and decreases with depth in the Montalto soils. The Elioak soils developed over the same kind of rock as the well drained Chester, Glenelg, and Manor soils, and the moderately well drained to somewhat poorly drained Glenville soils, which have a fragipan

Elioak silt loam, 3 to 8 percent slopes, moderately eroded (EaB2).—This soil is the most extensive Elioak soil in the county. Its profile is described as typical for the series. Included in mapping are a few nearly level spots, some small, gravelly areas, and a few severely eroded spots in which shallow gullies have formed.

This soil can be cultivated regularly and is suited to many kinds of crops if practices are used to control erosion. (Capability unit IIe-4; woodland suitability group 11)

Elioak silty clay loam, 8 to 15 percent slopes, severely eroded (EkC3).—This soil has lost all or nearly all of its original surface layer through erosion. Its present surface layer consists chiefly of material that was formerly subsoil. It is dark reddish-brown or dark-red, very sticky silty clay loam. This soil is difficult to work except within a very narrow range of moisture content.

Included with this soil in mapping are some small areas that contain some gravel in the surface layer and a few spots that are only moderately eroded.

This soil can be row-cropped occasionally, but it is better suited to hay, permanent pasture, and other sod crops, and to sodded orchards. (Capability unit IVe-3; woodland suitability group 11)

Elioak silty clay loam, 15 to 25 percent slopes, severely eroded (EkD3).—This soil has lost most of its original surface soil through erosion. Because it is more strongly sloping, it is more easily eroded than Elioak silty clay loam, 8 to 15 percent slopes, severely eroded. Included in mapping are some gravelly spots and a few small areas that are not severely eroded.

This soil is better suited to trees, pasture, or other permanent cover than to cultivated crops. (Capability unit VIe-2; woodland suitability group 11)

Elkton Series

The Elkton series consists of poorly drained soils that occur on upland flats on the Coastal Plain in the southern part of the county. These soils developed in old fine-textured marine sediments. The native vegetation is mixed wetland hardwoods, including oak, gum, swamp maple, and holly.

A typical profile has a grayish-brown surface layer about 7 inches thick and a light brownish-gray subsurface layer about 7 inches thick, both of silt loam that is crumbly but is slightly sticky when wet. The subsoil is about 16 inches thick and is gray or light gray prominently mottled with yellowish brown. This layer is silty clay loam in the upper part and is very sticky silty clay in the lower part. The underlying material is gray or light-gray silty clay that extends to a depth of 4 feet or more.

The Elkton soils are not difficult to work if they are neither too wet nor too dry. They have a seasonal high water table, and artificial drainage is needed for tilled crops. The Elkton soils that have a sandy loam plow layer can be worked throughout a wider range of moisture content than those that have a silt loam plow layer. These soils normally are difficult to drain because water moves through their subsoil very slowly. Ditches generally are more satisfactory than tile, but closer spacing is required than on coarser, more readily permeable soils. The Elkton soils have moderate to high available moisture capacity. Corn and soybeans are the most commonly grown cultivated crops. Poor drainage and a high water table are the main limitations affecting use.

Profile of Elkton silt loam, 0 to 2 percent slopes, in a cultivated field along State Route 9, about 3 miles east of Blackbird:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam; weak, medium, granular structure; friable, slightly sticky; roots abundant; strongly acid; clear, smooth boundary; horizon 7 to 8 inches thick.

A2—7 to 14 inches, light brownish-gray (10YR 6/2) silt loam; weak, fine, subangular blocky structure; friable, slightly sticky; roots common; few fine mottles or specks of yellowish brown (10YR 5/8); strongly acid; clear, smooth boundary; horizon 7 to 8 inches thick.

B21tg—14 to 24 inches, light-gray or gray (10YR 6/1) heavy silty clay loam; common, medium, prominent mottles of yellowish brown (10YR 5/8); moderate, medium, subangular blocky structure; firm, sticky and plastic; few thin coatings of silt or clay; very few roots; very strongly acid; gradual, smooth boundary; horizon 10 to 14 inches thick.

B22tg—24 to 30 inches, gray or light-gray (10YR 6/1) silty clay; common, medium, prominent mottles of yellowish brown (10YR 5/8); weak, very coarse, blocky structure; firm, very sticky and very plastic; no roots; thin coatings of clay, especially in pores; very strongly acid; gradual to diffuse boundary; horizon 6 to 10 inches thick.

Cg—30 to 48 inches +, gray or light-gray (10YR 6/1) silty clay; few, medium, prominent mottles of yellowish brown (10YR 5/8); structureless (massive); very firm, very sticky and very plastic; no roots; very strongly acid.

In New Castle County the A horizon is generally silt loam, but it is sandy loam in some areas. In undisturbed areas the A1 horizon generally is not more than 2 inches thick and is very dark grayish brown or very dark gray. The B2 horizon centers on silty clay, but it ranges from heavy silty clay loam to clay and has an average clay content of more than 35 percent. In places the C horizon is not so fine textured as the B2 horizon, but it is structureless and lacks clay coatings. Generally, there are no pebbles or other coarse fragments in the Elkton soils. The solum ranges from 30 to 40 inches in thickness. Bedrock is at a great depth.

The hue throughout the profile is 10YR or yellower. The matrix of the Ap and A2 horizons is 4 to 6 in value and is 0 to 2 or, in a few places, 3 in chroma; the Ap horizon generally has the lower value. The matrix of the Bt horizon is 5 or 6 in value and 0 to 2 in chroma. Mottles in the solum range from faint to prominent, their hue is 7.5YR or yellower, and their chroma is mostly 4 to 8. In unlimed areas the profile is strongly acid to extremely acid, and acidity generally increases with depth.

In this county soils other than the Elkton that are poorly drained include the Calvert, Fallsington, Hatboro, Kinkora, Othello, and Watchung. The Elkton soils are more acid than the Calvert soils, which have a fragipan in the lower subsoil and generally are less than 6 feet deep to bedrock. Elkton soils are very similar to Fallsington and Othello soils in appearance, but their subsoil is less sandy and less permeable than that of the Fallsington soils, and they contain less silt and more clay in their subsoil than the Othello soils. The Elkton soils developed in older sediments than the Kinkora soils and they contain a smaller amount of weatherable minerals, particularly mica. Elkton soils are more strongly acid and lower in natural plant nutrients than the Watchung soils and are deeper to bedrock. They have a more clayey subsoil than the Hatboro soils, which occur on flood plains or on local accumulations of very recent sediments.

The Elkton soils developed in the same kind of material as the moderately well drained Keyport soils and the very poorly drained Bayboro soils.

Elkton sandy loam, 0 to 2 percent slopes (ElA).—This soil is subject to little or no erosion. In most respects its profile is similar to that of Elkton silt loam, 0 to 2 percent slopes, but its surface layer is sandy loam. The subsoil contains enough sand to feel gritty in some places.

Included with this soil in mapping are scattered small areas that have slopes of slightly more than 2 percent and some small areas that are moderately eroded. Also included are small depressions where the surface has been recently covered with sandy material a few inches thick. (Capability unit IIIw–11; woodland suitability group 14)

Elkton silt loam, 0 to 2 percent slopes (EmA).—This soil is extensive in the county and is important to farming. The soil is a little more difficult to drain and to work than Elkton sandy loam, 0 to 2 percent slopes. It has the profile described as typical for the series.

Large areas of this soil have been drained and are used for corn, pasture, and some kinds of truck crops. The soil is well suited to native trees. (Capability unit IIIw–9; woodland suitability group 14)

Elkton silt loam, 2 to 5 percent slopes (EmB).—This soil has fairly rapid runoff, but its internal drainage is poor. Erosion is a moderate hazard. If drainage is improved and erosion is controlled, the soil is suited to pasture and some kinds of tilled crops. Most undrained areas are still wooded. (Capability unit IIIw–9; woodland suitability group 14)

Elsinboro Series

Soils of the Elsinboro series are deep and well drained. They occur on terraces, benches, and low bluffs above the flood plains along some of the major streams in the northern part of the county, particularly along the boundary between the Piedmont Plateau and the Coastal Plain. These soils developed in old alluvium that washed mainly from areas of crystalline micaceous rocks. The native vegetation is mainly oaks but includes other kinds of hardwoods. Most areas have been cleared.

A typical profile has a brown or dark-brown surface layer about 7 inches thick and a yellowish-brown subsurface layer about 5 inches thick. Both layers are silt loam that is slightly sticky when wet. The subsoil, about 24 inches thick, is strong-brown silty clay loam in the upper part and is strong-brown silt loam in the lower part. It is slightly sticky or sticky and contains mica flakes. The underlying material is strong-brown fine sandy loam that generally is highly micaceous.

The Elsinboro soils are fairly easy to work, but they should not be worked when too wet. In spring they warm up soon enough for all normal farming operations. These soils have high available moisture capacity. Slope and the hazard of erosion limit their uses. Although they lie close to streams, they are seldom flooded.

Profile of Elsinboro silt loam, 3 to 8 percent slopes, moderately eroded, in a cultivated area along County Route 352, about 1 mile north of Ogletown:

Ap—0 to 7 inches, brown or dark-brown (10YR 4/3) silt loam; weak, medium, granular structure; friable, slightly sticky; roots abundant; strongly acid; clear, smooth boundary; horizon 6 to 10 inches thick.

A2—7 to 12 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, granular structure; friable, slightly sticky and slightly plastic; roots plentiful; strongly acid; clear, smooth boundary; horizon 4 to 8 inches thick.

B21t—12 to 24 inches, strong-brown (7.5YR 5/6) light silty clay loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; roots common; some distinct clay coats; some mica flakes; strongly acid; gradual, smooth boundary; horizon 8 to 12 inches thick.

B22t—24 to 36 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable, sticky and slightly plastic; few roots; some faint clay coatings; mica flakes common to plentiful; strongly acid; clear, wavy boundary; horizon 10 to 15 inches thick.

C—36 to 48 inches +, strong-brown (7.5YR 5/6), micaceous fine sandy loam; structureless (massive) to weakly stratified and weakly blocky; friable; no roots; very strongly acid.

The A horizon is silt loam but is very near the loam boundary. The vertical differences in texture within the B horizon appear to reflect stratification, and the horizon includes clay loam in some places. A nonconforming IIC horizon occurs below a depth of 40 inches in some places; generally it contains many waterworn pebbles. Fine pebbles and cobblestones may occur in any horizon, but they are not common in the solum. The solum ranges from about 28 to more than 40 inches in thickness. Depth to nonconforming bedrock is 6 to 20 feet or more.

The A horizon is 10YR or 7.5YR in hue. The A1, or Ap, horizon generally is 4 in value and 2 or 3 in chroma. The A2 horizon is 4 to 6 in value and normally is 4 in chroma. The B2t horizon generally is 7.5YR in hue throughout, but it is 5YR in the lower part in some places. Value in the B2t horizon is 4 or 5 and chroma is 6 or 8. A transitional B3 horizon occurs between the B2t and the C horizon in some places. The C horizon may be uniform in color or variegated. In unlimed areas the reaction ranges from strongly acid to extremely acid; acidity increases with depth.

The Elsinboro soils are similar to the Chester and Glenelg soils, but they generally are deeper to bedrock and contain waterworn pebbles throughout the profile. The Elsinboro soils lie on the same terraces as the moderately well drained Delanco soils and the poorly drained, finer textured Kinkora soils.

Elsinboro silt loam, 3 to 8 percent slopes, moderately eroded (EnB2).—In most places this soil has lost a significant amount of its original surface soil through erosion. If management is good, however, further loss of soil can be checked by fairly simple conservation practices. Diversion terraces can be used to break the long slopes, reduce runoff, and help control erosion. This soil has the profile described as typical for the series.

Included with this soil in mapping are some areas that have been cut by shallow gullies and a number of acres that have slopes of slightly less than 3 percent. (Capability unit IIe–4; woodland suitability group 11)

Elsinboro silt loam, 8 to 15 percent slopes, moderately eroded (EnC2).—This soil generally has lost a large part of its original surface layer through erosion. In places the subsoil is practically exposed, and shallow gullies have formed in some areas.

This soil should not be cultivated unless it is protected by intensive conservation practices. (Capability unit IIIe–4; woodland suitability group 11)

Elsinboro-Delanco-Urban land complex, 0 to 8 percent slopes (EuB).—This mapping unit is extensive in some parts of the county, mainly along State Route 2 between Newark and Wilmington. It consists of level to gently sloping Elsinboro and Delanco soils that have been used for residential or other community purposes. Elsinboro soils originally made up about two-thirds of the complex, and Delanco soils made up the rest. A profile typical for the Elsinboro and Delanco soils is described for their respective series.

About 40 percent of the total acreage has been relatively undisturbed. About 40 percent consists of places where as much as two-thirds of the original soil profile has been removed or has been covered with as much as 18 inches of fill material. The remaining 20 percent of the complex has been covered with more than 18 inches of fill, or the soil profile has been almost entirely cut away. Most of the fill material is silty.

The Elsinboro soils are well drained. The Delanco soils are only moderately well drained, however, and impeded drainage and seasonal wetness limit their use. Suitability of the mapping unit for specific uses must be determined for each site. (Capability unit and woodland suitability group not assigned)

Fallsington Series

The Fallsington series consists of poorly drained soils that occur on upland flats in the southern, or Coastal Plain, part of the county. These soils developed on old sandy deposits containing moderate amounts of silt and clay. The principal native vegetation is oak, holly, birch, swamp maple, and other wetland hardwoods.

In a typical profile the plow layer is dark grayish-brown loam about 11 inches thick. The subsoil is about 19 inches thick. The upper part of the subsoil is slightly sticky when wet and consists of light brownish-gray sandy clay loam mottled with yellowish brown. The lower part is gray or light-gray sandy clay loam also mottled with yellowish brown. The underlying material is much the same color as the lower part of the subsoil, but it is sandier.

The Fallsington soils are easy to work when they are not too wet, but farm operations are delayed in spring until the water table is lowered. Because water moves readily through these soils, they are not difficult to drain where outlets are adequate. Tile lines generally are more suitable for drainage than ditches because ditches tend to cave in, especially if they are dug into the sandy underlying material. The Fallsington soils have a moderate to fairly high available moisture capacity and are suited to many kinds of crops. Use for crops, however, is limited by poor drainage and the fluctuating water table. Erosion is a hazard in the more sloping areas.

Profile of Fallsington loam, in a recently cultivated idle field, just north of County Route 440 near Thomas Corners:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, granular structure; friable; roots abundant; strongly acid; clear, wavy boundary; horizon 9 to 12 inches thick.

B21tg—11 to 22 inches, light brownish-gray (10YR 6/2) light sandy clay loam; common, medium, prominent mottles of yellowish brown (10YR 5/8); moderate, medium, subangular blocky structure; friable, slightly sticky; roots common; faint clay coatings; few, fine, smooth pebbles; strongly acid; clear, smooth boundary; horizon 9 to 14 inches thick.

B22tg—22 to 30 inches, gray or light-gray (10YR 6/1) sandy clay loam; common, coarse, prominent mottles of yellowish brown (10YR 5/8); moderate, coarse, subangular blocky structure; friable to firm, sticky and plastic; few roots; some thin clay coatings; some fine, smooth pebbles; strongly acid; clear, wavy boundary; horizon 6 to 12 inches thick.

Cg—30 to 48 inches +, gray or light-gray (10YR 6/1) sandy loam; few, fine, prominent mottles of yellowish brown (10YR 5/8); structureless (massive); friable, slightly sticky; no roots; some fine, smooth pebbles; very strongly acid.

The A horizon of Fallsington soils is loam or sandy loam in New Castle County. In unplowed areas there is a thin, dark A1 horizon and a somewhat thicker A2 horizon. The B2t horizon ranges from loam or heavy sandy loam to sandy clay loam and has a content of clay between 18 and 25 percent. The C horizon is coarser in texture than the B horizon and typically is less than 18 percent clay. The solum ranges from about 24 to 38 inches in thickness. Bedrock is at a great depth.

Throughout the profile the color of the matrix ranges from 10YR in hue to neutral. The A horizon is 3 to 5 in value and 1 to 3 in chroma. Value and chroma are lowest in the A1 horizon. The matrix of the B and C horizons is 4 to 6 in value and 0 to 2 in chroma. The B and C horizons are commonly mottled with yellowish brown or light brown, but they are not mottled in some places. Unless the Fallsington soils have been limed, they are strongly acid or extremely acid. Acidity commonly increases with depth and generally is strongest in the C horizon.

Like the Fallsington soils, the Calvert, Elkton, Hatboro, Kinkora, Othello, and Watchung soils are poorly drained. Fallsington soils, however, do not have a fragipan in the lower part of the subsoil like that in the Calvert soils, and they are deeper to bedrock than the Calvert and Watchung soils. Water penetrates the Fallsington soils more readily than it does the Elkton, Kinkora, and Watchung soils. Fallsington soils contain more sand and less silt throughout the profile than the Othello soils. They lack the mica content of the Hatboro soils, which occur on flood plains. Fallsington soils formed on the same kind of material as the well drained Sassafras, the moderately well drained Woodstown, and the very poorly drained Pocomoke soils.

Fallsington sandy loam (Fa).—In most places this soil is nearly level, but in scattered areas slopes are more than 2 percent and a little soil has been lost through erosion. Also, some material has accumulated in small local dips and depressions. The plow layer of Fallsington sandy loam contains more sand and less clay than that in the profile described as typical for the series.

Drained areas of this soil are used for corn, soybeans, truck crops, hay, and pasture, and undisturbed areas remain wooded. This soil is more sandy than Fallsington loam and can be worked earlier and more easily. (Capability unit IIIw-6; woodland suitability group 7)

Fallsington loam (Fs).—Most of this soil is practically level, but slopes are slightly more than 2 percent in some areas. The more sloping areas are slightly eroded. Also, some material has washed into dips and depressions in this soil. The profile of this soil is the one described as typical for the series.

Fallsington loam, the most extensive wet soil of the uplands, is important as cropland and woodland. If drainage is adequate, this soil is well suited to most common crops, especially to corn and soybeans. It cannot, however, be worked so easily or so early in spring as Fallsington sandy loam. (Capability unit IIIw-7; woodland suitability group 7)

Glenelg Series

The Glenelg series consists of deep, well-drained, gently sloping to steep soils that occur on uplands of the Piedmont Plateau. These soils are the most extensive and most important soils for farming in the Piedmont part of the country. The native vegetation is mixed hardwoods, mainly oaks. Large areas have been cleared.

In a typical profile the surface layer is brown or dark-brown loam that is very near the boundary of silt loam and is about 10 inches thick. The subsoil is about 16 inches thick. It is yellowish-brown silt loam in the upper part and is yellowish-brown silty clay loam in the lower part. This material is sticky when wet. Below the subsoil is disintegrated rock material overlying bedrock.

The Glenelg soils are fairly easy to work. In spring they warm up soon enough for all normal farming operations. Their available moisture capacity is moderate to high. These soils are used for practically all purposes. Slope and the hazard of erosion are the main limitations.

Profile of a moderately eroded Glenelg loam having a slope of 3 to 8 percent, in an idle field along County Route 242, about 1 mile north of Mt. Cuba:

Ap—0 to 10 inches, brown or dark-brown (10YR 4/3) loam that is very near the silt loam boundary; weak, medium, granular structure; friable, slightly sticky and slightly plastic; roots plentiful; some fine mica flakes; strongly acid; clear, smooth boundary; horizon 7 to 10 inches thick.

B21t—10 to 22 inches, yellowish-brown (10YR 5/6) heavy silt loam; weak, medium, subangular blocky structure; friable, sticky and slightly plastic; roots common; some thin clay coatings; mica flakes common; strongly acid; gradual, wavy boundary, horizon 9 to 14 inches thick.

B22t—22 to 26 inches, yellowish-brown (10YR 5/6) silty clay loam, moderate, medium, subangular blocky structure; friable to firm, sticky and plastic; few roots; some distinct clay coatings; mica flakes plentiful; strongly acid; gradual, wavy boundary; horizon 4 to 10 inches thick

C—26 to 42 inches +, loam or fine sandy loam saprolite that is variegated yellowish brown (10YR 5/4 to 5/8); very friable: no roots, some fragments of highly weathered mica schist; very strongly acid

The B2t horizon ranges from heavy loam to silty clay loam and has an average clay content of 18 to 35 percent. The C horizon ranges from sandy loam to silt loam in texture In many places a few fragments of weathered mica schist occur in the profile, most commonly in the C horizon In addition, a few angular fragments of hard, white quartzite may be scattered throughout. Locally, there are a few stones. The solum ranges from about 20 to 34 inches in thickness, and the depth to bedrock is 4 to 10 feet.

The A horizon generally is 10YR in hue In undisturbed areas there is a thin A1 horizon and a somewhat thicker A2 horizon. The A horizon has a value of 3 to 5, and a chroma of 2 to 4; the lower value and chroma are in the A1 horizon. The B horizon is 7.5YR or 10YR in hue, but in some places it approaches 5YR The B horizon is 4 or 5 in value and 6 or 8 in chroma. The C horizon is uniformly colored in some places and is variegated in others, but variegation is inherent and is not the result of wetness

The Glenelg soils are similar to the Chester and the Elsinboro soils, but their solum is generally thinner The Glenelg soils developed in the same kind of weathered rock material as the Chester, Elioak, Glenville, and Manor soils They are not so fine textured as the Elioak soils. The Glenelg soils are better drained than the Glenville soils, which have a fragipan. They are not so deep to bedrock as Manor soils, and their subsoil is finer textured than the surface layer, but the Manor soils have uniform texture throughout.

Glenelg and Manor loams, 3 to 8 percent slopes, moderately eroded (GmB2).—This undifferentiated unit occurs on the Piedmont Plateau in the northern part of the county. It consists mainly of Glenelg loam, but a smaller acreage is made up of Manor loam. Any given area may be occupied by the Glenelg soil, the Manor soil, or both soils in any proportion. Each soil has the profile described as typical for its respective series. In most places a considerable amount of the original surface layer has been washed away.

Included in mapping are some gravelly areas, a few small areas that are stony, and some severely eroded spots. Also included are small areas on ridgetops where slopes are less than 3 percent.

The hazard of erosion is the main limitation that affects use of these soils for farming. (Capability unit IIe-4; woodland suitability group 4)

Glenelg and Manor loams, 8 to 15 percent slopes, moderately eroded (GmC2).—These are the most extensively farmed soils of the uplands in the northern part of the county. They are subject to a severe hazard of erosion, and if regularly cultivated, they need intensive measures for controlling soil losses. Included in areas mapped as these soils are small areas in which the plow layer is somewhat gravelly. (Capability unit IIIe-4; woodland suitability group 4)

Glenelg and Manor loams, 8 to 15 percent slopes, severely eroded (GmC3).—These soils have a plow layer that is brighter colored, slightly more sticky, and more easily eroded than that of less severely eroded Glenelg and Manor soils. Some shallow gullies and a few deep ones have formed. The soils can be used for an occasional row crop, but they are more suitable for close-growing vegetation. Small areas included in mapping have a gravelly or stony surface layer. (Capability unit IVe-3; woodland suitability group 4)

Glenelg and Manor loams, 15 to 25 percent slopes, moderately eroded (GmD2).—These soils are so steep that they are poorly suited to tilled crops and should be protected by close-growing vegetation most of the time. Hay crops, pasture, and sodded orchards are among the suitable uses. Included in mapping are a few gravelly and stony spots. (Capability unit IVe-3; woodland suitability group 11)

Glenelg and Manor loams, 15 to 25 percent slopes, severely eroded (GmD3).—These soils are too steep and too severely eroded for regular cultivation. If they are carefully managed, they are of limited use for hay, pasture, or sodded orchards. A permanent cover of plants is needed to control erosion and to promote the absorption of water from rain and melting snow. Small areas included in mapping are gravelly or stony in the surface layer. (Capability unit VIe-2; woodland suitability group 11)

Glenelg and Manor loams, 25 to 45 percent slopes (GmE).—This unit consists of the steepest soils on uplands in the northern part of the county. These soils are so steep and so erodible that they cannot be safely cultivated. A cover of trees, sod, or other protective vegetation is needed at all times. Locally, a limited amount of hay or pasture can be produced.

Included in areas mapped as these soils are small areas that are moderately or severely eroded; spots in which the subsoil is redder and more sticky than normal; small areas having a thick, silty surface layer; and a few acres where slopes are greater than 45 percent. (Capability unit VIe-2; woodland suitability group 11)

Glenville Series

The Glenville series consists of moderately well drained to somewhat poorly drained soils that have a fragipan. These soils occur in depressions around the heads of drains, and along the upper courses of drainageways on uplands in the northern part of the county. They developed in micaceous material that weathered mainly from mica schist. The native vegetation is mostly oak but includes tulip-poplar and maple. Many areas have been cleared.

In a typical profile the surface layer is brown or dark-brown silt loam about 8 inches thick. The subsoil, about 40 inches thick, is yellowish-brown silty clay loam in the uppermost 22 inches. The lower part is a fragipan of yellowish-brown silty clay loam that is very firm and brittle. Water moves slowly through this layer and light brownish-gray mottles occur at a depth of 16 inches. Below the fragipan is disintegrated material from micaceous rock that is very crumbly.

The Glenville soils are easily worked at a favorable content of moisture, but they are wet in the spring and are slow to warm. Planting is generally delayed. Artificial drainage may be needed for some crops. These soils can be drained by tile or ditches, though neither should penetrate the fragipan. The soils have moderate available moisture capacity, but movement of water through them is limited by the fragipan. These soils are limited for some uses by seasonal wetness, impeded drainage, the slow movement of water through the subsoil, the restricted depth of the root zone, and, in the more sloping areas, a hazard of erosion.

Profile of Glenville silt loam, 0 to 3 percent slopes, in a cultivated field along County Route 237, about one-half mile east of Hockessin:

Ap—0 to 8 inches, brown or dark-brown (10YR 4/3) silt loam; weak, medium, granular structure; friable, slightly sticky and slightly plastic, roots abundant; strongly acid; clear, smooth boundary; horizon 8 to 10 inches thick

B21t—8 to 16 inches, yellowish-brown (10YR 5/6) light silty clay loam; weak, medium, subangular blocky structure, friable to firm, sticky and plastic; few roots; mica flakes evident; few thin clay coats strongly acid, clear, smooth boundary; horizon 7 to 9 inches thick

B22t—16 to 30 inches, variegated yellowish-brown (10YR 5/4 to 5/8) light silty clay loam, about 10 percent of horizon contains medium, distinct mottles of light brownish gray (10YR 6/2), moderate, medium, subangular blocky structure, friable to firm, sticky and plastic; very few roots discontinuous clay coats; mica flakes common; strongly acid; clear, smooth boundary, horizon 10 to 15 inches thick

Bx1—30 to 36 inches, yellowish-brown (10YR 5/4) light silty clay loam; about 30 percent of horizon contains medium, faint to distinct mottles of light brownish gray (10YR 6/2); moderate, medium, platy structure and medium subangular blocky structure, very firm, brittle, sticky and plastic; no roots; few prominent clay coats; mica flakes common, strongly acid; clear, smooth boundary; horizon 5 to 10 inches thick

Bx2—36 to 48 inches, yellowish-brown (10YR 5/4) light silty clay loam; about 50 percent medium and coarse, faint mottles of light brownish gray (10YR 6/2); moderate thin, platy structure and subangular blocky structure, firm to very firm, sticky and plastic, no roots, few distinct clay coats, mica flakes common to abundant; strongly acid, abrupt, wavy boundary; horizon 10 to 12 inches thick

C—48 to 54 inches +, yellowish-brown (10YR 5/4), highly micaceous saprolite of silt loam texture; very friable, slightly sticky; no roots; some fragments of schist and quartzite; very strongly acid.

The B2t and Bx horizons generally are light silty clay loam or heavy silt loam, but they are heavy loam or light clay loam in some places The C horizon is fine sandy loam or loam in some places Angular fragments of schist and white quartzite can occur but generally are not abundant Locally, there are colluvial pebbles or stones on or near the surface. The solum ranges from about 40 to 50 inches in thickness Depth to bedrock is 5 to 10 feet or more.

In wooded areas these soils have a thin dark grayish-brown A1 horizon and a light yellowish-brown A2 horizon that is 5 to 8 inches thick Hue throughout the solum is generally 10YR but may be 2 5Y or rarely 7 5YR in some part The B horizon ranges from 2 to 8 in chroma The mottles are highly variable in hue, value, and chroma; the range is from N 6/0 to 5YR 4/4 or 5/6, but mottles having a chroma of 2 or less occur within 10 inches of the upper boundary of the B2t horizon Mottles that have a high chroma may or may not occur in any given profile. The color in the C horizon ranges from 2 5Y 4/4 to 10YR 6/6. In places this horizon is mottled or streaked with colors that are grayer or brighter, or both, than the range given Except in limed areas, reaction is strongly acid to very strongly acid; acidity increases with depth

In this county soils other than the Glenville that contain a fragipan are the Aldino, Butlertown, and Calvert soils. The Glenville soils are a little less well drained and less silty than the Aldino and Butlertown soils, and they are not so deep to bedrock as the Butlertown soils. Glenville soils are better drained and less silty than the Calvert soils. They developed in nearly the same kind of material as the well-drained Chester, Glenelg, Elioak, and Manor soils.

Glenville silt loam, 0 to 3 percent slopes (GnA).—This soil is only slightly susceptible to erosion, but at times its use is limited by excess water. This soil has the profile described as typical for the series. Included in mapping are a few slightly to moderately eroded areas.

In addition to measures for improving drainage, ditches or tile lines are commonly needed for diverting seepage and runoff from adjacent higher areas. If the soil is drained, it is suited to many kinds of crops. In winter, however, alfalfa and other herbaceous perennials may be damaged by frost heaving. (Capability unit IIw–3; woodland suitability group 8)

Glenville silt loam, 3 to 8 percent slopes, moderately eroded (GnB2).—This soil has more rapid runoff than Glenville silt loam, 0 to 3 percent slopes, and is more susceptible to erosion. In most areas a part of the original surface layer has been removed through erosion. In spots this layer is so thin that normal plowing turns up part of the subsoil, and a few shallow gullies have formed. Included in mapping are scattered areas that have slopes of slightly more than 8 percent.

On this soil erosion is the main concern of management, but it can be checked by ordinary practices. The soil is well suited to many kinds of crops if drainage is improved and erosion is controlled. Some herbaceous perennials may be damaged by frost heaving. (Capability unit IIe–13; woodland suitability group 8)

Gravel Pits and Quarries

Gravel pits and Quarries (Gp) are areas from which the soil has been completely removed. Some of these have been used as a source of gravel or sand, and others as a source of soil material for highway construction and other purposes. Rock has been quarried in small areas.

These pits and quarries are no longer suitable for farming, but some of them could be reclaimed and used for recreation, wildlife habitat, or other nonfarm uses. Some areas could be filled, graded, and where necessary, drained, and then planted to grasses, shrubs, or trees. Some of the pits now hold water and others could be converted into ponds. (Capability unit VIIIs–4; woodland suitability group 24)

Hatboro Series

The Hatboro series consists of deep, wet soils that occur on the Piedmont Plateau in the northern part of the county. These soils occur on flood plains and on uplands. On the uplands they lie around the head of drains, along drainageways that do not have channels, and at the foot of slopes. They developed in materials that washed from areas of micaceous rocks, and they contain a considerable amount of fine mica. The native vegetation is willow, alder, gum, and other water-tolerant hardwoods.

In a typical profile the surface layer is silt loam about 9 inches thick. It is dark brown in the upper part and is dark grayish brown in the lower part. It contains many specks of dark reddish brown, brown, or dark brown. The subsoil, about 33 inches thick, is dark grayish-brown silt loam that is mottled or splotched with dark yellowish brown and is sticky and plastic when wet. It is underlain by dark-gray, micaceous loamy fine sand.

Except for the Johnston soils on the Coastal Plain, the Hatboro soils are the wettest and most poorly drained soils in the county. At a favorable content of moisture, however, they are fairly easy to work, though wetness commonly delays plowing and planting until late in spring. On the flood plains these soils are frequently flooded after a heavy rain or a rapid thaw. Artificial drainage is needed before the soils can be used intensively, and it lengthens the time that pasture can be grazed. Water moves fairly readily, though not rapidly, through the profile. The soils are fairly easy to drain with tile lines or ditches if outlets are adequate. Flooding and a seasonal high water table are the main limitations affecting use.

Profile of Hatboro silt loam, in a cleared but unused area along County Route 221, about one-half mile east of Granogue:

A11—0 to 4 inches, dark-brown (7.5YR 3/2) silt loam; weak, medium, granular structure; friable, slightly sticky, roots plentiful, many, fine specks of dark reddish brown (5YR 3/3), this horizon apparently is overwash that was recently deposited, strongly acid; clear, smooth boundary; horizon 0 to 6 inches thick

A12—4 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, coarse, granular structure; friable, slightly sticky and slightly plastic, roots common; abundant brown or dark-brown (7.5YR 4/4) specks; this layer appears to be the original surface horizon, mica flakes common; strongly acid, clear, smooth boundary, horizon 4 to 6 inches thick

B2g—9 to 42 inches, dark grayish-brown (10YR 4/2) heavy silt loam; mottled or splotched with dark yellowish brown (10YR 4/4); weak, medium, blocky and subangular blocky structure, friable, sticky and plastic, a few roots in upper part, many mica flakes; few very fine smooth pebbles, very strongly acid; horizon 30 to 36 inches thick

IICg—42 to 48 inches +, dark-gray (5Y 4/1), micaceous loamy fine sand, structureless (single grain), loose; considerable number of fine, smooth pebbles; very strongly acid

The B2g horizon ranges from silt loam to silty clay loam; its texture may be uniform or may vary with depth. In the B2g horizon there is no evidence of clay accumulation. In places this horizon appears to have platy structure, but this is likely stratification. The texture of the IICg horizon is variable, but in most places it is coarser than that of the overlying horizons. Some waterworn pebbles may occur in any part of the profile, though locally their quantity is significant only in the IICg horizon. A few flat fragments of mica schist occur in the profile in some places. Depth to the IIC horizon generally is between 34 and 48 inches. Nonconforming bedrock is at a depth of 6 to 20 feet or more.

In cultivated areas the Ap horizon has a value of 4 or 5 and generally a chroma of 2. In some places the dark reddish-brown fine specks do not occur in the A horizon. The B2g horizon is 4, 5, or 6, in value, and the matrix is 0, 1, or 2 in chroma. The mottles generally are 10YR or redder in hue and 4 to 6 in both value and chroma, but in places some mottles are neutral gray. The IICg horizon generally is 5Y or neutral in hue, 4 to 6 in value, and 0 to 2 in chroma. Mottles of any contrasting color occur in this horizon in some places. Acidity increases with depth.

The Hatboro soils most commonly occur on flood plains with the moderately well drained Codorus and the well drained Comus soils, and they developed on the same general kind of material as those soils.

Hatboro silt loam (Ha).—This soil generally occupies lower areas and depressions on flood plains. It is nearly level in most places but is gently sloping in scattered areas. This soil has the profile described as typical for the series. Included in mapping are some spots that are somewhat eroded or scoured by fairly recent floods.

If this soil is drained and protected from floods, it is well suited to corn, hay, and improved pasture. The use of areas subject to severe flooding is limited mainly to grazing or trees. (Capability unit IIIw–7; woodland suitability group 3)

Hatboro silt loam, local alluvium, 0 to 3 percent slopes (HbA).—This soil occurs only on uplands. It lies in depressions and at the base of slopes, where soil material that washed from other areas has accumulated. To a depth of 3 to 5 feet, the profile of this soil is similar to the one described as typical for the series. This soil, however, lies over a layer of old, dark-colored material that was the surface layer of what is now a buried soil. This layer is at about the same depth as the C horizon of Hatboro silt loam, but the soil material is finer textured and less easily penetrated by water than that of the C horizon.

Artificial drainage is needed if this soil is to be cropped. Runoff and seepage from adjacent higher soils should be intercepted and diverted from some areas. (Capability unit IIIw–7; woodland suitability group 3)

Hatboro silt loam, local alluvium, 3 to 12 percent slopes (HbC).—This soil is more susceptible to erosion than less sloping Hatboro soils, but wetness is the most important concern of management. Most of the runoff comes from adjacent higher slopes. The soil occurs mainly in small areas, and much of it is used for pasture. (Capability unit IIIw–7; woodland suitability group 3)

Johnston Series

The Johnston series consists of very wet, very poorly drained soils that occur on the Coastal Plain in the southern part of the county. These soils developed in recent accumulations of both alluvial sediments and large amounts of organic matter that are on the flood plains of streams. The principal native vegetation is swamp maple, gums, holly, pond pine, and some water-tolerant oaks. Few areas of these soils are cleared.

In a typical profile the surface layer is very dark gray and very dark brown loam about 24 inches thick. This layer is very strongly acid, somewhat sticky, and is high in content of organic matter. Directly below is loose sand that is light brownish gray and extremely acid.

After the water table has been naturally or artificially lowered, the Johnston soils are easy to work. Because the surface layer has low bulk density and is highly organic, limitations may be severe to use of heavy farm implements, logging trucks, or similar equipment. Artificial drainage is needed for most uses other than woodland or wildlife, and even in drained areas, these soils are slow to warm and planting dates frequently are delayed. Outlets may be difficult to locate, but where available, these soils are not difficult to drain by tile lines or ditches. These soils are suited to corn and some other crops if drainage and flood protection are adequate. But most areas remain in trees because these soils are difficult and costly to clear and they remain wet after clearing.

Profile of Johnston loam, in a wooded area along County Route 47, about 2 miles southwest of Blackbird:

A11—0 to 11 inches, very dark gray (10YR 3/1) heavy loam; weak, medium, granular structure that tends to be blocky; friable, slightly sticky; roots abundant; very low bulk density, high organic-matter content; very strongly acid; clear, smooth boundary; horizon 10 to 12 inches thick

A12—11 to 24 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; friable, slightly sticky and slightly plastic; roots common to plentiful; a few blotches of yellowish brown (10YR 5/8); low bulk density; high organic-matter content; very strongly acid; abrupt, smooth boundary; horizon 10 to 18 inches thick

IICg—24 to 42 inches +, light brownish-gray (10YR 6/2) sand; structureless (single grain); loose; no roots; tends to flow; extremely acid

The A horizon ranges from 20 to 30 inches in thickness The IICg horizon is sand or loamy sand Bedrock is at a great depth.

The color of the A horizon ranges from 5Y to 5YR in hue to neutral It is 2 or 3 in value and 0 to 2 in chroma The IICg horizon varies in color but is always gleyed In unlimed areas the profile is very strongly acid to extremely acid, and acidity generally increases with depth

The Johnston soils are similar to the Pocomoke and Bayboro soils, but Johnston soils do not have a sandy clay loam B horizon or comparable layer like that in the Pocomoke soils nor a clay to silty clay B horizon like that in the Bayboro soils. In contrast to Johnston soils, the Pocomoke and Bayboro soils do not occur on flood plains

Johnston loam (Jo).—This soil is nearly level. Included with it in mapping are places where the surface is somewhat mucky. Also included are some areas where the surface layer is siltier or sandier than normal. In these areas sandy overwash may have been deposited recently. Also included is a soil that has a thinner or somewhat lighter colored surface layer than the one described as typical for the series. Some included areas are extremely wet and swampy.

Where stream channels have been cleared, straightened, and deepened, this soil usually can be adequately drained for crops. Lateral ditches may be needed on the wider flood plains. Few of these improvements, however, have been made in this county. (Capability unit IIIw-7; woodland suitability group 7)

Keyport Series

The Keyport series consists of deep, moderately well drained soils that occur on uplands in the Coastal Plain part of New Castle County. These soils developed in old deposits of clay or silty clay. The native vegetation is mixed hardwoods that are tolerant of excess moisture.

In a typical profile the plow layer, about 7 inches thick, is dark yellowish-brown silt loam that is slightly sticky when wet. The subsoil is about 35 inches thick. In the upper part it is sticky, yellowish-brown silty clay loam. The lower part is yellowish-brown, very sticky silty clay that is mottled with light gray. The underlying material is clay or silty clay that is much the same color as the subsoil but is variegated with yellowish red.

In most places the Keyport soils are not difficult to work if the moisture content is favorable. Plowing and other tillage are more difficult in severely eroded areas because the plow layer is sticky, gummy, and plastic when it is wet and is very hard and cloddy when it is dry. Artificial drainage may be needed for some crops, especially in the more nearly level areas. Ditches are generally more suitable than tile because the subsoil is so slowly permeable that tile lines may not function well. The high available moisture capacity allows crops to grow fairly well, but use of these soils is limited by impeded drainage, slow movement of moisture, slope, and the erosion hazard.

Profile of Keyport silt loam, 0 to 2 percent slopes, in a cultivated area on County Route 468, about 2 miles northeast of Smyrna:

Ap—0 to 7 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, granular structure; friable, slightly sticky and slightly plastic; roots plentiful; strongly acid; clear, smooth boundary; horizon 6 to 8 inches thick.

B21t—7 to 17 inches, yellowish-brown (10YR 5/6) heavy silty clay loam; moderate, medium, blocky structure; firm, sticky and plastic; roots common; thin coats of brownish-yellow (10YR 6/6) clay; strongly acid; clear, smooth boundary; horizon 10 to 12 inches thick

B22t—17 to 42 inches, yellowish-brown (10YR 5/6 to 5/8) silty clay; about 40 percent of horizon contains medium, distinct mottles of light gray (10YR 7/2); strong, coarse, blocky structure; firm, very sticky and very plastic; very few roots; distinct, yellowish-brown (10YR 5/4) clay coats; strongly acid; diffuse boundary, horizon 20 to 30 inches thick

C—42 to 60 inches +, yellowish-brown (10YR 5/6) clay or silty clay, variegated with yellowish red (5YR 4/8); common, coarse, prominent mottles of light gray (10YR 7/1); structureless (massive); very firm, very sticky and very plastic; no roots; very strongly acid

The Ap horizon of these soils generally is silt loam, but in severely eroded areas it is silty clay loam The B2t horizon ranges from heavy silty clay loam to clay and normally has an average clay content of more than 40 percent. In some places the C horizon is not so fine textured as the B horizon. The boundary between the B and C horizons is diffuse or indistinct, and the lower part of the B horizon grades almost imperceptibly into the upper part of the C horizon. In undisturbed areas the A1 horizon is 2 to 4 inches thick and the A2 horizon is 6 to 8 inches thick The solum ranges from about 36 to 50 inches in thickness. Bedrock is at a great depth

The matrix of the solum normally is 10YR or yellower in hue, but some redder hues are commonly in the C horizon and, in some places, in the lower part of the B horizon The A horizon has a value of 3 to 6 and a chroma of 1 to 4; the lower values and chromas are in the A1 horizon The B horizon has a matrix value of 5 or 6 and a chroma of 6 or greater The matrix of the C horizon may or may not be redder in hue than that of the B horizon. Mottles in the C horizon commonly have a very low choma and generally have more contrast than those in the B horizon. Unlimed Keyport soils are strongly acid to extremely acid. Acidity normally increases with depth

The Keyport soils are similar to the Delanco, Mattapex, and Woodstown soils in color and in natural drainage, but they have a clay or silty clay subsoil that is lacking in all of those soils. Keyport soils formed on the same kind of old clayey sediments as the poorly drained Elkton soils and the very poorly drained Bayboro soils.

Keyport silt loam, 0 to 2 percent slopes (KeA).—This soil has the profile described as typical for the series. Included in mapping are small areas that are moderately eroded; a few acres where the surface layer contains more sand and less silt than is normal for this soil; and small areas where the lower subsoil is redder than that of most Keyport soils. In addition, there are a few shallow gullies.

Improved surface drainage is needed for disposing of excess water on this soil, particularly early in spring. (Capability unit IIw-8; woodland suitability group 14)

Keyport silt loam, 2 to 5 percent slopes, moderately eroded (KeB2).—This soil is more susceptible to erosion than Keyport silt loam, 0 to 2 percent slopes. Shallow gullies and a few deep ones have formed. Included in mapping are some gravelly spots and small areas in which the lower subsoil is redder than normal. (Capability unit IIe-13; woodland suitability group 14)

Keyport silt loam, 5 to 10 percent slopes, moderately eroded (KeC2).—Runoff is rapid on this soil, and a few shallow gullies have been cut. If row crops are grown, intensive measures are needed for controlling erosion. Included in mapping are some gravelly spots. (Capability unit IIIe-13; woodland suitability group 14)

Keyport silty clay loam, 5 to 10 percent slopes, severely eroded (KpC3).—All or nearly all of the original surface layer has been washed from this soil. Consequently, the combined thickness of the surface layer and subsoil generally is less than 40 inches. Gullies are common, and some of them are deep. The plow layer consists mostly of material that formerly was subsoil, and it is finer textured, more sticky, and brighter colored than the original surface layer. It is difficult to work, especially when it is a little too wet or too dry.

This soil is poorly suited to tilled crops, but it can be safely used for pasture or long-term hay. (Capability unit VIe-2; woodland suitability group 10)

Kinkora Series

The Kinkora series consists of level to gently sloping, poorly drained soils that occur on benchlike terraces just above the flood plains along some of the major streams in the northern part of the county. These soils developed in old alluvial sediments that were washed primarily from areas of crystalline rocks on the Piedmont Plateau. The native vegetation is mixed hardwoods that are tolerant of excess water.

In a typical profile the surface layer is dark-gray silt loam about 8 inches thick. Below this is a subsurface layer, about 4 inches thick, that is gray silt loam and is mottled with strong brown. The subsoil, about 18 inches thick, is heavy silty clay loam that is gray in the upper part and gray or light gray in the lower part. The underlying material is gray or light-gray silt loam and fine sandy loam. Mottles of strong brown occur in the subsoil, and mottles of yellowish brown are in the upper part of the underlying material. Mica flakes are common in lower layers.

The Kinkora soils are difficult to work when too dry or too wet, and they should not be worked when the water table is near the surface. For most crops and other uses, artificial drainage is needed to lower the water table and to drain off excess water during wet periods. Improving drainage may be difficult because water moves slowly or very slowly through the fine-textured subsoil. Ditches function better than tile, but ditches must be more closely spaced than in many other soils. Although the Kinkora soils have a high available moisture capacity, their use is generally limited by poor natural drainage and by a high water table.

Profile of Kinkora silt loam, 0 to 3 percent slopes, in a wooded area just north of the railroad right-of-way, about 1 mile east of Ruthby:

A1—0 to 8 inches, dark-gray (10YR 4/1) silt loam; weak, medium, granular structure; friable, slightly sticky and slightly plastic; roots abundant; strongly acid; clear, smooth boundary; horizon 6 to 8 inches thick (This is probably an old Ap horizon that has been reforested.)

A2g—8 to 12 inches, gray (10YR 5/1) silt loam; few, fine, prominent mottles of strong brown (7.5YR 5/6); moderate, coarse, granular structure to weak, subangular blocky structure, friable to firm, slightly sticky and slightly plastic; roots plentiful; strongly acid; clear, wavy boundary; horizon 3 to 6 inches thick.

B21tg—12 to 18 inches, gray (10YR 5/1) heavy silty clay loam; common, medium, prominent mottles of strong brown (7.5YR 5/6); moderate, medium, subangular blocky structure, firm, sticky and plastic, few roots; faint, discontinuous clay coats, traces of mica; very strongly acid, clear, wavy boundary; horizon 5 to 10 inches thick.

B22tg—18 to 30 inches, gray or light-gray (10YR 6/1) heavy silty clay loam; about 40 percent has coarse, prominent mottles of strong brown (7.5YR 5/6); moderate, medium, angular blocky structure; firm, sticky and plastic, very few roots, mica flakes common, distinct clay coats, very strongly acid; clear, wavy boundary; horizon 10 to 16 inches thick

C1—30 to 36 inches, gray or light-gray (10YR 6/1) silt loam; about 20 percent medium and coarse, prominent mottles of yellowish brown (10YR 5/8) structureless (massive); friable, slightly sticky and slightly plastic; no roots, some fine waterworn pebbles; many mica flakes; very strongly acid; clear, smooth boundary; horizon 4 to 10 inches thick

IIC2g—36 to 48 inches +, gray or light-gray (10YR 6/1) fine sandy loam; structureless; friable to loose; no roots; some fine waterworn pebbles; many fine to coarse mica flakes; very strongly acid.

The B horizon generally is heavy silty clay loam but in places is heavy clay loam, silty clay, or light clay The C horizon is coarser textured than the B horizon, and the IIC horizon is markedly coarser in texture. Waterworn pebbles and cobblestones may occur anywhere in the profile but are most abundant in the C horizon. These soils are characteristically micaceous. The solum ranges from about 24 to 40 inches in thickness, and depth to nonconforming bedrock is 6 to 20 feet or more.

In all horizons the color ranges from 10YR to 5Y in hue to neutral. In areas that have never been plowed, the A1 horizon generally is thinner than that described as typical. Where the A1 horizon is very thin, it may have a value of 3. The value is normally 4 or 5 in the Ap and A2 horizons, and chroma in the entire A horizon may be 0, 1, or 2. The matrix of the B horizon has a value of 5 or 6 and a chroma of 1, 2, or rarely 0 Mottling in the B horizon is 10YR or 7.5YR in hue, 4 to 6 in value, and 4 to 8 in chroma; in some places, however, very little mottling occurs The C and IIC horizons have about the same range of matrix color as the B horizon, but commonly the C horizon is not mottled In some places the C and IIC horizons are stratified. Unlimed, the Kinkora soils are strongly acid to extremely acid, and their acidity increases with depth

The Kinkora soils are similar to the Elkton soils in many respects, but they contain a much larger quantity of weatherable minerals, particularly mica. Soils other than the Kinkora that are poorly drained include the Calvert, Elkton, Fallsington, Hatboro, Othello, and Watchung The Kinkora soils are more acid than the Calvert soils; they lack the fragipan of those soils and are 6 feet deep or more to bedrock. Kinkora soils are similar to the Fallsington and Othello soils in appearance, but the Fallsington have a subsoil of moderately permeable sandy clay loam, and the Othello have a subsoil of more silty but less clayey material. The mica flakes that characterize the Kinkora soils are missing in the Fallsington and Othello soils. The Kinkora soils are more strongly acid than the Watchung soils, and in most places they are deeper to bedrock. The Kinkora soils are more clayey in the subsoil than the Hatboro soils, which lie on flood plains or local accumulations of very recent sediments Kinkora soils occur on the same kinds of terrace formations as the well drained Elsinboro and the moderately well drained Delanco soils, but the subsoil of the Kinkora soils contains more clay and is slowly permeable.

Kinkora silt loam, 0 to 3 percent slopes (KrA).—A profile of this soil is described as typical for the series. The soil generally is not used for crops, because it is difficult and costly to drain and can be worked only within a narrow range of moisture content. Pasture is suitable, but the soil is readily puddled and compacted if it is grazed when too wet. Growth of pasture plants is excellent under good management. (Capability unit Vw–1; woodland suitability group 13)

Kinkora silt loam, 3 to 8 percent slopes (KrB).—Although this soil is subject to erosion, its use is limited mainly by poor drainage. Ditches and, in some places, diversion terraces are needed for removing excess water. Part of the original surface layer has been washed away in some areas, and measures should be used to check erosion. (Capability unit VIw–2; woodland suitability group 13)

Made Land and Urban Land

Made land and Urban land (Ma) consists of areas that have been filled with soil material, trash, or both, and it also consists of land that has been so altered or disturbed by urban works and structures that classifying the soils is no longer feasible. In many areas the original soil has been covered by 18 inches to several feet of fill material that has been hauled in or graded from higher areas. In other places, as along the Delaware River, fill material has been hydraulically pumped in behind bulkheads. In small areas the soil profile has been entirely cut away. Many areas are used mainly for buildings, sidewalks, and streets. Made land and Urban land make up the mapping unit in about equal proportions.

This mapping unit is not suitable for farming. The suitability of a given area for any use must be determined by onsite examination. (Capability unit not assigned; woodland suitability group 24)

Manor Series

The Manor series consists of gently sloping to steep, well-drained soils that occupy uplands of the Piedmont Plateau in the northern part of the county. These soils are underlain by highly micaceous material that weathered in place from the underlying bedrock of mica schist. This material extends to a great depth. The native vegetation is hardwoods, dominately oaks. Pines have invaded in some places.

A typical profile has a brown or dark-brown loam surface layer about 5 inches thick. The subsoil is about 10 inches thick and is strong-brown loam that contains many fine mica flakes. This layer is slightly sticky when wet. Below it is variegated strong-brown and yellowish-brown, decomposed, micaceous rock material that overlies bedrock.

The Manor soils are easy to work, and they warm up quickly in spring. Although they have only moderate available moisture capacity, they usually supply moisture well because the thick underlying material can store a large amount of water. Roots normally grow to a great depth. Slope and the erosion hazard are the chief limitations that affect use.

In New Castle County the Manor soils were not mapped separately. They were mapped in a complex that is described below, and they also were mapped with the Glenelg soils in undifferentiated units. For descriptions of these undifferentiated units, see the Glenelg series.

Profile of a Manor loam, in a hayfield just northeast of Newark:

Ap—0 to 5 inches, brown or dark-brown (7.5YR 4/4) loam; weak, medium and coarse, granular structure; friable; roots abundant; strongly acid; clear, smooth boundary; horizon 4 to 8 inches thick.

B2—5 to 15 inches, strong-brown (7.5YR 5/6) loam; moderate, medium, granular structure; friable, slightly sticky; many roots; many fine mica flakes; strongly acid; clear, smooth boundary; horizon 8 to 17 inches thick.

C—15 to 60 inches +, variegated strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6), highly micaceous saprolite of light loam texture; very friable; roots common in upper part; some weathered schist and some fine fragments of hard quartzite; strongly acid.

In places the C horizon is fine sandy loam. Fragments of schist and quartzite can occur anywhere in the profile. The solum ranges from about 15 to 25 inches in thickness, and depth to bedrock is 6 to 10 feet or more.

In unplowed areas the A1 horizon is thin and generally dark brown. The B horizon normally has a hue of 7.5YR or 5YR, a value of 4 or 5, and a chroma of 6 to 8. The C horizon may have bands or variegations of almost any color, but strong brown, yellowish red, yellowish brown, or weak red is dominant in most places. Variegations are inherent from the weathered rock material. They are not caused by wetness. In unlimed areas the soils are strongly acid to very strongly acid.

The Manor soils are not closely similar to any other soils of the county, particularly in depth and in the ease with which their subsoil and underlying material are penetrated by roots. The Manor soils occur with other soils that developed on micaceous rock material, among them the Chester, Glenelg, Glenville, and Elioak soils.

Manor-Glenelg-Chester-Urban land complex, 0 to 8 percent slopes (McB).—This mapping unit occurs chiefly in areas northwest of Wilmington. It consists of level to sloping Manor, Glenelg, and Chester soils that have been used for residential or other community purposes. The soil series can be recognized, but the soils have been disturbed so much that it is impractical to separate them on the soil map.

Nearly half of the complex originally was Manor soils, about one-third was Glenelg soils, and the rest was Chester soils. About 40 to 45 percent of the total acreage has had as much as two-thirds of the original soil profile removed by cutting, or has been covered by as much as 18 inches of fill material. About 25 to 35 percent consists of land where the entire profile has been cut away or where more than 18 inches of fill or grading material has been brought in. The remaining 25 to 30 percent of the complex has been relatively undisturbed.

Drainage is good, except in places where it has been modified by fill material, and wetness generally is not a limitation that affects community development. The suitability of areas covered by a large amount of fill must be determined for each site. (Capability unit and woodland suitability group not assigned)

Matapeake Series

The Matapeake series consists of deep, well-drained soils that occur on uplands of the Coastal Plain in the southern part of the county. They are the most extensive soils in the county, and they account for about one-fourth of the total acreage. The native vegetation is chiefly mixed hardwoods most of which are oaks.

In a typical profile the surface layer is brown or dark-brown silt loam about 8 inches thick. This is underlain by a subsurface layer of yellowish-brown silt loam about 3 inches thick. The subsoil is about 21 inches thick. It consists of yellowish-brown silt loam in the upper part, brown silty clay loam in the middle part, and yellowish-brown very fine sandy loam in the lower part. All of the material in this layer is slightly sticky when wet. Underlying the subsoil is yellowish-brown fine sandy loam that is very crumbly and almost loose.

The Matapeake soils are easy to work at a favorable content of moisture, and they warm up readily in spring. They have high available moisture capacity and are suited to practically all uses. Many kinds of crops can be grown, including most truck crops. Especially well suited are such crops as asparagus, for the surface layer contains very little sand. Slope and the erosion hazard are the main features that limit use.

Profile of Matapeake silt loam, 0 to 2 percent slopes, in a cultivated area on County Route 437, about 3 miles northwest of Middletown:

Ap—0 to 8 inches, brown or dark-brown (10YR 4/3) silt loam; weak, medium, granular structure; friable; many roots; medium acid (limed); clear, smooth boundary; horizon 8 to 10 inches thick

A2—8 to 11 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, granular structure; friable; many roots; medium acid; clear, smooth boundary; horizon 2 to 5 inches thick.

B1—11 to 14 inches, yellowish-brown (10YR 5/4) heavy silt loam; weak, fine, subangular blocky structure; friable, slightly sticky; roots common; strongly acid; clear, wavy boundary; horizon 0 to 3 inches thick

B2t—14 to 26 inches, brown (7.5YR 5/4) light silty clay loam; moderate, medium, subangular blocky structure; friable to firm, slightly sticky and slightly plastic; few roots; almost continuous clay coats; strongly acid; clear, wavy boundary; horizon 10 to 14 inches thick

B22t—26 to 32 inches, yellowish-brown (10YR 5/6) very fine sandy loam, weak, medium, subangular blocky structure; friable, slightly sticky; very few roots; some faint clay coatings; strongly acid; clear, wavy boundary; horizon 4 to 8 inches thick

IIC—32 to 50 inches +, yellowish-brown (10YR 5/6) light fine sandy loam; structureless (single grain), very friable; no roots; strongly acid.

The B2t horizon is of heavy silt loam, light silty clay loam, or very fine sandy loam and has an average clay content between 18 and 35 percent In places a transitional IIB3 horizon occurs between the B22t and the IIC horizons. This transitional horizon generally is loam or sandy clay loam; it has weak structure and shows thin, if any, clay films In some places a conforming C horizon, normally of silt loam texture, occurs above the IIC horizon. Some fine smooth pebbles may be present, mostly in the IIC horizon Thickness of the solum ranges from about 28 to 40 inches Bedrock is at a great depth

In hue, the A horizon is 10YR or 2 5Y. In undisturbed areas an A1 horizon, 1 to 4 inches thick, occurs with an A2 horizon that is thicker than the one described as typical. The A horizon has a value of 3 to 6 and a chroma of 2 to 4; the lowest value and chroma are in the A1 horizon; only the A2 horizon has a value of 6 in some places Hue in the B2t horizon is 7 5YR or 10YR, value is 4 or 5, and chroma is 4 to 8, but the chroma is always less than 6 in some part of the B2t horizon. The C horizon may be yellower in hue than the B2t horizon, and it may be variegated or streaked. In unlimed areas the soils are strongly acid to extremely acid, and acidity normally increases with depth.

Soils in the county that are similar to the Matapeake in morphology are the Collington, Montalto, Neshaminy, and Sassafras The Matapeake soils have a less sandy solum than the Collington and Sassafras soils, and they have not been strongly influenced by glauconite, or greensand, like the Collington soils. Matapeake soils are not so red in the subsoil as the Montalto and Neshaminy soils; their subsoil is not so fine textured and sticky; and they are deeper to bedrock The Matapeake soils are similar to the Talleyville soils in the upper part of their profile, but the Talleyville are red and highly clayey below a depth of 3 or 4 feet Matapeake soils developed in the same kind of material as the moderately well drained Butlertown and Mattapex soils and the poorly drained Othello soils.

Matapeake silt loam, 0 to 2 percent slopes (MeA)—This soil has the profile described as typical for the series. It is one of the best soils for farming in the county. If it is well managed, it has practically no hazards or limitations that affect cropping or other uses. Included in mapping are a few eroded spots. (Capability unit I–4; woodland suitability group 10)

Matapeake silt loam, 2 to 5 percent slopes, moderately eroded (MeB2)—This soil, the most extensive in New Castle County, has lost a significant amount of its original surface layer through erosion. Included with it in mapping are very small, widely scattered areas that have been gullied or otherwise severely eroded. Also included are a few uneroded areas; some of these are covered with trees. (Capability unit IIe–4; woodland suitability group 10)

Matapeake silt loam, 5 to 10 percent slopes, moderately eroded (MeC2)—This soil is more erodible than less sloping Matapeake soils. In fields that are regularly cultivated, intensive measures are needed for safely disposing of runoff and controlling erosion. (Capability unit IIIe–4; woodland suitability group 10)

Matapeake silt loam, 5 to 10 percent slopes, severely eroded (MeC3).—Most of the original surface layer has been washed from this soil, and the plow layer contains much sticky material that formerly was subsoil. Because the plow layer tends to puddle when wet and crusts as it dries, it makes a poor seedbed and is difficult to work. In addition, there are many gullies, some of which are deep. Included in mapping are spots of a soil that has a firm, brittle subsoil and is not quite so well drained as normal Matapeake soils.

This soil is suitable for hay, pasture, sodded orchards, and an occasional cultivated crop. (Capability unit IVe–3; woodland suitability group 18)

Matapeake silt loam, 10 to 15 percent slopes, moderately eroded (MeD2).—This soil is poorly suited to tilled crops, but it can be safely used for hay, pasture, or sodded orchards. In fields where crops are grown, intensively applied measures are needed for controlling erosion. Included in mapping are small areas that are wooded and uneroded, and a few acres where the lower subsoil is compact and brittle. (Capability unit IVe–3; woodland suitability group 10)

Matapeake silt loam, 10 to 15 percent slopes, severely eroded (MeD3).—This soil has lost most or all of its original surface layer through erosion. Few to many gullies have been formed, and some of them are deep. Included in mapping are a few spots in which the lower subsoil is compact and brittle.

This soil is not suitable for regular cultivation, but under good management it can be used for hay crops, pasture, or sodded orchards. (Capability unit VIe–2; woodland suitability group 18)

Matapeake silt loam, silty substratum, 0 to 2 percent slopes (MkA).—This soil has a silt loam surface layer and subsoil that range from 40 to 60 inches in total thickness, and it is underlain by material that is silty instead of fine sandy loam. Both the surface layer and subsoil contain less sand than normal Matapeake silt loams.

This soil is well suited to most crops grown in the county. It is excellent for some kinds of truck crops, such as asparagus. (Capability unit I-4; woodland suitability group 10)

Matapeake silt loam, silty substratum, 2 to 5 percent slopes, moderately eroded (MkB2).—Erosion is a hazard on this soil, and in most areas part of the original surface layer has been washed away. A few shallow gullies have been cut in some places.

This soil is well suited to most of the common crops. It is especially well suited to asparagus, spinach, and other vegetable crops in which the quality is lowered if the marketed product contains sand. Measures are needed to reduce runoff and to check soil losses. (Capability unit IIe-4; woodland suitability group 10)

Matapeake silt loam, silty substratum, 5 to 10 percent slopes, moderately eroded (MkC2).—The surface layer and subsoil of this soil are thicker than those of normal Matapeake soils, and the underlying material is silty. In fields that are regularly cultivated, intensive measures are needed for disposing of runoff and controlling erosion. (Capability unit IIIe-4; woodland suitability group 10)

Matapeake-Sassafras-Urban land complex, 0 to 5 percent slopes (MsB).—This mapping unit consists of Matapeake and Sassafras soils that have been used for residential and other community purposes in areas just south and southwest of Wilmington. Although the soils can be identified by series, it is impractical to separate them on the soil map.

More than two-thirds of the complex originally was Matapeake soils, and the rest was Sassafras soils. About 75 percent of the total acreage has been covered with as much as 18 inches of fill or grading material, or has had as much as two-thirds of the original soil profile removed by grading or leveling. About 15 percent of the complex has been covered with more than 18 inches of fill, or the soil profile has been almost entirely cut away. The remaining 10 percent has been relatively undisturbed. A profile typical for the Matapeake and Sassafras soils is described for their respective series.

The fill material used to cover the soils is chiefly sandy loam or silt loam in texture. Except where this material is deep, drainage is good and wetness does not limit suitability of the mapping unit for building sites and other residential and community uses. Suitability of deeply filled areas must be determined for each site. (Capability unit and woodland suitability group not assigned)

Mattapex Series

In the Mattapex series are deep, moderately well drained soils that lie on the Coastal Plain. Here, they developed in silty material underlain by older, coarser textured sediments. The native vegetation is mostly water-tolerant hardwoods, dominantly oaks.

A typical profile has a surface layer of dark grayish-brown silt loam about 9 inches thick, and a subsurface layer of yellowish-brown silt loam about 3 inches thick. The subsoil, about 36 inches thick, is dark yellowish-brown and yellowish-brown silt loam in the upper part. In the lower part this layer is brown or dark-brown silty clay loam that contains distinct mottles of light brownish gray and grayish brown. Below the subsoil is yellowish-brown sandy loam.

The Mattapex soils are fairly easy to work, but they may not dry and warm soon enough in spring for early planting. Artificial drainage is needed for some crops, especially in the more nearly level areas. If outlets are adequate, however, the soils are not difficult to drain by ditching or tiling. Ditches should not penetrate into the sandy material beneath the subsoil. These soils have high available moisture capacity, but some uses are limited by seasonal wetness and impeded drainage. Erosion is a hazard in sloping areas.

Profile of Mattapex silt loam, 0 to 2 percent slopes, in a cultivated area on County Route 343, about 1½ miles southeast of Christiana:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable, slightly sticky; many roots; medium acid (limed); clear, smooth boundary: horizon 8 to 10 inches thick.

A2—9 to 12 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, granular structure; friable, slightly sticky; roots common; strongly acid to medium acid; gradual, smooth boundary; horizon 2 to 5 inches thick.

B1—12 to 15 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; very weak, medium, subangular blocky structure; friable, slightly sticky; few roots; strongly acid; gradual, smooth boundary; horizon 2 to 5 inches thick

B21t—15 to 26 inches, yellowish-brown (10YR 5/6) heavy silt loam that is variegated with brown or dark brown (7.5YR 4/4) in lower part; moderate, medium, subangular blocky structure; friable, slightly sticky; few roots; faint to distinct, dark yellowish-brown (10YR 4/4), discontinuous clay coats; strongly acid; clear, smooth boundary; horizon 10 to 11 inches thick.

B22t—26 to 32 inches, brown or dark-brown (7.5YR 4/4) light silty clay loam; common, medium, distinct mottles of light brownish-gray (2.5Y 6/2); moderate, medium and coarse, subangular blocky structure; friable to firm, slightly sticky and slightly plastic; no roots; distinct but discontinuous, dark yellowish-brown (10YR 4/4) clay coats; strongly acid; gradual, smooth boundary; horizon 6 to 8 inches thick

B23t—32 to 48 inches, brown or dark-brown (7.5YR 4/4) light silty clay loam; common, fine, distinct and a few, coarse, distinct mottles of grayish brown (10YR 5/2); moderate, coarse, subangular blocky structure that tends to be platy; friable to firm, slightly sticky and slightly plastic; no roots; distinct but discontinuous clay coats that are dark yellowish brown (10YR 4/4); finer textured material in old large root channels; some smooth gravel; strongly acid; abrupt, wavy boundary; horizon 0 to 18 inches thick

IIC—48 to 54 inches +, yellowish-brown (10YR 5/8) coarse sandy loam; structureless (massive); friable; no roots; some smooth gravel; strongly acid to very strongly acid.

The B2t horizon is heavy silt loam or light silty clay loam and has an average clay content between 18 and 35 percent. In some places the B23t horizon is missing, and in others it is replaced by a B3 horizon that has structure but lacks discernible clay coatings. Above the IIC horizon, there may be a conforming C horizon, generally of silt loam texture. Some smooth pebbles occur in places, most commonly in the IIC horizon. The solum normally ranges from 28 to 42 inches in thickness, exclusive of the B23t horizon, which may not be present. Bedrock is at a great depth.

The hue of the matrix in the profile centers on 10YR but includes 2.5Y and ranges to 7.5YR in some places In undisturbed areas there is a thin, dark A1 horizon and an A2 horizon thicker than that described In the A horizon, value is 3 to 5 and chroma is 1 to 4; the lower value and chroma are in the A1 horizon In the B horizon the matrix has a value of 4 or 5 and a chroma of 3 to 6, but a chroma of less than 6 always is present in some part of the B2t horizon. The chroma of the mottles may be either high or low, but no mottling occurs with a chroma of 2 or less in the upper 10 inches of the B2t horizon Such grayish mottling occurs, however, somewhere within the second 10 inches of this horizon The C horizon may or may not be mottled with either a low or a high chroma Unlimed, these soils are strongly acid to extremely acid. Acidity normally increases with depth.

The Mattapex soils are similar to the Delanco, Keyport, and Woodstown soils in morphology. The Mattapex soils are more silty throughout the solum than the Delanco and Woodstown soils, and they lack the clay or silty clay subsoil of the Keyport soils. Similar to Mattapex soils in drainage are the moderately well drained Aldino and Butlertown soils, which have a fragipan in the lower part of their subsoil. The Mattapex soils developed in the same kind of silty material as the well drained Matapeake soils, the moderately well drained Butlertown soils, which have a fragipan, and the poorly drained Othello soils.

Mattapex silt loam, 0 to 2 percent slopes (MtA).—This soil has the profile described as typical for the series. Except for impeded drainage, there are few or no limitations that affect use and management. Removing excess water from the surface and lowering the water table in spring are the main concerns. A few acres included in mapping are eroded. (Capability unit IIw–1; woodland suitability group 14)

Mattapex silt loam, 2 to 5 percent slopes, moderately eroded (MtB2).—This soil has better surface drainage than Mattapex silt loam, 0 to 2 percent slopes, but its internal drainage is impeded and results in seasonal wetness. Erosion is a hazard, and a significant part of the original surface layer has been lost. Included in mapping are a few severely eroded spots and some gullies.

If this soil is cropped, it needs the protection of measures that control erosion. (Capability unit IIe–16; woodland suitability group 14)

Mattapex silt loam, 5 to 10 percent slopes, moderately eroded (MtC2).—This soil is highly susceptible to erosion, but it also is seasonally wet and requires improved drainage for some uses. In fields that are cropped, measures are needed that control soil losses. (Capability unit IIIe–16; woodland suitability group 14)

Mattapex silt loam, 5 to 10 percent slopes, severely eroded (MtC3).—Most of the original surface layer has been eroded from this soil, and some gullies have been formed. Plowing to normal depth is in material that was subsoil. Because the soil is highly erodible, it is unsuitable for continuous cultivation and is more safely used for hay or improved pasture. Although seasonal wetness is a limitation, artificial drainage is not needed for hay and pasture. Included in mapping are a few acres where slopes are a little more than 10 percent. (Capability unit IVe–9; woodland suitability group 10)

Mixed Alluvial Land

Mixed alluvial land (Mv) occurs on flood plains, mainly on the Coastal Plain in the southern part of the county. It is flooded at least once a year in most areas, and flooding lasts for long periods in some places. Drainage generally is poor, but there are some spots that are better drained. The soil material lacks distinct or uniform characteristics and cannot be identified. Within short distances the texture throughout the profile ranges from sand to loam or silt loam to clay in texture, and in some areas it is gravelly. The surface layer is mainly light gray or dark gray, but it is black in places where much organic matter has accumulated.

Because this land is variable and commonly wet, it is little if ever used for farm crops. Most areas are wooded, but some have been cleared or partly cleared and are used for unimproved pasture. (Capability unit VIw-1; woodland suitability group 7)

Montalto Series

The Montalto series consists of well-drained soils that occur on the Piedmont Plateau in the northern part of the county. These soils developed in material that weathered in place from gabbro, diorite, and other dark-colored basic rocks. The native vegetation is mixed hardwoods.

A typical profile has a dark-brown surface layer about 5 inches thick and a reddish-brown subsurface layer about 4 inches thick. Both layers are silt loam that is crumbly but is slightly sticky when wet. The subsoil is about 31 inches thick. In the upper part it is yellowish-red silty clay loam. Next is the main part of the subsoil, a layer of dark-red silty clay and a layer of dark-red silty clay loam. Both layers are sticky and plastic when wet. This material is underlain by dark-red silty clay loam that extends to bedrock.

Most Montalto soils can be worked fairly easily if their moisture content is favorable. In severely eroded areas, however, the plow layer is more sticky than normal and is difficult to work, even when it is only slightly too wet. The Montalto soils are well suited to most of the common crops. They have high available moisture capacity, and their natural content of calcium and other plant nutrients is fairly high. The main features that limit use are slope and the erosion hazard.

In New Castle County the Montalto soils were not mapped separately. They were mapped only with the Neshaminy soils in undifferentiated units. For descriptions of these units, see the Neshaminy series.

Profile of a Montalto silt loam, in a hayfield along County Route 364, about 1 mile south of Newark:

Ap—0 to 5 inches, dark-brown (7.5YR 3/2) silt loam; weak, medium, granular structure; friable, slightly sticky; roots abundant; strongly acid; clear, smooth boundary; horizon 4 to 8 inches thick

A2—5 to 9 inches, reddish-brown (5YR 5/4) silt loam; weak, medium, granular structure, friable, slightly sticky; roots plentiful; strongly acid; clear, wavy boundary; horizon 3 to 5 inches thick

B1—9 to 16 inches, yellowish-red (5YR 4/6) silty clay loam; weak, medium, subangular blocky structure; friable to firm, sticky and slightly plastic; roots common; strongly acid; gradual, wavy boundary, horizon 5 to 8 inches thick.

B21t—16 to 32 inches, dark-red (2.5YR 3/6) silty clay; moderate, medium, subangular blocky structure; firm, sticky and plastic; few roots; continuous clay coats; strongly acid; gradual, wavy boundary; horizon 12 to 24 inches thick

B22t—32 to 40 inches, dark-red (2.5YR 3/6) heavy silty clay loam; weak to moderate, medium, subangular blocky structure; friable to firm, sticky and plastic; very few roots; thin clay coats, very dark films; few fragments of rock; strongly acid, clear, wavy boundary; horizon 5 to 15 inches thick.

C—40 to 48 inches +, dark-red (2.5YR 3/6) silty clay loam; structureless (massive); friable, slightly sticky and slightly plastic; no roots; some disintegrated, dark-colored rock; strongly acid to medium acid.

In New Castle County the texture of the Ap horizon normally is silt loam, but in severely eroded areas it is silty clay loam. The B2t horizon ranges from heavy silty clay loam or heavy clay loam to clay, and it has an average clay content of more than 35 percent. In most places the C horizon is not so fine textured as the B2t horizon. Coarse fragments of diabase or similar rocks can occur in any part of the profile. The solum ranges from about 38 to 60 inches in thickness. Depth to bedrock is 5 to 12 feet.

The A horizon ranges from 7.5YR to 2.5YR in hue. In undisturbed areas the A1 horizon is very thin. The A horizon is 3 or 4 or even 5 in value and 2 to 4 in chroma; the lowest value generally is in the A1 horizon. Hue in the B2t horizon generally is 2.5YR but includes 10R and 5YR. The B horizon normally is 3 or 4 in value and 4 or 6 in chroma. The C horizon varies in color; it generally has the same range in hue as the B2t horizon but is yellower in some places. The reaction is medium acid to strongly acid in unlimed areas, but acidity normally decreases somewhat with depth and may approach neutral close to bedrock.

The Montalto soils are similar to the Collington, Matapeake, Neshaminy, and Sassafras soils in morphology. The solum of the Montalto soils contains less sand than that of the Sassafras soils and also that of the Collington soils, which have been strongly influenced by glauconite or greensand. Montalto soils have a less silty, more clayey B2t horizon than the Matapeake and Neshaminy soils. Also, they are redder in the subsoil than the Collington, Matapeake, and Sassafras soils and are not so deep to bedrock. In texture and color the Montalto soils are similar to the Elioak soils, which are more strongly acid and characteristically contain much fine mica. The Montalto soils developed in the same or somewhat the same kind of material as the well-drained Talleyville and the poorly drained Watchung soils, and the lower part of their B horizon is red like that of the Talleyville soils. In contrast to the Montalto, however, the Talleyville soils are mainly brown in the upper 3 to 4 feet of their profile.

Neshaminy Series

The Neshaminy series consists of well-drained soils that occur on the Piedmont Plateau in the northern part of the county. These soils developed in material that weathered in place, generally from mixed basic and acid rocks. The native vegetation is mixed hardwoods, mainly oak and hickory.

A typical profile has a dark-brown surface layer about 4 inches thick and a strong-brown subsurface layer about 7 inches thick. Both layers are silt loam that is crumbly but is slightly sticky when wet. The subsoil is yellowish-red silty clay loam that is about 29 inches thick and is sticky when wet. This layer is underlain by disintegrated rock material.

The Neshaminy soils generally are not difficult to work, but in severely eroded areas their plow layer is more sticky than normal and should not be tilled if it is even a little too wet. The soils are suited to many kinds of crops. They have high available moisture capacity and are fairly high in content of calcium and other plant nutrients. Slope, the erosion hazard, and local stoniness are the chief limitations that affect use.

Profile of a Neshaminy silt loam, in a wooded area along State Route 141, about 1 mile southeast of Greenville:

A1—0 to 4 inches, dark-brown (7.5YR 3/2) silt loam; weak, medium, granular structure; friable, slightly sticky; many roots; medium acid to strongly acid; clear, smooth boundary; horizon 4 to 5 inches thick.

A2—4 to 11 inches, strong-brown (7.5YR 5/6) heavy silt loam; weak, medium, granular to subangular blocky structure; friable, slightly sticky and slightly plastic; many roots; strongly acid; clear, wavy boundary; horizon 5 to 7 inches thick.

B21t—11 to 24 inches, yellowish-red (5YR 5/6) silty clay loam, moderate, medium, subangular blocky structure; firm, sticky and plastic; roots common; few prominent strong-brown (7.5YR 5/6) clay coatings; some medium, angular gravel; strongly acid; gradual, smooth boundary; horizon 12 to 18 inches thick.

B22t—24 to 40 inches, yellowish-red (5YR 4/6) heavy silty clay loam; moderate to strong, medium, subangular blocky structure; firm, sticky and plastic; few roots in upper part of horizon; thin clay coatings; few black films and flakes; strongly acid to medium acid; clear, wavy boundary; horizon 15 to 20 inches thick.

C—40 to 50 inches +, silt loam saprolite that is variegated strong brown (7.5YR 5/6) and yellowish red (5YR 5/6); friable to firm, slightly sticky and slightly plastic; no roots, medium acid.

In New Castle County the A horizon normally is silt loam, but in several areas it is generally silty clay loam. In most places the average content of clay in the B2t horizon is between 25 and 35 percent, but in parts of some profiles it is a little more than 35 percent. The C horizon is generally loam or silt loam in texture. In places the profile contains angular pebbles and stones of quartzite, acid crystalline rock, or basic rock. The solum ranges from about 36 to 50 inches in thickness, but the average thickness is about 40 inches. Depth to hard bedrock generally ranges from 6 to 10 feet; bedrock consists of semibasic rocks or of gneiss, granitized schist, granodiorite, gabbro, diabase, and similar mixed rocks, and in some places, of serpentine.

The A horizon has a hue of 10YR or 7.5YR, a value of 3 to 5, an a chroma of 2 to 6. The lower value and chroma generally are in the A1 horizon. Hue in the B2t horizon centers on 5YR but includes 7.5YR and in places is nearly 2.5YR. Redness commonly increases with depth, and the profile is reddest in the lower part of the B2t horizon. Value in this horizon is 3 to 5, and chroma is 3 to 8. The C horizon is uniformly colored in some places and is variegated in others. In unlimed areas the profile is strongly acid to medium acid. Acidity generally decreases with depth, and base saturation in the C horizon ranges from 35 to 60 percent.

The Neshaminy soils are similar in morphology to the Collington, Matapeake, Montalto, and Sassafras soils. The solum of Neshaminy soils contains less sand than that of Collington and Sassafras soils; Collington soils have been strongly influenced by glauconite. The Neshaminy soils are somewhat less silty and more clayey in their B2t horizon than the Matapeake soils. The B2t horizon of the Neshaminy soils is not so red and contains less clay than that of the Montalto soils. The Neshaminy soils are less acid and generally more sticky than the Chester soils, which developed on acid, micaceous rocks. The Neshaminy soils are the only soils in the county that developed in material weathered in place from both acid and basic rocks.

Neshaminy and Montalto silt loams, 0 to 3 percent slopes (NmA).—The soils in this undifferentiated unit are subject to little or no erosion and are among the best soils in the county for farming. Most of the total acreage is Neshaminy silt loam, but some of it is Montalto silt loam. Any given area may consist of the Neshaminy soil, the Montalto soil, or both soils in any proportion. Included in mapping are some gravelly areas, which are indicated by symbol on the soil map. Also included are a few eroded areas.

The soils in this unit are well suited to most crops and can be farmed intensively if they are well managed. (Capability unit I-4; woodland suitability group 4)

Neshaminy and Montalto silt loams, 3 to 8 percent slopes, moderately eroded (NmB2).—The soils in this unit have lost part of their original surface layer through erosion, but only in a few places has the loss been severe. A few shallow gullies have been cut, and there are some galled spots in which the subsoil is practically exposed. Erosion is a continuing hazard because water from rain and melting snow is absorbed fairly slowly. Included in areas mapped as these soils are some gravelly areas and a few areas where the soil is shallower to bedrock than normal.

The soils in this unit can be safely used for cultivated crops if conservation measures are adequate. (Capability unit IIe-4; woodland suitability group 4)

Neshaminy and Montalto silt loams, 8 to 15 percent slopes, moderately eroded (NmC2).—Erosion has removed part of the original surface layer from these soils, and a few shallow gullies have formed. Included in mapping are some gravelly areas and a few areas where the soil is shallower to bedrock than normal.

By using intensive measures for controlling erosion, the soils in this unit can be kept in regular cultivation. (Capability unit IIIe-4; woodland suitability group 4)

Neshaminy and Montalto silty clay loams, 8 to 15 percent slopes, severely eroded (NnC3).—These soils have lost all or nearly all of their original surface layer through erosion, and the plow layer contains a large amount of subsoil material. This layer is reddish, in poor tilth, sticky when wet, and difficult to work except within a fairly narrow range of moisture content. Many gullies have been cut in these soils. Included in mapping are some gravelly areas.

The soils in this unit can be used for an occasional clean-tilled crop but should be protected by hay or other sod crops most of the time. (Capability unit IVe-3; woodland suitability group 4)

Neshaminy and Montalto silty clay loams, 15 to 25 percent slopes, severely eroded (NnD3).—These soils are shallower to bedrock than uneroded Neshaminy or Montalto soils. They have lost nearly all of their original surface layer through erosion, and their plow layer is chiefly subsoil material. This layer contains more clay and is stickier than that of less severely eroded Neshaminy and Montalto soils. Included in mapping are small gravelly areas.

The soils in this unit are not suited to cultivated crops. They are in poor tilth and are difficult to work if only a little too wet or too dry. The soils are well suited to hay crops, pasture, and sodded orchards. (Capability unit VIe-2; woodland suitability group 4)

Neshaminy and Talleyville very stony silt loams, 3 to 35 percent slopes (NsE).—Areas mapped as these soils may consist of the Neshaminy soil, the Talleyville soil, or both. Loose stones and boulders prevent cultivation by conventional methods, and other uses are limited as well. These stones and boulders are mainly diabase, gabbro, and other dark-colored basic rocks, but in places they are schist, quartzite, and similar rocks.

If some of the stones were removed, these soils might be used for hay crops or permanent pasture. Woodland, wildlife habitat, and some forms of recreation are more suitable uses. (Capability unit VIs-3; woodland suitability group 4)

Neshaminy-Talleyville-Urban land complex, 0 to 8 percent slopes (NtB).—This mapping unit occurs chiefly in the northern and northeastern suburbs of Wilmington. It consists of well-drained Neshaminy and Talleyville soils that are used for residential and other community developments. About three-fifths of the total acreage was originally Neshaminy soils, and the rest was Talleyville soils. The soil series can be recognized, but in most places the soils have been disturbed so much that separating them on the soil map is impractical.

About 50 percent of the complex has been covered with as much as 18 inches of fill or grading material, or has had as much as two-thirds of the original soil profile removed by cutting. About 25 percent of the complex has been covered with more than 18 inches of fill or has had almost all of the original soil cut away. The remaining 25 percent of the complex has not been significantly disturbed.

The fill material used to cover the soils is mainly silt loam or silty clay loam. Except where the natural drainage has been modified by fill material, wetness is not a limitation to use of the complex for community developments. In places where the fill material is deep, suitability must be determined for each site. (Capability unit and woodland suitability group not assigned)

Neshaminy-Talleyville-Urban land complex, 8 to 25 percent slopes (NtD).—This mapping unit is much the same as the one just described, but the soils are more sloping and have greater limitations for some uses. (Capability unit and woodland suitability group not assigned)

Othello Series

The Othello series consists of poorly drained soils that occur on upland flats of the Coastal Plain in the southern part of the county. These soils developed in highly silty material underlain by sand. The native vegetation is wetland hardwoods, mostly oaks, sweetgum, blackgum, swamp maple, and holly.

A typical profile has a dark grayish-brown silt loam surface layer about 7 inches thick and a pale-brown very fine sandy loam subsurface layer about 3 inches thick. The subsoil, about 20 inches thick, is gray or light-gray silt loam that is mottled with yellowish brown and is sticky when wet. Below the subsoil is yellowish-brown very fine sandy loam mottled with gray or light gray.

The Othello soils are not difficult to work at a favorable content of moisture, but they should not be worked when the water table is near the surface. Artificial drainage is needed for most uses, particularly to lower the water table in the spring and to remove excess water in wet periods. These soils generally are fairly easy to drain, because water moves through the subsoil fairly rapidly. Tile lines or ditches are suitable, but the ditches should not penetrate the underlying sandy material. The available moisture capacity is high. These soils are limited in use chiefly by poor drainage and a seasonal high water table.

Profile of Othello silt loam, in a hayfield along County Route 433, about one-half mile west of Summit Bridge:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable, slightly sticky; roots abundant; strongly acid; clear, smooth boundary; horizon 6 to 10 inches thick.

A2—7 to 10 inches, pale-brown (10YR 6/3) very fine sandy loam; weak, medium, granular structure; friable, slightly sticky; roots plentiful; strongly acid; clear, smooth boundary; horizon 2 to 5 inches thick.

B21tg—10 to 21 inches, gray or light-gray (5Y 6/1) heavy silt loam; few, medium, prominent mottles of yellowish brown (10YR 5/6); very weak, fine, subangular blocky structure; friable to firm, sticky and slightly plastic; roots fairly common; some thin clay films; strongly acid; clear, smooth boundary; horizon 8 to 12 inches thick.

B22tg—21 to 30 inches, gray or light-gray (5Y 6/1) heavy silt loam; abundant, medium and coarse, prominent mottles of yellowish brown (10YR 5/6); weak, medium, subangular blocky structure; friable to firm, sticky and plastic; very few roots; some thin clay films; strongly acid; clear, smooth boundary; horizon 8 to 12 inches thick.

C—30 to 50 inches +, yellowish-brown (10YR 5/6) very fine sandy loam; common, medium, prominent mottles of gray or light gray (10YR 6/1); structureless (massive); friable, slightly sticky; no roots; very strongly acid.

The A horizon generally is silt loam, but in part it may be very fine sandy loam The B2t horizon ranges from heavy silt loam to silty clay loam The C horizon is silt loam or very fine sandy loam In some places the C horizon is underlain by a IIC horizon of sandy loam or coarser textured material, and in places this IIC horizon replaces the C horizon within a depth of 5 feet. Some fine smooth pebbles can occur in the profile, most commonly in the IIC horizon. The solum ranges from about 24 to 36 inches in thickness Bedrock is at a great depth.

Color of the A horizon ranges from 10YR in hue to neutral, from 3 to 6 in value, and from 0 to 3 in chroma; the lowest value and chroma are in the very thin A1 horizon. The B horizon ranges from 2.5Y to neutral in hue The matrix of the B horizon is 5 or 6 in value and 0 to 2 or 3 in chroma. Mottles are 10YR or 7 5YR in hue, 5 or 6 in value, and 4 to 8 in chroma The matrix of the C horizon may be gray and contain mottles having high chroma, or it may have high chroma with gray mottling, or it may be gray without mottling Unlimed, these soils are strongly acid to extremely acid, and acidity generally increases with depth.

In this county soils other than the Othello that are poorly drained are in the Calvert, Elkton, Fallsington, Hatboro, Kinkora, and Watchung series The Othello soils are more acid and much deeper to bedrock than the Calvert soils, which have a fragipan. Although the Othello soils are somewhat similar to the Elkton and the Fallsington soils, they have a silt loam subsoil, whereas in the Elkton soils that horizon is silty clay and in the Fallsington it is sandy clay loam. The Othello soils have a coarser textured subsoil than the Kinkora and Watchung soils; the Kinkora soils characteristically contain much fine mica, and the Watchung soils are only 5 to 10 feet deep to very hard bedrock. The Othello soils are not subject to flooding as are the micaceous Hatboro soils. The Othello soils formed on the same kind of material as the well drained Matapeake soils and the moderately well drained Mattapex and Butlertown soils

Othello silt loam (Ot).—This poorly drained, nearly level soil occurs in areas of the Coastal Plain where the well-drained Matapeake soils are dominant. This soil has the profile described as typical for the Othello series. Included in mapping are a few acres that have slopes of slightly more than 2 percent. (Capability unit IIIw–7; woodland suitability group 14)

Othello-Fallsington-Urban land complex (Ou).—This mapping unit lies mainly along the lower part of the Christina River and along the Delaware River between Wilmington and the Pennsylvania State line. Small areas occur in and near the town of New Castle. The unit consists of poorly drained, nearly level Othello and Fallsington soils that have been used for residential, commercial, and industrial development. It is impractical to separate these soils on the map, but about two-thirds of the complex originally was Othello soils and one-third was Fallsington soils. A profile typical for these soils is described for their respective series.

About 25 percent of this complex has been relatively undisturbed. Most of the remaining 75 percent has been covered with as much as 18 inches of fill material. Some small areas have been covered with more than 18 inches of fill, but in few if any areas has the original soil profile been entirely removed.

Although the mapping unit has been artificially drained in many places, seasonal wetness and a high water table limit its suitability for building sites and other residential and community uses. (Capability unit and woodland suitability group not assigned)

Pocomoke Series

The Pocomoke series consists of very poorly drained soils that occur on flats and in depressions of the uplands in the southern, or Coastal Plain, part of the county. The native vegetation is wetland hardwoods, including swamp maple, oak, gum, and a few pond pines.

In a typical profile the surface layer is black loam about 12 inches thick. The subsurface layer is gray or light-gray loam or fine sandy loam about 6 inches thick. The subsoil is about 14 inches thick and is gray or light-gray sandy clay loam. Although this layer is sticky and plastic, water moves through it readily. Underlying the subsoil is gray or light-gray fine sand that is usually saturated with water.

If the water table is lowered, the Pocomoke soils are usually easy to work. Normally, however, the water table remains at or near the surface until late in spring. Where outlets are lacking, the soils may be ponded for fairly long periods. In areas having adequate outlets, ditches or tile lines can be used to improve drainage, though ditches should not penetrate the loose sandy material below the subsoil. These soils have moderate available moisture capacity, but their use is limited by very poor natural drainage and a very high water table. In addition, extreme acidity limits the growth of some crops.

Profile of Pocomoke loam, in an unplowed field just off County Route 395, about 1 mile south of Glasgow:

Ap—0 to 12 inches, black (10YR 2/1) loam; weak, fine, granular structure; friable, slightly sticky; roots abundant; very strongly acid; abrupt, smooth boundary; horizon 10 to 14 inches thick.

A2g—12 to 18 inches, gray or light-gray (10YR 6/1) loam or fine sandy loam; weak, very fine, granular structure; very friable, slightly sticky; roots fairly common, very strongly acid; clear, smooth boundary; horizon 4 to 6 inches thick.

B2tg—18 to 32 inches, gray or light-gray (10YR 6/1) sandy clay loam; weak to moderate, medium, blocky and subangular blocky structure; friable to firm, sticky and plastic; some faint, dark-gray coats of clay; very strongly acid; clear, smooth boundary; horizon 10 to 20 inches thick.

IICg—32 to 42 inches +; gray or light-gray (10YR 6/1) fine sand; structureless (single grain); loose, no roots; material tends to flow; very strongly acid

The A horizon is generally loam but may be fine sandy loam in some part The B2t horizon ranges from heavy sandy loam to sandy clay loam in texture, and its average clay content is between 18 and 25 percent. A few fine, smooth pebbles occur, particularly in the C horizon. The solum normally ranges from 24 to 36 inches in thickness. Bedrock is at a great depth.

The A1, or Ap, horizon is generally black, but in places it is very dark gray, very dark brown, or very dark grayish brown. Throughout the profile, except in horizons that are mottled, are hues of 10YR or yellower. The value of the matrix in the B and C horizons is 4 to 6 and the chroma is 0, 1, or rarely 2 The A2, B, and C horizons may have mottles with a hue of 10YR or 7.5YR, a value of 4 to 6, and a chroma of 4 to 8 In unlimed areas these soils are very strongly acid to extremely acid In most places acidity increases with depth

The Pocomoke soils are similar to the Bayboro soils in color and natural drainage, but the Bayboro have a clayey, very slowly permeable subsoil Pocomoke soils have a dark surface layer like that of the Johnston soils, but the Johnston lack a gray B horizon and occur only on the flood plains of streams. The Pocomoke soils formed on the same kinds of old upland sediments as the well drained Sassafras soils, the moderately well drained Woodstown soils, and the poorly drained Fallsington soils.

Pocomoke loam (Po).—Unless this soil is drained, it is not suitable for most farm uses. Undrained areas are mainly wooded. Trees grow well on this soil. If drainage is improved, many kinds of crops can be produced. Included in mapping are a few acres where the surface layer is a little more silty or more sandy than normal. (Capability unit IIIw–7; woodland suitability group 7)

Rumford Series

The Rumford series consists of deep, somewhat excessively drained soils of the uplands on the Coastal Plain. These soils developed in beds of very sandy old sediments containing a small amount of clay and very little silt. They are the sandiest soils in New Castle County. The native vegetation consists of scrub hardwoods and some Virginia pine.

A typical profile has a brown or dark-brown surface layer about 8 inches thick and a yellowish-brown subsurface layer about 4 inches thick. Both of these layers are loamy sand. The subsoil, about 24 inches thick, is yellowish-brown sandy loam in the upper part. In the middle part it is strong-brown sandy clay loam, and in the lower part it is strong-brown sandy loam. Below the subsoil is strong-brown, loose loamy sand.

These soils are easy to work and likely are the first soils in the county to warm in spring. They can be planted to some of the earliest crops, particularly truck crops, and they also are suited to melons, cucumbers, sweetpotatoes, and other summer crops. The soils have low available moisture capacity, but they respond well to irrigation. Their natural supply of plant nutrients is low, and large applications of fertilizer are needed for most crops. Soil blowing is a hazard, and sloping areas are subject to water erosion.

Profile of Rumford loamy sand, 2 to 5 percent slopes, moderately eroded, in a cultivated area on County Route 47, about 1 mile north of Blackbird:

Ap—0 to 8 inches, brown or dark-brown (10YR 4/3) loamy sand; very weak, fine, granular structure; loose to very friable; roots abundant; strongly acid; clear, smooth boundary; horizon 7 to 10 inches thick

A2—8 to 12 inches, yellowish-brown (10YR 5/4) loamy sand; very weak, fine, granular structure; very friable; roots common; strongly acid; clear, smooth boundary; horizon 4 to 8 inches thick.

B1—12 to 18 inches, yellowish-brown (10YR 5/6) sandy loam; weak, medium, granular and subangular blocky structure; very friable; roots common; strongly acid; gradual, smooth boundary; horizon 5 to 8 inches thick.

B2t—18 to 30 inches, strong-brown (7.5YR 5/6) light sandy clay loam; weak, medium, subangular blocky structure; friable; slightly sticky; few roots; some thin clay films and clay bridges between sand grains; strongly acid; clear, smooth boundary; horizon 8 to 14 inches thick.

B3—30 to 36 inches, strong-brown (7.5YR 5/6) sandy loam; weak, medium, granular structure; very friable; very few roots; strongly acid; gradual, smooth boundary; horizon 0 to 8 inches thick

C—36 to 48 inches +, strong-brown (7.5YR 5/6) loamy sand; structureless (single grain); loose; no roots; strongly acid

The B2t horizon is sandy loam or light sandy clay loam and has a clay content that averages less than 18 percent. The C horizon may be sand, fine sand, or loamy sand. The B1 and B3 horizons are transitional in texture and other characteristics. A few fine, smooth pebbles occur in places, but are mostly in the C horizon. The solum ranges from about 24 to 40 inches in thickness. Bedrock is at a great depth

The A horizon generally is 10YR in hue. It has a value of 3 to 5 and a chroma of 1 to 4; the lowest value and chroma are in the very thin A1 horizon In the B horizon the hue is mainly 7.5YR, but in places it is 5YR, and in the B1 and B3 horizons it may be 10YR. Value in the B horizon is 5 or 6, and chroma is 6 or 8. The C horizon generally has the same range in color as the B horizon, but in some places it is yellower in hue and has a higher value. In unlimed areas the Rumford soils are strongly acid to extremely acid Their acidity commonly increases with depth Base saturation is very low.

The Rumford soils are more sandy throughout their profile than any other soils in the county They most nearly resemble the Sassafras soils, but they are more sandy and less silty and clayey than Sassafras soils, and they do not hold moisture and plant nutrients so well

Rumford loamy sand, 2 to 5 percent slopes, moderately eroded (RuB2).—A profile of this soil is described as typical for the series. Erosion is only a slight hazard because rainfall enters the soil rapidly and little runs off. The available moisture capacity is low, however, and the soil is droughty if rainfall is inadequate. Also, the capacity to retain plant nutrients is low. Included in areas mapped as this soil are a few nearly level spots and small areas in which the subsoil is more sandy than normal. (Capability unit IIs–4; woodland suitability group 10)

Rumford loamy sand, 5 to 10 percent slopes, moderately eroded (RuC2).—This soil is more susceptible to erosion than the soil just described. In addition, its use is limited by a low capacity to hold moisture and plant nutrients. Spots included in mapping have a more sandy subsoil than normal. (Capability unit IIIe–33; woodland suitability group 10)

Sassafras Series

The Sassafras series consist of deep, well-drained soils on uplands of the Coastal Plain in the southern part of the county. These soils developed in beds of sandy old sediments that contain moderate amounts of silt and clay. The native vegetation is mostly mixed hardwoods, but some shortleaf pine and Virginia pine also are common.

A typical profile has a dark grayish-brown surface layer about 8 inches thick and a yellowish-brown subsurface layer about 9 inches thick. Both layers are sandy loam. The subsoil, about 20 inches thick, is sticky, brown to strong-brown sandy loam and sandy clay loam. Water moves readily through the subsoil. Just below is strong-brown sand or loamy sand.

The Sassafras soils are easy to work, and they warm up quickly in spring. They have moderate available moisture capacity and are suited to many kinds of crops. In sloping areas, however, use is limited by the erosion hazard.

Profile of Sassafras sandy loam, 0 to 2 percent slopes, in a cultivated area on County Route 47, about one-half mile west of Prices Corners:

Ap—0 to 8 inches, dark-grayish-brown (10YR 4/2) sandy loam; weak, medium, granular structure; friable, slightly sticky; roots abundant; strongly acid; clear, smooth boundary; horizon 8 to 10 inches thick

A2—8 to 17 inches, yellowish-brown (10YR 5/4) light sandy loam; weak, fine, granular structure; very friable; roots abundant; strongly acid; clear, wavy boundary; horizon 7 to 10 inches thick

B21t—17 to 26 inches, strong-brown (7.5YR 5/6) heavy sandy loam; weak, medium, subangular blocky structure; friable, slightly sticky; roots common; discontinuous clay coats; strongly acid; gradual, wavy boundary; horizon 6 to 10 inches thick

B22t—26 to 37 inches, brown (7.5YR 5/4) sandy clay loam; moderate, medium, subangular blocky structure; friable to firm, sticky and slightly plastic; few roots; almost continuous clay coats; strongly acid; clear, wavy boundary; horizon 9 to 20 inches thick

C—37 to 50 inches +, strong-brown (7 5YR 5/8) sand or loamy sand; structureless (single grain); loose to very friable; very strongly acid

The B2t horizon generally is sandy clay loam, but in places it is heavy sandy loam, heavy loam, or light sandy clay loam. The clay content in the B2t horizon ranges from 18 to 30 percent. The C horizon is coarser in texture than the B horizon, and it commonly is coarser textured than the A horizon. The C horizon contains fine, smooth pebbles in some places The solum ranges from about 30 to 40 inches in thickness. Bedrock is at a great depth.

The A horizon is generally 10YR in hue, 3 to 5 in value, and 1 to 4 in chroma; the lowest value and chroma are in the very thin A1 horizon, which occurs in undisturbed areas Hue of the B horizon centers on 7 5YR but includes 5YR and in places grades toward 10YR Value in the B horizon is 5 or 6, and chroma is 4 to 8, but a chroma of less than 6 is usually present in some part of the B2t horizon. The C horizon is similar to the B horizon in color, but commonly it has higher value and chroma. In unlimed areas the profile is strongly acid or very strongly acid. Normally, base saturation is between 25 and 35 percent.

The Sassafras soils are similar to the Collington, Matapeake, Montalto, and Neshaminy soils in morphology. In contrast to the Sassafras soils, the Collington soils have been influenced by glauconite, or greensand, and their olive-brown subsoil is lower in chroma than the one in the Sassafras soils The solum of Sassafras soils contains less silt and much more sand than that of the Matapeake soils Sassafras soils are much deeper to bedrock than the Neshaminy and Montalto soils. They have a somewhat less clayey, much more sandy subsoil than the Neshaminy soils, and they do not have the dark-red, highly clayey subsoil of the Montalto soils The Sassafras soils formed on the same kind of old upland sediments as the moderately well drained Woodstown soils; the poorly drained Fallsington soils, which have a gray surface layer; and the very poorly drained Pocomoke soils, which have a black surface layer.

Sassafras sandy loam, 0 to 2 percent slopes (SaA).—This soil is so nearly level that it is subject to little or no erosion. It is well drained, holds moisture fairly well, and is well suited to practically all crops, especially fairly early truck crops. This soil has the profile described as typical for the series. Included in mapping are small, widely scattered areas where the surface layer is somewhat gravelly. (Capability unit I–5; woodland suitability group 10)

Sassafras sandy loam, 2 to 5 percent slopes, moderately eroded (SaB2).—Erosion is a moderate hazard on this soil, but it can be controlled by using simple and easily applied measures. Areas mapped as this soil include some gullies, some widely scattered spots that are severely eroded, and a few areas that are somewhat gravelly. (Capability unit IIe–5; woodland suitability group 10)

Sassafras sandy loam, 5 to 10 percent slopes, moderately eroded (SaC2).—This soil is more susceptible to erosion than less sloping Sassafras soils. Slopes generally are smooth, fairly long, and regular, but in some places there are small sinks, locally called whale wallows. A few shallow gullies have formed in widely scattered areas. Included in mapping are small wooded areas where little if any soil has been lost through erosion.

This soil can be safely cultivated if it is protected by suitable practices. (Capability unit IIIe–5; woodland suitability group 10)

Sassafras sandy loam, 5 to 10 percent slopes, severely eroded (SaC3).—This soil has a plow layer that consists mostly of subsoil material and is brighter brown and more sticky than the original surface layer. In some areas many gullies have formed, and in places the subsoil is exposed. Included in mapping are a few gravelly spots.

This soil is poorly suited to tilled crops, but it can be used for hay or pasture. (Capability unit IVe–5; woodland suitability group 18)

Sassafras sandy loam, 10 to 15 percent slopes, moderately eroded (SaD2).—This soil has lost a large part of its original surface layer through erosion. Locally, a few gullies have been cut. Included in mapping are small wooded areas that are only slightly eroded, and these should be kept in trees. Also included are some gravelly areas. (Capability unit IVe–5; woodland suitability group 10)

Sassafras sandy loam, 10 to 15 percent slopes, severely eroded (SaD3).—The plow layer of this soil consists almost entirely of material brought up from the subsoil. Many gullies have been formed, and some of them are deep. Small areas included in mapping are somewhat gravelly.

This soil is not suited to clean-tilled crops. If it is well managed, it can be used for hay, pasture, or sodded orchards. Some areas can be reforested. (Capability unit VIe–2; woodland suitability group 18)

Sassafras and Matapeake soils, 15 to 30 percent slopes (SmE).—These soils are silty to sandy in texture and, in most places, are much thinner than normal above the underlying sandy material. Some areas are wooded; in these there has been little or no erosion. Other areas have been cleared and are severely eroded. Small inclusions are gravelly, and a few spots are seasonally wet.

These soils are not suited to cultivated crops, but they can be safely used for hay, pasture, or sodded orchards. (Capability unit VIe–2; woodland suitability group 10)

Silty and Clayey Land

Silty and clayey land consists of old deposits of clay that have been overlain by material of varying texture, chiefly silty. This land lies at higher elevations on the Coastal Plain, adjacent to the Piedmont Plateau.

The mantle of silty material ranges from a few inches to many feet in thickness and from gray to yellow and brown and almost to red in color. Its thickness varies widely within short distances. This material and the clayey material under it are not related in origin. The clay can be almost any color or mixture of colors—red, purplish red, gray, yellow, brown, pink, or white. It is very plastic and sticky when wet and has very poor stability. Stabilizing cuts through this material is difficult, for the clay commonly slides, slumps, or flows down the surface of a cut and covers roads or other areas below it. If the material is disturbed, it is even more unstable.

The available moisture capacity is variable but generally is low. The content of plant nutrients is very low, and the risk of erosion is very severe. Although some areas are cultivated and some have been used as a source of clay, most of the acreage is idle or covered with scrub trees. Some areas are used for residential and other community purposes. The land is so unstable, particularly if disturbed, that it has very severe limitations affecting its use for roads, highways, building foundations, homes with basements, and similar developments.

Silty and clayey land, gently sloping (StB).—This land has slopes of 0 to 5 percent. It is difficult to protect from erosion, especially in areas that are cropped. In some places a considerable amount of fine, smooth gravel is on and near the surface. (Capability unit IIIe-42; woodland suitability group 17)

Silty and clayey land, sloping (StC).—Erosion is a severe hazard on this land. Pasture is a suitable use, though an occasional cultivated crop can be grown if management is exceptionally good. The surface should be protected by a plant cover most of the time. A few areas of this land are gravelly. (Capability unit IVe-3; woodland suitability group 17)

Silty and clayey land, steep (StE).—This land has slopes ranging from 12 to 40 percent. It is too steep and too unstable for cultivation and many other uses. Deep-rooted plants that form a protective cover are needed at all times. These plants can be safely grazed to a limited extent. (Capability unit VIIe-2; woodland suitability group 17)

Talleyville Series

The Talleyville series is made up of very deep, well-drained soils that occur in the northern part of the county. These soils have a very thick surface layer and a subsoil that developed in two distinctly different kinds of material. The surface layer and upper part of the subsoil developed in a mantle of silty material; the lower part of the subsoil, in material weathered in place from diabase and other dark-colored rocks. The native vegetation likely was mixed hardwoods, but little if any of the original woodland remains.

A typical profile has a dark-brown silt loam plow layer about 8 inches thick and a dark yellowish-brown silt loam subsurface layer about 2 inches thick. The subsoil is about 54 inches thick. In the upper part it is strong-brown silt loam. The middle part consists mainly of red silty clay loam, and the lower part is red clay that is sticky and plastic when wet. Below the subsoil is red sandy clay that extends to a great depth.

The Talleyville soils are easy to work at a favorable content of moisture, and they warm up readily in spring. These soils have very high available moisture capacity. They are suited to practically all uses, except where limited by slope and the erosion hazard. Although they are excellent soils for farming, most of their acreage is located in expanding residential areas.

Profile of Talleyville silt loam, 2 to 5 percent slopes, moderately eroded, in a sodded orchard just off County Route 212 near Talleys Corners, about 2 miles northeast of Talleyville:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silt loam; moderate, fine, subangular blocky structure; friable; strongly acid; clear, smooth boundary; horizon 6 to 8 inches thick

A2—8 to 10 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, thin, platy and very fine, blocky structure; friable; very strongly acid; clear, smooth boundary; horizon 2 to 3 inches thick

B21—10 to 33 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable to firm; dark-brown (10YR 4/3) silt coatings in root channels and in wormholes; no evident clay coatings; very strongly acid; gradual, wavy boundary; horizon 10 to 24 inches thick

B22t—33 to 44 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, coarse, blocky structure that breaks readily to fine, blocky structure; firm in place; distinct, patchy clay coats; about 20 percent, by volume, pockets of yellowish-red (5YR 4/8) silty clay loam 4 to 6 inches across; about 5 percent gravel; very strongly acid; gradual, wavy boundary; horizon 10 to 12 inches thick.

B23t—44 to 51 inches, silty clay loam that is mainly red (2.5YR 4/6); about 20 percent strong brown (7.5YR 5/6); moderate, medium, blocky structure that breaks readily to fine, blocky structure; firm, slightly sticky; faint clay coatings; 2 percent gravel; strongly acid; clear, wavy boundary; horizon 7 to 12 inches thick.

IIB24t—51 to 64 inches, red (2.5YR 4/6) clay; moderate, coarse and very coarse, blocky structure; firm, sticky and plastic; faint clay coatings; 5 percent weathered fragments of gabbro; strongly acid; diffuse boundary.

IIC—64 to 72 inches +, red (2.5YR 4/6) sandy clay; weak, coarse, subangular blocky structure; friable to firm, plastic and slightly sticky; 5 to 15 percent weathered fragments of gabbro that increase in number with depth; strongly acid.

The A, B21, and B22t horizons normally are silt loam in texture, but the B22t horizon is light silty clay loam in some places. Although the Ap horizon has subangular blocky structure in the typical profile, commonly this horizon is granular in structure. The B23t horizon of silty clay loam is transitional to the IIB24t horizon, which is clay or silty clay. Gravel or stones may occur anywhere in the profile. Stones within the silty mantle most likely rolled in from other areas. The solum ranges from 48 to 72 inches in thickness. Depth to bedrock is 6 to 10 feet or more.

The A horizon is 10YR or 7.5YR in hue, generally 3 or 4 in value, and 3 or 4 in chroma. The B21, B22t, and B23t horizons have a hue of 7.5YR, 5YR, or 2.5YR; the redness increases with depth. In these horizons the value is 4 or 5 and the chroma is 6 to 8. The red IIB24t horizon has a value of 3 or 4 and a chroma of 6 or more. In unlimed areas the profile is strongly acid or very strongly acid. Base saturation ranges from 30 to 35 percent in the solum, but it is lower in the IIC horizon.

No other soils in the county developed in the same sequence of materials as the Talleyville soils, and none has a solum so thick as the Talleyville. The upper part of the solum in Talleyville soils resembles that in the Matapeake soils, and the lower part resembles the subsoil of the Montalto soils.

Talleyville silt loam, 2 to 5 percent slopes, moderately eroded (TaB2).—This soil has the profile described as typical for the series. In most places the soil has lost part of its original surface layer through erosion. If it is protected and otherwise well managed, however, it can be safely kept in cultivation. (Capability unit IIe-4; woodland suitability group 4)

Talleyville silt loam, 5 to 10 percent slopes, moderately eroded (TaC2).—This eroded soil has lost much of its original surface layer. Management is needed that conserves moisture and controls erosion. (Capability unit IIIe-4; woodland suitability group 4)

Tidal Marsh

Tidal marsh (Tm) consists of areas that are regularly flooded by tidal waters. The soil material has not been examined in detail, but it ranges from sand to clay and in some places is mucky or peaty. Besides being more or less salty, some areas apparently contain a fairly large amount of sulfur compounds. If these areas were drained and reclaimed, the sulfur compounds would be oxidized to other compounds that normally are highly toxic to crops and most other plants. Areas of Tidal marsh that extend inland along some of the streams are less affected by salt than areas that are close to the Delaware River.

Tidal marsh is of little or no use for farming at the present time because it is not suitable for crops, pasture, or timber. About the only practical uses are for wildlife and recreation. Some areas have been hydraulically covered with fill material to form Made land, which is part of the land type, Made land and Urban land. (Capability unit VIIIw-1; woodland suitability group 24)

Watchung Series

In the Watchung series are poorly drained soils that occupy flats, depressions, and similar areas of the Piedmont Plateau in the northern part of the county. These soils have developed in materials weathered from dark basic rocks, usually disabase or gabbro. The native vegetation is wetland hardwoods, dominantly oaks.

In a typical profile the surface layer is dark-gray silt loam about 8 inches thick. The subsoil, about 22 inches thick, contains prominent mottles of brown and yellowish brown. The upper part of this layer is gray or light-gray silty clay loam, and the lower part is gray silty clay. Underlying the subsoil is gray silt loam that is mottled with brown and yellowish brown.

The Watchung soils usually are difficult to work. They are wet and sticky for long periods, and their surface layer becomes hard and cloddy as it dries. Water moves through the soil profile very slowly, and improving drainage is difficult. Although these soils have high available moisture capacity and are well supplied with plant nutrients, they are so wet and so difficult to drain that they are little used for crops. They are used for grazing in some places, but many areas are idle or still wooded.

Profile of a Watchung silt loam, in an idle field along County Route 214, about 1 mile east of Brandywine:

Ap—0 to 8 inches, dark-gray (10YR 4/1) silt loam, weak, fine, granular structure and thin, platy structure; friable, slightly sticky; strongly acid; clear, wavy boundary, horizon 6 to 8 inches thick.

B21tg—8 to 18 inches, gray or light-gray (10YR 6/1) heavy silty clay loam; common, medium, prominent mottles of brown (7.5YR 5/4) and yellowish brown (10YR 5/6); firm, sticky and plastic; some thin, gray (5Y 5/1) clay films; strongly acid; gradual, smooth boundary; horizon 8 to 12 inches thick.

B22tg—18 to 30 inches, gray (5Y 5/1) silty clay; many, medium, prominent mottles of yellowish brown (10YR 5/6); firm, very sticky and very plastic; distinct, brown (7.5YR 5/4) clay coats; strongly acid to medium acid; gradual, wavy boundary; horizon 10 to 20 inches thick

Cg—30 to 48 inches +, gray (5Y 5/1) silt loam; a few, coarse, prominent mottles of brown (7.5YR 5/4) and yellowish brown (10YR 5/6); structureless (massive); friable to firm; strongly acid to medium acid.

Texture of the B2t horizons is chiefly silty clay but includes clay and heavy silty clay loam. The average clay content in this horizon is well above 35 percent. The C horizon commonly shows traces of the parent rock. Gravel occurs in some places, and there may be stones in the profile, mostly on and near the surface. Generally, the stones are colluvial in origin. The solum ranges from 24 to 40 inches in thickness. Depth to bedrock normally is between 5 and 10 feet.

The Ap horizon is dark grayish brown or dark gray In wooded areas there is a thin A1 horizon; this generally is one unit lower in value than the Ap horizon. In the B2t horizon the matrix is 2.5Y, 5Y, or 10YR in hue; 4, 5, or rarely 6 in value; and normally 1 or 2 but possibly 3 in chroma Mottles in the B2t horizons are fine to coarse, distinct to prominent, and common to many. Most of the mottles are 10YR to 5YR in hue, 4 or 5 in value, and 4 to 6 in chroma. The C horizon has about the same range in color as the B horizon. Greenish specks are common; these are thought to be fine remnants of decomposed rock. Unlined, the soils are strongly acid to medium acid. Their acidity decreases with depth and may approach neutral in the lower part of the C horizon. Base saturation in this horizon is very high

Like the Watchung soils, the Calvert, Elkton, Fallsington, Kinkora, and Othello soils are poorly drained. The Watchung soils have a finer textured subsoil than the Calvert, Fallsington, and Othello soils, and they lack the fragipan of the Calvert soils. Watchung soils resemble the Elkton and Kinkora soils in their fine-textured subsoil, but they are less strongly acid than those soils. The Watchung soils are not nearly so deep to bedrock as the Elkton, Fallsington, and Othello soils Watchung soils developed in the same or nearly the same kind of residual material as the well-drained Montalto soils The well-drained Talleyville and Neshaminy soils developed in part from similar material

Watchung very stony silt loam (Wa).—This soil has many stones and boulders on and near the surface and elsewhere in the profile. It is of little use for farming but can support water-tolerant trees and provide cover and perhaps food for some kinds of wildlife. (Capability unit VIIs-4; woodland suitability group 13)

Watchung and Calvert silt loams, 0 to 3 percent slopes (WcA).—The soils in this undifferentiated unit are poorly drained. Any given area mapped as this unit may consist of Watchung silt loam, Calvert silt loam, or both soils in any proportion. The Watchung soil has the profile described as typical for the series. A typical profile of the Calvert soil is described under the Calvert series. Included in mapping are a few eroded spots.

Except for pasture that provides limited grazing, these soils are little used for farming. They are difficult to drain, though the improvement of drainage helps to increase the growth of forage plants. (Capability unit Vw-1; woodland suitability group 13)

Watchung and Calvert silt loams, 3 to 8 percent slopes (WcB).—Water from rain and melting snow enters these soils very slowly, and much of it runs off. Consequently, erosion is a hazard. A few gullies have formed, and in spots some of the original surface layer has washed away. Even so, wetness is the main limitation, and the improvement of drainage is the primary concern. Included in mapping are a few acres where slopes are slightly more than 8 percent.

These soils are little used for crops, but they are suitable for pasture. (Capability unit VIw-2; woodland suitability group 13)

Woodstown Series

The Woodstown series consists of deep, moderately well drained soils that occupy uplands of the Coastal Plain in the southern part of the county. These soils developed in old deposits of sandy material that contained a moderate amount of silt and clay. The native vegetation is water-tolerant hardwoods, mainly oaks.

In a typical profile the surface layer is brown or dark-brown loam about 7 inches thick, and the subsurface layer is yellowish-brown loam or fine sandy loam about 3 inches thick. The subsoil, about 26 inches thick, is yellowish-brown fine sandy clay loam in the uppermost 20 inches and is yellowish-brown sandy loam in the lower part. The upper 10 inches of the subsoil is free of mottles, but below 10 inches there are mottles of light brownish gray. The underlying material is yellowish-brown sandy loam and loamy sand mottled with gray or light gray.

The Woodstown soils generally are easy to work, but they tend to be wet in the spring and are fairly slow to warm. Consequently, planting dates may be delayed. Artificial drainage is commonly needed for some crops, particularly in the more nearly level areas. These soils are not difficult to drain by ditching or tiling if outlets are adequate. Ditches should not penetrate the loose, sandy underlying material. The available moisture capacity is high. Impeded drainage and seasonal wetness limit the use of these soils, and erosion is a hazard in sloping areas.

Profile of Woodstown loam, 0 to 2 percent slopes, in a cultivated area along County Route 479, about 1 mile west of Reynolds Corners:

Ap—0 to 7 inches, brown or dark-brown (10YR 4/3) loam; weak, medium, granular structure; friable, slightly sticky; many roots; strongly acid; clear, wavy boundary; horizon 6 to 8 inches thick.

A2—7 to 10 inches, yellowish-brown (10YR 5/4) loam or fine sandy loam; weak, medium, granular structure, friable; slightly sticky; many roots, strongly acid; clear, smooth boundary; horizon 2 to 4 inches thick.

B21t—10 to 20 inches, yellowish-brown (10YR 5/6) fine sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; roots fairly common; some thin clay coats; strongly acid; clear, smooth boundary; horizon 10 to 14 inches thick.

B22t—20 to 30 inches, yellowish-brown (10YR 5/6) fine sandy clay loam; common, medium, distinct mottles of light brownish gray (10YR 6/2); moderate, medium, subangular blocky structure; friable to firm, sticky and slightly plastic; few roots; some yellowish-brown clay coats; strongly acid; clear, smooth boundary; horizon 10 to 14 inches thick.

B3—30 to 36 inches, yellowish-brown (10YR 5/6) sandy loam; about 50 percent is coarse, distinct mottles of light brownish gray (10YR 6/2); weak to moderate, medium, subangular blocky structure, friable, slightly sticky; very few roots; strongly acid, clear, smooth boundary; horizon 0 to 6 inches thick.

C1—36 to 42 inches, yellowish-brown (10YR 5/4) light sandy loam; about 50 percent coarse, distinct mottles of gray or light gray (10YR 6/1); structureless (single grain); very friable; no roots; strongly acid; clear, smooth boundary; horizon 4 to 8 inches thick.

C2—42 to 48 inches +, yellowish-brown (10YR 5/4) loamy sand; about 50 percent coarse, distinct mottles of gray or light gray (10YR 6/1); structureless (single grain); loose; strongly acid

In New Castle County the A horizon is sandy loam in some places. The Bt horizon ranges from heavy sandy loam to sandy clay loam and typically has a content of clay between 18 and 25 percent. The solum ranges from about 28 to 40 inches in thickness Bedrock is at a great depth.

All horizons generally are 10YR or 2 5Y in hue, but in some places the lower B horizon and the C horizon have a hue of 5Y. In undisturbed areas there is a dark grayish-brown A1 horizon 2 to 5 inches thick The A horizon has a value of 3 to 6 and a chroma of 1 to 4; the lowest value and chroma are in the A1 horizon. The B21t horizon is 5 or 6 in value and 6 to 8 in chroma The matrix of the B22t horizon is nearly like the B21t horizon in color, but it is mottled with grayish colors that generally are 2 or lower in chroma. In addition, the B22t horizon may contain mottles of high chroma. The B3 and C horizons have about the same color range as the B22t horizon, but normally they contain many more mottles than that horizon, and in places the gray mottles are dominant. The B3 horizon is missing in many places. In unlimed areas the reaction ranges from strongly acid to extremely acid. The acidity commonly increases with depth.

The Woodstown soils are similar to the Aldino, Butlertown, Delanco, Keyport, and Mattapex soils in natural drainage. The Woodstown soils do not contain a fragipan in the lower part of the subsoil like that in the Aldino and Butlertown soils, and they are much deeper to bedrock than Aldino soils. The Woodstown soils are less silty and more sandy in the solum than the Delanco and Mattapex soils. They do not have a heavy, clayey subsoil like that in the Keyport soils, and water moves much more rapidly through their subsoil than through the one in the Keyport soils.

Woodstown soils developed on the same kinds of material as the well-drained Sassafras, the grayish, poorly drained Fallsington, and the black, very poorly drained Pocomoke soils.

Woodstown sandy loam, 0 to 2 percent slopes (WoA).—This soil has a much sandier plow layer than Woodstown loam, 0 to 2 percent slopes, and normally is easier to drain and to work than that soil. Seasonal wetness limits use, and removing excess water is the main concern of management. (Capability unit IIw-5; woodland suitability group 7)

Woodstown sandy loam, 2 to 5 percent slopes, moderately eroded (WoB2).—The use of this soil is limited more by the erosion hazard than by impeded drainage. Included in mapping are a few acres where slopes are more than 5 percent and some severely eroded spots in which a few gullies have formed. (Capability unit IIe-36; woodland suitability group 7)

Woodstown loam, 0 to 2 percent slopes (WsA).—A profile of this soil is described as typical for the series. Impeded drainage and seasonal wetness are the main limitations that restrict use; there is little or no hazard of erosion. (Capability unit IIw-1; woodland suitability group 7)

Woodstown loam, 2 to 5 percent slopes, moderately eroded (WsB2).—Erosion is a hazard on this soil, but impeded drainage also limits use. A few small areas included in mapping are severely eroded, and a few have slopes of more than 5 percent. (Capability unit IIe-16; woodland suitability group 7)

Use and Management of Soils

The soils of New Castle County are used for crops, trees, and pasture, and, in some parts of the county, cropland is being used rapidly for residential and other nonfarm purposes. This section explains how the soils can be managed for these purposes and also for wildlife and in the building of highways, farm ponds, and other engineering structures. Also given are the estimated yields of the principal crops and pasture grasses.

In presenting information about the use of soils for crops and pasture and as woodland for wood products, the procedure is to describe a group that is made up of similar soils that are suitable for those purposes and to suggest use and management for the group. In the section on engineering, the soils are not grouped but are placed in tables so that properties significant to engineering work can be readily given. In the section on nonfarm uses, the soils are rated according to their limitations for selected uses.

Crops and Pasture

This subsection explains the system of capability classification used by the Soil Conservation Service, suggests management by capability groups of soils, and discusses general practices of managing soils for crops and pasture. Also, a table lists estimated yields of principal crops and pasture plants on arable soils under a high, or improved, level of management.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are 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 range, for forest trees, or engineering.

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

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

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

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

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, 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-4 or IIIe-5. 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 New Castle County the capability units are not in numerical order, because a statewide system is used in Delaware and all the capability units in the system are not in New Castle County.

Management by capability units

The soils in New Castle County have been placed in 36 capability units. The soils in each unit have about the same limitations, are subject to similar risks of damage, need about the same kind of management, and respond to management in about the same way. Made land and Urban land and the seven complexes that include Urban land have not been placed in a capability unit because they are generally the sites for industrial, residential, or other community development.

In the following pages each capability unit is described, and management for each is discussed. The names of the soil series represented are given in the description of each capability unit, but this does not mean that all of the soils in a given series are in the unit. To determine the soils in a capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I-4

This unit consists of deep, well-drained, medium-textured soils that occur on uplands and are nearly level and not more than slightly eroded. These soils are in the Chester, Matapeake, Montalto, and Neshaminy series. They are fairly easy to work. Moisture and plant nutrients are retained well and readily released to plants.

These soils are well suited to general farming. They can be intensively cultivated under good management that includes minimum tillage and use of all available crop residue. Practices are needed that keep the supply of plant nutrients high and that provide legumes and green-manure crops. Also needed is considerable lime in some places.

In this county the soils in this capability unit occupy about 11,680 acres.

CAPABILITY UNIT I-5

Sassafras sandy loam, 0 to 2 percent slopes, is the only soil in this capability unit. This soil occurs on uplands and is deep and well drained. It is easy to work and warms up more quickly than do finer textured soils.

The soil in this unit is well suited to crops that are planted early in spring. It can be intensively cultivated under good management. Good management includes minimum tillage and the use of all available crop residue. Practices are needed that keep the supply of plant nutrients high and that include legumes and green-manure crops in the cropping system. Moderate amounts of lime are needed in some places.

In this county this soil occupies about 280 acres.

CAPABILITY UNIT I-6

Comus silt loam is the only soil in this capability unit. This nearly level soil occurs on flood plains and is deep and well drained. It is generally subject to flooding, but it can be worked fairly easily after the danger of flooding has past. Moisture and plant nutrients are retained very well.

Because of the hazard of flooding, use of this soil is commonly limited to corn, forage crops, and pasture. Good management includes minimum tillage and use of all available crop residue. Practices are needed that keep the supply of plant nutrients high and that provide suitable cover crops. Considerable lime is needed in some places. In most places artificial drainage and practices that control erosion are not needed. In areas where the hazard of flooding is moderate, however, this soil should be managed as if it were in capability unit IIw-7. Where flooding is very frequent or severe, the use and management given for capability unit Vw-1 are suitable.

In this county this soil occupies about 453 acres.

CAPABILITY UNIT IIe-4

This unit consists of deep, well-drained, medium-textured soils that occur on uplands and are gently sloping and moderately eroded. These soils are in the Chester, Elioak, Elsinboro, Glenelg, Manor, Matapeake, Montalto, Neshaminy, and Talleyville series. The plow layer of these soils is crumbly silt loam or loam. Moisture and plant nutrients are retained well and are readily released to plants.

Under practices that normally are easy to apply, these soils are suitable for intensive cultivation. One of these practices is contour tillage where practical, and it is practical in most places. Also needed is minimum tillage and full use of crop residue. Crop rotations that include a large proportion of close-growing crops are advisable. Controlled grazing is necessary where these soils are used for pasture.

The soils in this unit occupy about 67,372 acres in this county.

CAPABILITY UNIT IIe-5

This unit consists of deep, well-drained, moderately coarse textured soils that occur on uplands and are gently sloping and moderately eroded. These soils are in the Collington and the Sassafras series. Their plow layer is crumbly to very crumbly sandy loam or fine sandy loam. Moisture and plant nutrients are retained moderately well, and these soils are easy to work.

The soils in this unit are suited to cultivated crops if management is good. Management practices are fairly easy to apply. A plant cover is needed for as much of the time as possible. Crop rotations should be at least 3 years long, and in this time only one clean-tilled crop should be grown. Contour tillage is needed where slopes permit it, and farming in contour strips is advisable. Good management includes minimum tillage and use of all available crop residue. The supply of plant nutrients should be kept high, and moderate amounts of lime are needed in some places. Controlled grazing is necessary where these soils are used for pasture.

In this county the soils of this unit occupy about 4,530 acres.

CAPABILITY UNIT IIe-13

This unit consists of moderately well drained, medium-textured soils that occur on uplands and are gently sloping and moderately eroded. These soils are in the Aldino, Glenville, and Keyport series. They have a very slowly permeable subsoil. The Aldino and Glenville soils have a fragipan in the lower part of the subsoil, and the Keyport soils have a sticky subsoil that is rich in clay.

Because of slope, runoff on these soils is so rapid that protection from erosion is more important than improvement of drainage. These soils may be too wet in some seasons and too dry in others. Planting may be delayed in spring. Good management includes practices that help to control erosion and, especially early in spring, that remove excess water. Among these practices are stripcropping in graded rows and use of interceptor ditches, diversion terraces, and sodded waterways. Tile lines or ditches are needed in local areas. The crop rotation should last at least 3 years and should provide only one clean-tilled crop. Crops that may be damaged by frost heaving in winter should not be planted.

The soils of this unit occupy about 12,367 acres in the county.

CAPABILITY UNIT IIe-16

This unit consists of moderately well drained, medium-textured soils that occur on uplands and are gently sloping and moderately eroded. These soils are in the Butlertown, Delanco, Mattapex, and Woodstown series. Permeability in the subsoil is moderate to moderately slow.

Because of slope, protecting these soils from erosion is more important than improving drainage. Improvement of internal drainage is not needed for some crops and generally is limited to spot drainage by tile lines or ditches. Because these soils tend to be wet in spring, planting is commonly delayed. The crop rotations should last at least 3 years and should include only one clean-tilled crop. Stripcropping, sodded waterways, and a few interceptors and diversion terraces as needed help to control erosion and to dispose of excess water safely. Planting crops that may be damaged by frost heaving in winter is not advisable.

The soils in this unit occupy about 5,810 acres in this county.

CAPABILITY UNIT IIe-36

Woodstown sandy loam, 2 to 5 percent slopes, moderately eroded, is the only soil in this unit. This soil occurs on uplands. It has a moderately permeable subsoil and is moderately well drained.

This soil is easier to work and generally is easier to drain than the soils in capability unit IIe-16 because it has a sandier surface layer and a more permeable subsoil. Also, crop damage by frost heaving generally is less. Planting, however, may be delayed in spring because of wetness. Needed for controlling erosion and for disposing of excess water are stripcropping, sodded waterways, and in places interceptors and diversion terraces. Tile lines are suitable where drainage is needed, but for many crops drainage may not be needed.

This soil occupies about 1,044 acres in the county.

CAPABILITY UNIT IIw-1

In this unit are nearly level, moderately well drained, medium-textured soils that occur on uplands. These soils are in the Butlertown, Delanco, Mattapex, and Woodstown series. Permeability of the subsoil is moderate to moderately slow. The hazard of erosion is not more than slight.

If adequate drainage is provided, these soils are suited to most crops commonly grown in the county. Drainage is not difficult and can be done by tile or open ditches. Planting is often late, however, and some perennial crops may be damaged by frost heaving. If drainage is adequate, limitations to farming are few.

In this county the soils in this unit occupy about 6,513 acres.

CAPABILITY UNIT IIw-3

This unit consists of nearly level, moderately well drained, medium-textured soils that occur on uplands and have a slowly permeable fragipan in the lower part of the subsoil. These soils are in the Aldino and the Glenville series. Drainage is needed for most uses.

These soils are well suited to most common crops if management is good and provides cultivation when these soils are neither too dry nor too wet. Not suitable, however, are crops that may be damaged by frost heaving in winter. Properly spaced tile lines or V-type ditches are generally adequate for removing excess water, but neither should be installed below the top of the fragipan.

The soils of this unit occupy about 2,798 acres in the county.

CAPABILITY UNIT IIw-5

Woodstown sandy loam, 0 to 2 percent slopes, is the only soil in this unit. This soil occurs on uplands, has a moderately permeable subsoil, and is moderately well drained.

The soil in this group is fairly easy to work and to drain. Tile lines function very well, and ditches also can be used. Some perennial crops may be damaged by frost heaving. Planting dates may be delayed because this soil does not dry or warm early in spring.

This soil occupies about 731 acres in the county.

CAPABILITY UNIT IIw-7

Codorus silt loam is the only soil in this capability unit. This soil is nearly level and moderately well drained. It occurs on flood plains and is likely to be flooded. The water table is seasonably high, and the subsoil is poorly aerated part of the year. This soil is mostly in pasture and is wooded in some areas, but it is suitable for many kinds of crops if drainage is improved. V-type ditches are commonly used for drainage, though tile lines also can be used. Runoff from higher areas should be intercepted and diverted. Main stream channels must be kept clean, and some of them may need deepening and straightening. In areas where the hazard of flooding is very frequent or severe, this soil ought to be used and managed as the soils in capability unit Vw-1.

This soil occupies about 1,830 acres in this county.

CAPABILITY UNIT IIw-8

Keyport silt loam, 0 to 2 percent slopes, is the only soil in this capability unit. This soil occurs on uplands and is moderately well drained. Its subsoil is clayey and very slowly permeable.

Drainage is difficult in most places because water enters and moves through the soil so slowly. Properly spaced ditches are needed for drainage, for tile lines do not function properly in the tight subsoil. This soil can be worked only within a narrow range of moisture content. Heavy machinery tends to compact the surface layer and cause puddling if the content of moisture is high. Perennial crops may be damaged by frost heaving, but corn, soybeans, pasture plants, and some other crops can be grown if management is good. Crops planted late grow better than crops planted early.

This soil occupies about 2,982 acres in this county.

CAPABILITY UNIT IIs-4

Rumford loamy sand, 2 to 5 percent slopes, moderately eroded, is the only soil in this capability unit. This deep soil occurs on uplands and is somewhat excessively drained. It has a thin sandy surface layer and a somewhat finer textured, moderately permeable subsoil.

Because this soil warms early in spring, it can be used for crops that are planted early. Some crops may grow faster on more moist, fertile soils than they do on this soil, but the early harvest and good quality of the crops may compensate for faster growth.

Seasonal droughtiness is the most important limitation to use and management, though moderate practices of erosion control are needed in some places. Because the sandy surface layer tends to blow when it is dry, a plant cover is needed as much of the time as feasible. Windbreaks are useful in places. Practices are needed for conserving moisture and plant nutrients, and most crops require large additions of fertilizer. In the dry periods of the growing season, irrigation is especially desirable. Contour tillage in alternating strips of row crops and close-growing crops helps to slow runoff and to increase absorption of water by the soil.

This soil occupies about 739 acres in the county.

CAPABILITY UNIT IIIe-4

In this unit are deep, well-drained, medium-textured soils that occur on uplands and are moderately sloping and moderately eroded. These soils are in the Chester, Elsinboro, Glenelg, Manor, Matapeake, Montalto, Neshaminy, and Talleyville series. Slopes are as much as 10 percent on the Coastal Plain and as much as 15 percent on the Piedmont Plateau.

Use of these soils for crops is limited unless practices of soil and water conservation are intensive. Tillage should be kept to a minimum and should be on contour strips. Where crops are grown, the rotations should last at least 4 years, and close-growing plants should be grown most of this time. Well-sodded diversion terraces and waterways are needed for carrying off excess water (fig. 9).

In this county these soils occupy about 14,705 acres.

CAPABILITY UNIT IIIe-5

Sassafras sandy loam, 5 to 10 percent slopes, moderately eroded, is the only soil in this capability unit. This deep soil is well drained and occurs on uplands. It is somewhat droughty in long, dry periods. This moderately sloping soil is severely limited for cropping unless practices of soil and water conservation are intensive. Practices that help to control erosion and conserve moisture include use of contour stripcropping, diversion terraces, and sodded waterways. In crop rotations, tilled crops should be planted no more than once in 4 years. Tillage is easy but should be kept to a minimum. Irrigation is needed in droughty periods.

This soil occupies about 1,791 acres in the county.

CAPABILITY UNIT IIIe-13

Keyport silt loam, 5 to 10 percent slopes, moderately eroded, is the only soil in this unit. This soil occurs on uplands. It has a very slowly permeable subsoil and is moderately well drained. Runoff is especially rapid, and the chief limitation to use for farming is the severe hazard of erosion in areas not protected by good practices of management.

Contour stripcropping and diversion terraces help to control runoff and erosion. Because planting usually is late in spring, this soil is not well suited to crops that may be damaged by frost heaving. Open ditches are needed in local wet spots. Tile lines do not function properly in the fine-textured, sticky, very slowly permeable subsoil.

This soil occupies about 874 acres in this county.

CAPABILITY UNIT IIIe-16

In this unit are moderately well drained, medium-textured, moderately sloping soils that are moderately eroded and have a subsoil with moderately slow permeability. These soils occur on uplands. They are in the Butlertown and Mattapex series. The hazard of erosion is severe because runoff is rapid and water does not easily penetrate into and through the soil.

At close intervals suitable interceptors and diversion terraces are needed to collect runoff and safely dispose of it through sodded waterways or through properly spaced tile lines. Other drainage improvement generally is not needed for most crops or for other uses. If tilled crops are grown, they should be planted only once in rotations that last 4 or preferably 5 years.

These soils occupy about 391 acres in this county.

CAPABILITY UNIT IIIe-33

Rumford loamy sand, 5 to 10 percent slopes, moderately eroded, is the only soil in this capability unit. This deep soil occurs on uplands and is somewhat excessively drained. It has a sandy surface layer that is underlain by a somewhat finer textured, moderately permeable subsoil. Erosion is probably the most important limitation to cultivation, but for general farming, practices other than those that control erosion are needed. Intensive practices are needed to conserve moisture because this soil is periodically droughty. Supplemental irrigation should be available if needed. If these practices of management are properly applied, this soil is especially well suited to truck crops and other crops that are planted early. In the rotations used, close-growing crops should be grown for as much time as feasible and row crops should not be grown more than once in 4 years. The crops should be grown in narrow strips on the contour. Windbreaks may be useful to check soil blowing if this soil is worked when dry.

In this county this soil occupies about 232 acres.

CAPABILITY UNIT IIIe-42

Silty and clayey land, gently sloping, is the only soil in this capability unit. This land is well drained in most places and has a highly unstable clay subsoil. It has a mantle of silty material that is a few inches to several feet thick and is underlain by variously colored, but dominantly red, clay. This land can be cultivated, but is low in fertility, tends to be seasonally droughty, and is rapidly eroded in areas where it is not protected and stabilized.

All cropping should be on the contour. Good management is needed to check erosion, conserve moisture, and supply large amounts of plant nutrients. Even when all of these practices are applied, crop growth may be poor. In areas that are not well protected, gullying tends to be severe, and exposed subsoil material may slip or flow, particularly when saturated.

This soil occupies about 140 acres in the county.

CAPABILITY UNIT IIIw-6

Fallsington sandy loam is the only soil in this capability unit. This nearly level soil occurs on uplands. It has a moderately permeable subsoil and is poorly drained. The water table is at or near the surface in spring and winter and seldom falls below a depth of about 3 feet. As a result, some areas are ponded for a long time. Fertility and available moisture capacity are moderate, and the soil is easy to work.

Under artificial drainage and other good management, corn, soybeans, and some hay and pasture can be grown on this soil. Truck and other specialty crops also can be grown. If adequate outlets are available, drainage is not difficult and tile lines generally function well. If ditches are used to provide drainage, they should not penetrate into the loose, sandy underlying material. Interceptor ditches and diversion terraces can be used to safely dispose of excess runoff.

This soil occupies about 10,063 acres in the county.

CAPABILITY UNIT IIIw-7

In this unit are poorly drained and very poorly drained, medium-textured soils that have a moderately permeable to moderately slowly permeable subsoil. These soils are in the Fallsington, Hatboro, Johnston, Othello, and Pocomoke series. The Johnston and some of the Hatboro soils occur on flood plains and have some limitations of flooding. In all of the soils, the water table is at or near the surface in winter and spring, and it seldom falls much below a depth of 3 feet. Available moisture capacity is high, but these soils are fairly difficult to work when they are a little too dry or too wet.

If adequate outlets are available, drainage is not too difficult. Either tile lines or ditches can be used to pro-

***Figure 9.*—An asparagus field on soils of capability unit IIIe-4 where a permanently sodded waterway is used for carrying off excess water. The sodded strip is used as a temporary roadway in dry periods.**

vide drainage. The drains must be more closely spaced than for the soil in capability unit IIIw-6. If ditches are used to provide drainage, they should not penetrate into the sandy material that underlies some of the soils. Interceptor ditches and diversion terraces can be used to safely dispose of excess runoff. If these soils are properly drained, they are suited to corn and soybeans, as well as to hay and pasture plants. Some erosion control is needed on the more sloping soils.

These soils occupy about 26,132 acres in this county.

CAPABILITY UNIT IIIw-9

In this unit are poorly drained and very poorly drained, medium-textured soils that are nearly level and in depressional areas or are gently sloping. These soils are on uplands and have a fine-textured, very slowly permeable subsoil. They are in the Bayboro and Elkton series. The water table is at or near the surface in winter and at times late in spring. The depressional areas, therefore, are likely to be ponded.

The soils in this unit are more difficult to drain than other poorly drained and very poorly drained soils of the county. Because of the tight subsoil, tile drains do not function properly. Interceptor ditches and diversion terraces can be used safely to dispose of excess runoff. Closely spacing the ditches and grading the areas between the ditches provide better surface drainage in some areas. In other areas crops are planted in elevated or graded rows. Corn and soybeans are the crops commonly grown, though hay or pasture plants are grown in some places. Practices that control erosion are needed on some of the more sloping soils.

In this county the soils in this capability unit occupy about 9,504 acres.

CAPABILITY UNIT IIIw-11

The only soil in this capability unit is Elkton sandy loam, 0 to 2 percent slopes. This soil is poorly drained and occurs on uplands. It has a fine-textured, very slowly permeable subsoil. In winter and spring, the water table is at or near the surface.

Ditches that are properly spaced remove water readily from the plow layer, but the subsoil is slow to drain. If adequate outlets are available, ditches can be used to drain the subsoil, but tile drains do not function properly. Interceptor ditches and diversion terraces can be used to remove excess runoff. The plow layer is easy to work after this soil is adequately drained. Corn and soybeans are the crops commonly grown.

This soil occupies about 694 acres in the county.

CAPABILITY UNIT IVe-3

This unit consists of deep, well-drained, medium-textured to moderately fine textured soils that are moderately sloping to strongly sloping and occur on uplands. These soils are moderately eroded or are severely eroded. They are in the Chester, Elioak, Glenelg, Manor, Matapeake, Montalto, and Neshaminy series. The land type, Silty and clayey land, sloping, is also in this unit. In the severely eroded soils, the present surface layer consists mostly of material from the subsoil that has been mixed with the remaining surface layer by plowing. Many gullies cut the areas.

Slope and erosion make these soils marginal for tilled crops. Tilled crops should be grown no more than once in 5 years, and they should be planted on the contour in narrow strips where feasible. Other erosion practices also are needed and must be intensively applied and maintained. Better uses for the soils of this unit are for permanent hay or pasture or for orchards that are planted on the contour and that have a permanent ground cover.

These soils occupy about 11,703 acres in this county.

CAPABILITY UNIT IVe-5

In this unit are deep, well-drained, moderately coarse textured soils that are moderately sloping to strongly sloping and occur on uplands. These soils are in the Collington and Sassafras series. Some of them are moderately eroded, and others are severely eroded. They are among the earliest soils of the county to warm in spring and have a sandy surface layer that generally is easy to work.

Slopes and erosion make the soils of this unit marginal for tilled crops. Tilled crops should not be grown more than once in 5 years, and they should be planted on the contour in narrow strips where feasible. Better uses of these soils are for permanent hay or pasture or for orchards that are planted on the contour and that have a permanent ground cover. All practices for the control of erosion must be intensively applied and carefully maintained. Also, moisture must be conserved because the moisture holding capacity of these soils is only moderate. Wherever economically feasible, irrigation is beneficial.

These soils occupy about 1,960 acres in the county.

CAPABILITY UNIT IVe-9

Mattapex silt loam, 5 to 10 percent slopes, severely eroded, is the only soil in this capability unit. This soil is moderately well drained and occurs on uplands. All of the original surface layer has been washed away, and the present plow layer consists of material that formerly was in the subsoil.

The hazard of further erosion is very high on this soil, and growth of tilled crops is strictly marginal. Artificial drainage probably is not needed, but diversion terraces and sodded waterways are needed for safe removal of excess water. Corn or other tilled crops should not be planted more than 1 year in 5; hay, pasture plants, or other close-growing vegetation should be kept on this soil the rest of the time.

This soil occupies about 197 acres in the county.

CAPABILITY UNIT Vw-1

This unit consists of poorly drained, medium-textured soils that have such a very slowly permeable subsoil that drainage for cultivation is not feasible. These nearly level soils are on uplands. Areas are on flats and depressions, around and above the heads of drainageways, and on old stream terraces. These soils are in the Calvert, Kinkora, and Watchung series.

Drainage can be improved by diverting runoff from higher areas to open ditches for safe removal. Tile drains normally do not function well in these soils. Most areas are in wooded wetland, but cleared areas generally are idle or are used for grazing. In most places improved pasture is the most suitable use for these soils.

In this county these soils occupy about 2,526 acres.

CAPABILITY UNIT VIe-2

In this unit are deep, dominantly well drained soils that are steep or are strongly sloping and severely eroded. These soils are in the Chester, Collington, Elioak, Glenelg, Keyport, Manor, Montalto, Matapeake, Neshaminy, and Sassafras series. They occur in nearly all parts of the county, and the individual areas generally are small.

These soils are either too steep or too severely eroded for safe cultivation. If clean-tilled crops are grown, all of the surface layer, and in many places part of the subsoil, is likely to be lost. Further erosion may even occur where hay crops are grown unless intensive practices are used for control of erosion. Pasture generally is the most suitable use other than woodland for these soils, but good management that includes controlling grazing is needed. Areas now in trees should remain wooded, and some areas ought to be reforested.

The soils in this unit occupy about 9,817 acres in the county.

CAPABILITY UNIT VIw-1

This unit consists of only Mixed alluvial land, which is made up of alluvial material that was recently deposited on flood plains. This land is dominantly poorly drained.

Grazing is one of the most suitable uses for Mixed alluvial land, though preparing the areas for grazing may not be economical. Where feasible, grasses and legumes that tolerate wetness and that are suitable for grazing can be established in areas already cleared. Grazing is seasonal, because the water table is high for much of the year and most areas are subject to frequent flooding. Wooded areas are best kept in trees and managed for woodcrops, and some cleared areas should be planted to trees. All of the areas provide habitat for some kinds of wildlife. Many sites are suitable for ponds or small lakes.

In this county Mixed alluvial land occupies about 3,702 acres.

CAPABILITY UNIT VIw-2

This unit consists of gently sloping, wet soils that generally are not feasible to drain for crops. These soils are in the Calvert, Kinkora, and Watchung series. Their surface layer is hard when dry, tough when moist, and sticky when wet.

The soils in this unit are not suited to cultivation, because they are so difficult to drain and to work. They also erode rapidly if the vegetative cover is removed. Drainage other than partial surface drainage to improve grazing is impractical, because the subsoil of these soils is so slowly permeable. Areas to be grazed can be improved by installing ditches, seeding, and applying fertilizer and lime. In addition, brush and weeds should be controlled. Wooded areas are best kept in trees.

The soils in this unit occupy about 425 acres in the county.

CAPABILITY UNIT VIs-3

Only Neshaminy and Talleyville very stony silt loams, 3 to 35 percent slopes, is in this unit. These soils occur on uplands and are well drained.

Stones and slopes make these soils unsuitable for cultivation, though they can be used for grazing. Limited hay crops can be grown in some areas if the stones are at least partly removed, the areas are adequately seeded, and lime and fertilizer are applied. Controlling grazing helps to prevent destruction of the sod by trampling and thus helps to control erosion. Control of weeds and brush may be difficult. Wooded areas are best kept in trees, and some areas ought to be reforested.

The soils in this unit occupy about 684 acres in the county.

CAPABILITY UNIT VIIe-2

This unit consists only of Silty and clayey land, steep, which is made up of dominantly well drained soil material. The soil material is highly unstable clay in the lower part. This material, particularly that just below the surface, tends to slip and flow, especially when wet. Stabilizing the areas with vegetation is difficult even under the best conditions, and it is almost impossible if the soil is tilled or grazed. A dense cover of vegetation is needed at all times. Wooded areas should be kept in trees and managed as woodland. Cleared areas ought to be reforested.

Silty and clayey land, steep, occupies about 237 acres in this county.

CAPABILITY UNIT VIIs-4

Watchung very stony silt loam is the only soil in this capability unit. It is poorly drained. Because it is stony and so wet, most areas are suitable only for wetland trees. Some areas, however, can be used for limited seasonal grazing. It is not feasible nor economical to improve this soil for crops. Wooded areas can be managed for wooded crops and as habitat for some kinds of wildlife.

In this county this soil occupies about 106 acres.

CAPABILITY UNIT VIIIw-1

This unit consists of only Tidal marsh, which is made up of land that is regularly flooded by high tides. These marshy areas have no present use in farming, but they provide habitat for waterfowl, muskrats, and other wildlife. Bulkheads have been built in some areas, and the areas filled in. In this way the areas were converted to Made land, which can be used for industrial or similar purposes.

Tidal marsh occupies about 23,242 acres in this county.

CAPABILITY UNIT VIIIs-4

This unit consists only of Gravel pits and Quarries. Unless these areas are completely reclaimed, they have no practical use in farming. Gravel pits and Quarries occupy about 788 acres in this county.

General management requirements

Some of the management practices needed to obtain a good growth of crops are applicable to many of the soils in New Castle County. These practices include draining the soils that are wet all or part of the year, irrigating where needed and practical, using soil amendments in proper amounts and at appropriate times, choosing a suitable rotation, tilling the soils properly, and managing crop residue.

DRAINAGE

Improving drainage is one of the main management needs in New Castle County. Artificial drainage is needed on about 38 percent of the acreage suitable for crops. Unless drainage is well established and maintained on this acreage, crops commonly grow poorly or fail completely. About 2 percent of the acreage in the county is not ordinarily used for crops, but improving drainage on this acreage increases the amount and quality of forage produced for grazing. In some parts of the county there are farms that are located mostly or entirely on well-drained soils.

Soils that require no artificial drainage are those of the Chester, Collington, Comus, Elioak, Elsinboro, Glenelg, Manor, Matapeake, Montalto, Neshaminy, Talleyville, Rumford, and Sassafras series. Also in this group is Silty and clayey land. These soils make up about 60 percent of the acreage in the county that is available for farming.

Soils that require moderate artificial drainage are those of the Aldino, Butlertown, Codorus, Delanco, Glenville, Keyport, Mattapex, and Woodstown series. These soils make up about 17 percent of the county that is available for farming.

Soils that require intensive artificial drainage are the Elkton, Fallsington, Hatboro, Kinkora, Othello, Calvert, and Watchung and the land type, Mixed alluvial land. All of these make up about 21 percent of the county that is available for farming.

Soils that require very intensive artificial drainage are those of the Bayboro, Johnston, and Pocomoke series. These soils make up the remaining 2 percent of the acreage that is available for farming.

The kinds of drainage systems that are suitable for the soils of this county are explained in the "Delaware Agricultural Drainage Guide" (*11*).

The Codorus, Comus, and Johnston soils, some areas of the Hatboro soils, and Mixed alluvial land generally are subject to flooding by streams. The severity of the flood hazard varies from place to place, and the records of flooding are the best guides to the need for protection.

IRRIGATION

The availability of water for irrigation can be important in sustaining the growth of crops during extended dry periods. In New Castle County, where many of the soils are sloping to hilly, crops are irrigated almost exclusively by the sprinkler method.

Information concerning irrigation is given in the "Delaware Guide for Sprinkler Irrigation" (*9*), which is available from the University of Delaware. Features that affect the suitability of individual soils for irrigation are given in tables 5 and 6 in the section "Engineering Uses of Soils."

SOIL AMENDMENTS

Nearly all of the soils in the county are acid, and only few of them are naturally high in plant nutrients. For these reasons, additions of fertilizer and lime are needed for most crops. The amount of lime and the kinds and amounts of fertilizer needed can be determined by soil tests. Assistance in determining the specific requirement on each soil can be obtained from the county agricultural agent, who will arrange to have soils tested at the laboratories of the University of Delaware.

Only a small amount of lime but a very large amount of fertilizer are needed on the Rumford and other sandy soils of the county. On many other soils, more lime but less fertilizer are needed for a favorable growth of crops.

CROP RESIDUE

Leaving crop residue on the surface and then plowing it under are important conservation practices on nearly all of the soils in New Castle County. All plant material that is not needed for harvest should be left in the field. Residue on or near the surface helps to protect the soil from blowing and from water erosion. Later, if the residue is turned under, it supplies organic matter, improves structure and the moisture-holding capacity of the plow layer, increases aeration and infiltration, and decreases runoff. This is especially important on the Rumford and other sandy soils and also on the Keyport and other clayey soils.

Corn, soybeans, cover crops, and green-manure crops provide residue that can be used to help maintain the soils in this county. Except when cover crops and green-manure crops are grown for seed, they are not generally harvested and can be used for soil improvement and protection. If corn is grown for silage, practically all of the plant is removed. If corn is grown only for grain, however, the leaves and stalks can be left in the field after the corn is harvested. This residue can be left on the surface and later turned under. Leaving the stalks and leaves of corn in the field reduces soil losses from 10 to 25 percent, depending on the kind of soil, the yield level of the corn, and the tillage practices used.

Estimated yields

Table 2 shows the estimated average yields per acre of the principal crops grown on most soils of the county under improved management. Yields are not listed for Gravel pits and Quarries, Made land and Urban land, Tidal marsh, and the seven complexes that include Urban land. These mapping units either are not suitable or are not available for farming.

The yields given in the table are those that are obtained under management followed by farmers who use good conservation practices. This level of management is considered high, and at this level each soil is used within its capability.

To obtain the yields listed in table 2, all or nearly all of the following practices are needed:

1. Contour tillage, stripcropping, terracing, minimum tillage, and similar measures are used wherever needed to help control erosion; the soils that need drainage are adequately drained; excess water is disposed of safely; and irrigation water is applied to soils and crops that need it.
2. Crop rotations are of adequate length. They generally consist of a tilled crop that helps to control weeds; a deep-rooted crop that helps improve soil structure and improves permeability; legumes for 1 year or more to help maintain or improve fertility; and a close-growing crop for 1 year or more. A close-growing crop improves structure and tilth, supplies organic matter, and reduces erosion.

TABLE 2.—*Estimated average yields per acre of principal crops grown under improved, or high-level, management*

[Absence of figure indicates that crop is not suited to the soil or is not commonly grown on it]

Soil	Corn	Oats	Wheat	Irish potatoes	Soybeans	Alfalfa-grass hay	Clover-grass hay	Bluegrass pasture	Tall-grass pasture
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days*
Aldino silt loam, 0 to 3 percent slopes	75	50	35	--	--	3.1	3.0	140	180
Aldino silt loam, 3 to 8 percent slopes, moderately eroded	80	50	35	--	--	3.3	3.2	150	190
Bayboro silt loam	80	--	--	--	30	--	3.0	115	170
Butlertown silt loam, 0 to 2 percent slopes	115	60	40	650	40	4.5	3.5	120	260
Butlertown silt loam, 2 to 5 percent slopes, moderately eroded	115	60	40	650	40	4.5	3.5	120	260
Butlertown silt loam, 5 to 10 percent slopes, moderately eroded	105	60	40	625	--	4.5	3.5	120	260
Chester loam, 0 to 3 percent slopes	115	60	45	665	--	4.8	3.3	140	275
Chester loam, 3 to 8 percent slopes, moderately eroded	115	60	40	645	--	4.7	3.2	140	270
Chester loam, 8 to 15 percent slopes, moderately eroded	105	55	40	610	--	4.4	3.0	140	250
Chester loam, 8 to 15 percent slopes, severely eroded	85	50	40	560	--	4.2	2.9	140	240
Chester loam, 15 to 25 percent slopes, moderately eroded	95	55	35	580	--	4.3	3.0	140	245
Chester loam, 15 to 25 percent slopes, severely eroded	--	--	--	--	--	4.0	2.8	130	225
Codorus silt loam	100	--	--	--	--	--	3.3	150	230
Collington fine sandy loam, 2 to 5 percent slopes, moderately eroded	110	55	40	600	45	4.0	3.0	115	230
Collington fine sandy loam, 5 to 10 percent slopes, severely eroded	90	50	35	550	--	3.5	3.0	115	200
Collington fine sandy loam, 10 to 25 percent slopes, severely eroded	--	--	--	--	--	3.5	3.0	115	200

See footnote at end of table.

TABLE 2.—*Estimated average yields per acre of principal crops grown under improved, or high-level, management*—Continued

Soil	Corn	Oats	Wheat	Irish potatoes	Soybeans	Alfalfa-grass hay	Clover-grass hay	Bluegrass pasture	Tall-grass pasture
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Comus silt loam	115	60	45			4.5	3.5	150	260
Delanco silt loam, 0 to 3 percent slopes	100	55	40			4.0	3.0	115	230
Delanco silt loam, 3 to 8 percent slopes, moderately eroded	105	55	40			4.0	3.0	115	230
Elioak silt loam, 3 to 8 percent slopes, moderately eroded	115	60	40	645		4.7	3.2	140	270
Elioak silty clay loam, 8 to 15 percent slopes, severely eroded	85	50	40			4.2	2.9	140	240
Elioak silty clay loam, 15 to 25 percent slopes, severely eroded						4.0	2.8	130	225
Elkton sandy loam, 0 to 2 percent slopes	80				30		3.0	115	170
Elkton silt loam, 0 to 2 percent slopes	80				30		3.0	115	170
Elkton silt loam, 2 to 5 percent slopes	85				35		3.1	115	170
Elsinboro silt loam, 3 to 8 percent slopes, moderately eroded	115	60	40	645		4.7	3.2	130	250
Elsinboro silt loam, 8 to 15 percent slopes, moderately eroded	105	55	40	610		4.4	3.0	130	230
Fallsington sandy loam	85				35		3.0	115	170
Fallsington loam	90				35		3.0	115	170
Glenelg and Manor loams, 3 to 8 percent slopes, moderately eroded	115	60	40	645		4.7	3.2	140	270
Glenelg and Manor loams, 8 to 15 percent slopes, moderately eroded	105	55	40	610		4.4	3.0	140	250
Glenelg and Manor loams, 8 to 15 percent slopes, severely eroded	85	50	40	560		4.2	2.9	140	240
Glenelg and Manor loams, 15 to 25 percent slopes, moderately eroded	95	55	35	580		4.3	3.0	140	245
Glenelg and Manor loams, 15 to 25 percent slopes, severely eroded						4.0	2.8	130	225
Glenelg and Manor loams, 25 to 45 percent slopes						4.1	2.9	140	230
Glenville silt loam, 0 to 3 percent slopes	75	45	30			3.0	3.0	140	170
Glenville silt loam, 3 to 8 percent slopes, moderately eroded	80	45	30			3.2	3.1	150	180
Hatboro silt loam	90						3.0	140	170
Hatboro silt loam, local alluvium, 0 to 3 percent slopes	95						3.2	140	170
Hatboro silt loam, local alluvium, 3 to 12 percent slopes	100						3.2	140	180
Johnston loam	90				25		2.8	130	170
Keyport silt loam, 0 to 2 percent slopes	90	55	35		35	3.5	3.0	115	200
Keyport silt loam, 2 to 5 percent slopes, moderately eroded	95	55	35		40	3.5	3.0	115	200
Keyport silt loam, 5 to 10 percent slopes, moderately eroded	90	45	35		40	3.5	3.0	115	200
Keyport silty clay loam, 5 to 10 percent slopes, severely eroded						3.0	2.5	85	170
Kinkora silt loam, 0 to 3 percent slopes	85						3.1	120	180
Kinkora silt loam, 3 to 8 percent slopes	90						3.2	120	180
Matapeake silt loam, 0 to 2 percent slopes	115	60	40	650	40	4.5	3.5	120	255
Matapeake silt loam, 2 to 5 percent slopes, moderately eroded	115	60	40	650	40	4.5	3.5	120	255
Matapeake silt loam, 5 to 10 percent slopes, moderately eroded	105	60	40	625		4.5	3.5	120	255
Matapeake silt loam, 5 to 10 percent slopes, severely eroded	95	50	30	550		4.0	3.0	115	230
Matapeake silt loam, 10 to 15 percent slopes, moderately eroded	95	50	35	500		4.5	3.5	120	255
Matapeake silt loam, 10 to 15 percent slopes, severely eroded						4.0	3.0	115	230
Matapeake silt loam, silty substratum, 0 to 2 percent slopes	120	60	45	675	45	4.8	3.6	130	270
Matapeake silt loam, silty substratum, 2 to 5 percent slopes, moderately eroded	120	60	45	675	45	4.8	3.6	130	270
Matapeake silt loam, silty substratum, 5 to 10 percent slopes, moderately eroded	110	60	45	650		4.8	3.6	130	270
Mattapex silt loam, 0 to 2 percent slopes	100	60	40		40	4.0	3.5	120	230
Mattapex silt loam, 2 to 5 percent slopes, moderately eroded	105	60	40		40	4.0	3.5	120	230
Mattapex silt loam, 5 to 10 percent slopes, moderately eroded	95	60	40			4.0	3.5	120	230

See footnote at end of table.

TABLE 2.—*Estimated average yields per acre of principal crops grown under improved, or high-level, management*—Continued

Soil	Corn	Oats	Wheat	Irish potatoes	Soybeans	Alfalfa-grass hay	Clover-grass hay	Bluegrass pasture	Tall-grass pasture
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Mattapex silt loam, 5 to 10 percent slopes, severely eroded	85	50	35	----	----	3.7	3.2	115	210
Mixed alluvial land	----	----	----	----	----	----	----	130	170
Neshaminy and Montalto silt loams, 0 to 3 percent slopes	115	60	45	665	----	4.8	3.3	140	275
Neshaminy and Montalto silt loams, 3 to 8 percent slopes, moderately eroded	115	60	40	645	----	4.7	3.2	140	270
Neshaminy and Montalto silt loams, 8 to 15 percent slopes, moderately eroded	105	55	40	610	----	4.4	3.0	140	250
Neshaminy and Montalto silty clay loams, 8 to 15 percent slopes, severely eroded	85	50	40	----	----	4.2	2.9	140	240
Neshaminy and Montalto silty clay loams, 15 to 25 percent slopes, severely eroded	----	----	----	----	----	4.0	2.8	130	225
Neshaminy and Talleyville very stony silt loams, 3 to 35 percent slopes	----	----	----	----	----	----	----	110	----
Othello silt loam	80	----	----	----	30	----	3.0	115	170
Pocomoke loam	90	----	----	----	35	----	3.0	115	170
Rumford loamy sand, 2 to 5 percent slopes, moderately eroded	90	55	35	550	40	4.0	3.0	115	230
Rumford loamy sand, 5 to 10 percent slopes, moderately eroded	80	55	35	500	40	4.0	3.0	115	230
Sassafras sandy loam, 0 to 2 percent slopes	100	55	40	600	45	4.0	3.0	115	230
Sassafras sandy loam, 2 to 5 percent slopes, moderately eroded	100	55	40	600	45	4.0	3.0	115	230
Sassafras sandy loam, 5 to 10 percent slopes, moderately eroded	90	55	40	600	----	4.0	3.0	115	230
Sassafras sandy loam, 5 to 10 percent slopes, severely eroded	80	50	35	550	----	3.5	3.0	115	200
Sassafras sandy loam, 10 to 15 percent slopes, moderately eroded	70	50	35	575	----	4.0	3.0	115	230
Sassafras sandy loam, 10 to 15 percent slopes, severely eroded						3.0	2.0	60	170
Sassafras and Matapeake soils, 15 to 30 percent slopes	----	----	----	----	----	3.5	2.5	85	200
Silty and clayey land, gently sloping	80	----	----	----	----	3.5	2.5	70	150
Silty and clayey land, sloping	65	----	----	----	----	3.0	2.0	60	130
Silty and clayey land, steep	----	----	----	----	----	----	----	50	110
Talleyville silt loam, 2 to 5 percent slopes, moderately eroded	120	65	45	680	45	4.8	3.6	130	270
Talleyville silt loam, 5 to 10 percent slopes, moderately eroded	110	60	45	650	----	4.8	3.6	130	270
Watchung very stony silt loam	----	----	----	----	----	----	----	75	100
Watchung and Calvert silt loams, 0 to 3 percent slopes	----	----	----	----	----	----	----	85	110
Watchung and Calvert silt loams, 3 to 8 percent slopes	----	----	----	----	----	----	----	90	125
Woodstown sandy loam, 0 to 2 percent slopes	90	50	40	----	45	4.0	3.0	115	230
Woodstown sandy loam, 2 to 5 percent slopes, moderately eroded	90	50	40	----	45	4.0	3.0	115	230
Woodstown loam, 0 to 2 percent slopes	100	55	40	----	45	4.0	3.0	115	230
Woodstown loam, 2 to 5 percent slopes, moderately eroded	100	55	40	----	45	4.0	3.0	115	230

[1] Cow-acre-days is a term used to express the carrying capacity of pasture It is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30 days of grazing for two cows has a carrying capacity of 60 cow-acre-days.

3. Manure, crop residue, and green-manure crops are turned under to supply nitrogen, other plant nutrients, and organic matter. This also improves tilth and aids in controlling erosion.
4. Fertilizer and lime are applied according to the needs indicated by soil tests.
5. Suitable methods of plowing, preparing the seedbed, and cultivating are used, but tillage is kept to a minimum.
6. Soil preparation, planting, cultivating, and harvesting are done at the right time and in the right way.
7. Crop varieties suited to the soil are selected for planting.
8. Weeds, diseases, and insects are controlled.

The yields shown in table 2 are not presumed to be the highest yields obtainable, but they set a goal that is practical for most farmers to reach if they use good management. Yields on the same soil can be expected to vary because of differences in management, the weather, the crop varieties grown, and the numbers and kinds of insects, diseases, and weeds.

The table gives yields that show the relative productivity of the soils. Although the general level of crop yields and the yield estimates tend to rise over a period of years, the relationship of the soils to each other normally remains the same. The yield estimates in this table were made in 1965. Estimates are updated from time to time and are available at the Office of the Soil Conservation Service, Newark, Delaware.

More information about management practices needed to obtain high yields can be found in the sections "Capability grouping" and "General management requirements."

Use of Soils as Woodland

Commercial woodland occupies about 61,300 acres in New Castle County (*2*). The dominant trees are hardwoods, mostly oaks, though much of the timber harvested has been yellow-poplar. Some kinds of oak are suited to wetlands, and some to the well-drained uplands. Other hardwoods common in the county are sweetgum, blackgum, holly, swamp maple, hickory, beech, and locust (*4*). Practically all of the stands have been severely cut over. Some areas that once were cleared and, in some places, cultivated are now in second-growth stands.

Conifers are not naturally common in the county, but some species are suitable for planting. Pond pine is native in some wet areas, and Virginia pine grows in some areas of better drained sandy soils. An occasional tree or thin stand of loblolly pine occurs, and there are a few shortleaf pine and pitch pine. White pine is the conifer preferred for planting in the northern, or Piedmont, part of the county. Loblolly pine can be successfully planted on the Coastal Plain. Information on the growth and production of loblolly pine on soils in southern New Castle County is available from studies made on the same kinds of soils in nearby areas of Delaware and Maryland.

Woodland suitability groups

Just as soils are placed in capability classes, subclasses, and units according to their suitability for crops and pasture, they can be grouped according to their suitability for trees. Each woodland suitability group is made up of soils that are suitable for about the same kinds of trees, require about the same management, and have about the same potential productivity for wood crops.

The potential productivity of a soil for trees can be expressed in different ways. In this section the potential productivity for loblolly pine is expressed as the site index, and that for most other tree species is given in terms of annual growth.

The site index for a given soil is the height, in feet, that a tree growing on that soil will reach in 50 years. Except for Virginia pine, annual growth is listed as the number of board feet that is produced in one year at age 50 years. Site index can be used for normal trees growing in even-aged stands that have not been adversely affected by fire, grazing, ice, storm damage, or other external factors. For Virginia pine the annual growth is expressed in cords of pulpwood.

All the soils in one woodland suitability group are similar with respect to the hazards and limitations that affect management. These are seedling mortality, plant competition, equipment limitations, and the hazard of erosion and windthrow. The limitations are rated slight, moderate, or severe.

Plant competition refers to competition from weeds, vines, and other undesirable plants and trees that invade when openings are made in the canopy. The ratings for equipment limitations are based on the degree that soil characteristics and topographic features restrict or prohibit the use of equipment commonly used in woodland management. Seedling mortality refers to the expected degree of mortality of naturally occurring or planted trees as influenced by the kind of soil. The hazard of windthrow is determined on the basis of properties of the soils that influence the development of tree roots. The rating for hazard of erosion is determined on the basis of the erodibility of the soil when it is not fully protected by a woodland cover, as in the seedling stages of tree growth, or after the marketable trees have been harvested.

In the following discussion of woodland suitability groups, the groups are not numbered consecutively, because they are part of a system of grouping that is used throughout Delaware and Maryland, and only a comparatively few of all the groups are represented in this county. The names of the soil series represented are mentioned in the description of each woodland group, but this does not mean that all the soils of a given series appear in the group. Soils mapped in complexes that contain Urban land have not been placed in groups, as most of their acreage is used for residential, commercial, or other community purposes. To find the names of the soils in any given woodland group, refer to the "Guide to Mapping Units" at the back of this soil survey.

WOODLAND SUITABILITY GROUP 3

This group consists of poorly drained soils of the Hatboro series. These soils occur on flood plains and on foot slopes, generally adjacent to flood plains, of the Piedmont Plateau in the northern part of the county.

These soils are excellent for wetland oaks, especially pin oak, and they are very good for yellow-poplar in areas not subject to flooding. At age 50 years, the expected annual growth per acre is about 275 board feet for pin oak and about 490 board feet for yellow-poplar. White pine is preferred for planting. Scotch pine and white pine are suitable for producing Christmas trees commercially.

Seedling mortality is moderate because of frost heaving and, on flood plains, damage by floodwater. Improving drainage or planting trees in mounds is desirable. Competition from undesirable plants is severe. Wetness and the risk of flooding severely limit the use of equipment Erosion and windthrow are only slight hazards.

WOODLAND SUITABILITY GROUP 4

This group consists of deep, well-drained soils that occur in the northern, or Piedmont, part of the county. These soils are in the Chester, Glenelg, Neshaminy, Manor, Montalto, and Talleyville series.

The soils in this group are very good sites for hardwoods. At age 50 years, the expected annual growth per acre is about 480 board feet for yellow-poplar and about 275 board feet for mixed upland oaks. White pine, black walnut, and yellow-poplar are preferred for planting. Scotch pine, Norway spruce, Austrian pine, white pine, and blue spruce are suitable for producing Christmas trees commercially.

Seedling mortality is slight on these soils. Plant competition is moderate or severe. In areas where slopes are not more than 15 percent, limitations to the use of equipment are only slight if the soil is dry or nearly dry but are moderate if the soil is wet. Where slopes exceed 15 percent, equipment limitations are moderate or severe. Windthrow is only a slight hazard. The risk of erosion is slight on slopes of 0 to 15 percent, moderate on slopes of 15 to 25 percent, and severe on slopes of more than 25 percent.

WOODLAND SUITABILITY GROUP 5

Collington fine sandy loam, 2 to 5 percent slopes, moderately eroded, is the only soil in this group. This soil occurs only in the southern part of the county. It is deep and well drained, and it contains a moderate amount of glauconite.

This soil is good for loblolly pine and is very good for oaks and yellow-poplar. At age 50 years, the expected annual growth per acre is about 275 board feet for upland oaks, about 490 board feet for yellow-poplar, and about 470 board feet for loblolly pine. The site index for loblolly pine is about 80. White pine, yellow-poplar, and loblolly pine are preferred for planting. Scotch pine, Austrian pine, and white pine are suitable for producing Christmas trees commercially.

Seedling mortality, equipment limitations, and the hazards of windthrow and of erosion are only slight on the soil in this group. Competition from unwanted woody plants is moderate, particularly for pines.

WOODLAND SUITABILITY GROUP 7

This group consists of Mixed alluvial land and soils of the Bayboro, Butlertown, Delanco, Fallsington, Johnston, Pocomoke, and Woodstown series. All of these soils have impeded drainage.

These soils are very good sites for loblolly pine, yellow-poplar, sweetgum, and ash. At age 50 years, the expected annual growth per acre is about 680 board feet for loblolly pine and about 490 board feet for yellow-poplar. The expected yearly growth of sweetgum and ash has not been estimated. The site index for loblolly pine is about 90. Loblolly pine and sweetgum are preferred for planting, but if seedlings are planted in soils on flood plains, improved drainage or mounding is desirable. Scotch pine and white pine are suitable for Christmas trees.

Seedling mortality is moderate on these soils, but competition from herbaceous plants and brush is severe. Except on the Butlertown soils, equipment limitations are severe because of a seasonal high water table; the limitation is only moderate on the Butlertown soils. There is little or no hazard of windthrow and erosion.

WOODLAND SUITABILITY GROUP 8

In this group are acid, moderately well drained Glenville soils, which contain a fragipan in the lower part of their subsoil. These soils lie on the Piedmont Plateau.

The soils in this group are very good sites for upland oaks and are good for yellow-poplar and hickory. At age 50 years, the expected annual growth per acre of upland oaks is about 275 board feet. White pine is preferred for planting. Scotch pine, Norway spruce, Austrian pine, and white pine are suitable for producing Christmas trees commercially.

Seedling mortality is slight on these soils. Plant competition is moderate for hardwoods but is severe for pines. The use of equipment is moderately or severely limited by a perched water table that is near the surface in wet periods. The hazard of erosion is only slight, but that of windthrow is slight or moderate because the fragipan commonly restricts root growth to some degree.

WOODLAND SUITABILITY GROUP 9

This group consists of moderately well drained and well drained soils that occur on flood plains in the northern, or Piedmont, part of the county. These soils are in the Codorus and Comus series.

The soils in this group are very good or excellent sites for yellow-poplar and adapted oaks. At age 50 years, the expected annual growth per acre is 275 to 350 board feet for oaks and is 500 to 600 board feet for yellow-poplar. Other important trees are black walnut, hickory, and beech. Preferred for planting are white pine, yellow-poplar, and black walnut. Suitable for producing Christmas trees commercially are Douglas-fir, Scotch pine, Norway spruce, Austrian pine, and white pine.

Seedling mortality and the hazards of windthrow and erosion are only slight. Competition from annual weeds, grasses, and other unwanted plants is severe. Limitations on the use of equipment are moderate because flooding is a hazard and the water table is high part of the year.

WOODLAND SUITABILITY GROUP 10

This group is made up of well drained and moderately well drained soils in the Butlertown, Keyport, Matapeake, Mattapex, Rumford, and Sassafras series. These soils all have good surface drainage. They lie on the Coastal Plain in the southern part of the county.

Oaks and other hardwoods are the dominant native trees on the soils in this group, but planted loblolly pine is generally better suited than hardwoods. For loblolly pine, the site index is about 80 and, at age 50 years, the expected annual growth per acre is about 470 board feet. Loblolly pine is preferred for planting, but white pine and sweetgum also are suitable. Scotch pine, Austrian pine, and white pine can be grown for Christmas trees.

Competition from hardwood brush is moderate for trees in plantations, but no other significant limitations or hazards affect woodland management on the soils in this group.

WOODLAND SUITABILITY GROUP 11

This group consists of well-drained soils that occur in the northern, or Piedmont, part of the county. These soils are in the Elioak, Elsinboro, Glenelg, and Manor series.

The soils in this group are good sites for upland oaks and for yellow-poplar. At age 50 years, the expected annual growth per acre is about 200 board feet for oaks and about 350 board feet for yellow-poplar. Other important trees are hickory and beech. White pine is preferred for planting. Scotch pine, Norway spruce, Austrian pine, white pine, and blue spruce are suitable for producing Christmas trees commercially.

Seedling mortality is only slight on these soils. Plant competition is slight for hardwoods but is moderate for pines. Limitations on the use of equipment are slight on slopes of not more than 15 percent and are moderate on slopes exceeding 15 percent. Windthrow is only a slight hazard. The risk of erosion is slight on slopes of 0 to 15 percent, moderate on slopes of 15 to 25 percent, and severe on slopes of more than 25 percent.

WOODLAND SUITABILITY GROUP 12

This group consists of moderately well drained Aldino soils that occur on uplands of the Piedmont Plateau. These soils contain a fragipan in the lower part of their subsoil. They are similar to the soils in woodland group 8 but are not so strongly acid.

These soils are good sites for upland oaks and yellow-poplar. At age 50 years, the expected annual growth per acre is about 200 board feet for oaks and about 350 board feet for yellow-poplar. Other important trees are white ash, basswood, maple, hickory, and beech. White pine is preferred for planting. Scotch pine, white pine, and Norway spruce are suitable for the production of Christmas trees.

Seedling mortality is only slight on the soils in this group. Plant competition is severe for pines but generally is only slight for hardwoods. The equipment limitations are moderate to severe in winter and early in spring when a perched water table is high. The hazards of erosion and windthrow generally are only slight.

WOODLAND SUITABILITY GROUP 13

This group consists of poorly drained soils that lie on the Piedmont Plateau in the northern part of the county. These soils are in the Calvert, Kinkora, and Watchung series. They are used little for farming, and most areas have a cover of wetland forest trees.

Although the soils of this group naturally support many kinds of trees, they have not been evaluated for the production of timber. Norway spruce, Scotch pine, and white pine are suitable for producing Christmas trees.

Seedling mortality is moderate to severe because of extreme seasonal wetness and the hazard of frost heaving in winter. Competition is severe from brush and herbaceous plants for trees in plantations. The limitation on the use of equipment is severe because of seasonal wetness and the clayey, unstable subsoil, particularly when the soils are wet. Windthrow is a moderate hazard because the depth that tree roots penetrate is limited. There is little or no hazard of erosion.

WOODLAND SUITABILITY GROUP 14

In this group are moderately well drained to poorly drained soils of the Coastal Plain in the southern part of the county. These soils are in the Elkton, Keyport, Mattapex, and Othello series.

These soils are good sites for loblolly pine and sweetgum, and they also produce a good growth of white oak. At age 50 years, the expected annual growth per acre of loblolly pine is about 470 board feet. For this species the site index is about 80 on the soils of this group. Loblolly pine is preferred for planting. For producing Christmas trees commercially, Scotch pine and white pine are suitable.

Because of seasonal wetness, seedling mortality is moderate. Weeds and brush compete severely with pine in plantations. The use of heavy equipment is severely limited by seasonal wetness. There is little or no erosion hazard, but windthrow is a moderate hazard on the Keyport and Elkton soils, which have a clayey subsoil. On the other soils of the group, the risk of windthrow is only slight.

WOODLAND SUITABILITY GROUP 17

In this group is gently sloping to steep Silty and clayey land. This land occurs along the upper boundary of the Coastal Plain and consists of silty material that is underlain by unstable clay.

This land is a fair site for Virginia pine, which is the only species that grows at least fairly well. The natural vegetation is mostly scrub hardwoods. The expected average yearly growth of Virginia pine at 50 years of age is about 0.8 cord of pulpwood per acre. This pine is preferred for planting, but Scotch pine also is suitable for producing Christmas trees.

Seedling mortality and plant competition are slight on this land type. When the land is dry, the limitation to the use of equipment is slight, but when the soil material is thoroughly wet, it tends to slip, slide, and flow, particularly under heavy loads and on steep slopes. Erosion is a slight to severe hazard, depending on the degree of slope. Windthrow is a moderate hazard.

WOODLAND SUITABILITY GROUP 18

This group consists of well-drained soils that are severely eroded. These soils are in the Collington, Matapeake, and Sassafras series. They occur in the southern, or Coastal Plain, part of the county.

These soils are fair sites for loblolly pine. At age 50 years, loblolly pine can be expected to produce a yearly growth of about 320 board feet per acre; the site index is about 70. Although some areas have been invaded by Virginia pine, the species preferred for planting is loblolly pine. Scotch pine, Austrian pine, white pine, and Virginia pine are suitable for Christmas trees, but producing such trees commercially may not be economically feasible.

Seedling mortality is generally moderate because seedbeds on this land are poor. Plant competition is slight. Equipment limitations are moderate on soils having slopes of not more than 15 percent and are severe on steeper slopes. The hazard of windthrow is moderate, and that of erosion is severe.

WOODLAND SUITABILITY GROUP 24

This group consists of miscellaneous land types that are not suitable for producing wood crops without major reclamation, which generally is not feasible.

Wildlife

Although the natural habitat has been altered for most kinds of wildlife in the county, and much of it has been practically destroyed, many areas are suitable for various kinds of game birds and mammals. About 85 percent of the land area is potentially fair or better as habitat for openland wildlife. Examples of openland wildlife are rabbit, quail, other upland game birds, and some deer. More than 90 percent of the county is potentially fair or better as habitat for woodland wildlife, including deer, squirrel, and turkey. About 30 percent is potentially fair or better as habitat for wetland wildlife. This includes raccoon, woodcock, muskrat, and waterfowl.

Table 3 lists most of the soils of the county and rates their suitability for eight elements of wildlife habitat and for three kinds of wildlife. Not listed are Gravel pits and Quarries, Made land and Urban land, and the seven complexes that include Urban land. In table 3 the soils are rated good, fair, poor, and not suited.

A rating of *good* indicates that the soil is well suited to a given habitat element or kind of wildlife and has few or no limitations. A rating of *fair* shows that the soil is suited to the habitat element or kind of wildlife, but it has moderate limitations. A rating of *poor* indicates that the soil can be used for a given habitat element or kind of wildlife, but its limitations are severe. A rating of *not suited* means that limitations are so severe that use is not feasible.

The elements of wildlife habitat are discussed in the following paragraphs.

Grain and seed crops include corn, sorghum, millet, soybeans, buckwheat, cowpeas, wheat, oats, barley, rye, and other crops that produce grain or grainlike seeds used by wildlife.

Grasses and legumes are commonly planted for forage for livestock but also are valuable for wildlife. These include lespedeza, alfalfa, clover, tall fescue, bromegrass, bluegrass, and timothy.

Wild herbaceous upland plants are native annuals or other herbaceous plants that commonly grow in upland areas. They include panicgrass and other native grasses, partridgepeas, beggartick, lespedeza, and other native herbs that wildlife use for food or cover.

Hardwood woody plants are trees and shrubs that grow vigorously and produce heavy crops of seed or other fruit. They are established naturally or are planted. Included are sumac, dogwood, persimmon, sassafras, hazelnut, multiflora rose, autumn-olive, wild cherry, various kinds of oak and hickory, huckleberry, highbush cranberry, blackhaw, and various kinds of holly.

Coniferous woody plants are coniferous trees and shrubs that are native or are planted. Examples are Virginia pine, shortleaf pine, red pine, Scotch pine, Norway spruce, redcedar, and Atlantic white-cedar. The rating is based on whether young trees grow slowly and develop dense foliage, not on the size of mature plants. A soil that is considered good for growing Christmas trees generally rates good.

Wetland food and cover plants provide food and cover for waterfowl and furbearing animals. They include barnyard grass, bulrush, cattail, waterwillow, smartweed, duckweed, arrow-arum, and various kinds of sedges.

Shallow water developments are impoundments in which the water can be controlled at a level ranging from the natural water table to within 2 feet above it.

Excavated ponds are dug-out ponds that depend on ground water, not runoff from surrounding areas. The level of water in ponds normally fluctuates with the level of ground water. Migrating waterfowl may be especially attracted to such ponds.

Farm ponds of the impounded type are not included in table 3, but they can be important in producing fresh water fish. If fish are to be produced, part of the pond should be at least 6 feet deep. Table 6 in the section "Engineering Uses of Soils" gives features of most soils in the county that affect the choice of sites for ponds. Migratory waterfowl frequently rest on farm ponds.

Engineering Uses of Soils [2]

In this section many of the soil properties important in engineering are estimated for most soils in the county, and the soils are interpreted according to their use in engineering. Among the soil properties important to engineers are shear strength, drainage, grain size, plasticity, and permeability to water. Shrink-swell characteristics, depth to the water table, depth to bedrock, topography, available water capacity, flood hazard, and degree of acidity or alkalinity are also important. In part, the information was obtained by examining the soils in the field and evaluating their characteristics as they apply to engineering needs. Chiefly, however, the section is based on facts obtained by testing soil samples at a number of locations in the county. Also used were the results of analyses made in other parts of Delaware and in adjacent States. The information in this survey can be used to—

1. Make soil and land use studies that will aid in selecting and developing sites for industry, business, homes, and recreation.
2. Assist in designing drainage and irrigation systems and in planning farm ponds and reservoirs, diversion terraces, and structures for soil and water conservation.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables, and in planning detailed investigations at the selected locations.
4. Locate probable sources of sand, gravel, and other construction material.
5. Correlate performance of engineering structures with soil mapping units to develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other sources that can be readily used by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

With the use of the soil map for identification, the engineering interpretations in this section can be useful for many purposes. It should be emphasized, however, that the interpretations do not eliminate the need for sampling and testing at the site of specific engineering works where loads are heavy and where the excavations are deeper than here reported. Even in these situations, however, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected. The information in this section shows, for example, that the Butlertown soils are not suitable as a source of sand or gravel. It also shows that the Sassafras soils are suitable for use in constructing dikes, dams, levees, and other embankments. It does not show, however, just how good the Sassafras soils are for these purposes in any particular area. Tests at the site will be necessary to obtain this information.

Much of the information in this section is given in tables 4, 5, and 6. Additional information useful to engineers can be found in other sections of this soil survey, particularly the section "Descriptions of the Soils."

Some of the terms used by soil scientists may not be familiar to the engineer, and some terms may have special meaning in soil science. Several of these terms are defined in the Glossary at the back of this survey.

[2] KENDALL P. JARVIS, conservation engineer, Soil Conservation Service, assisted in preparing this section.

TABLE 3.—*Suitability of soils for elements*

Soil and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Aldino				
AdA	Fair	Good	Good	Good
AdB2	Fair	Good	Good	Good
Bayboro Ba	Not suited	Poor	Poor	Good
Butlertown				
BuA	Good	Good	Good	Good
BuB2, BuC2	Fair	Good	Good	Good
Chester				
ChA	Good	Good	Good	Good
ChB2, ChC2	Fair	Good	Good	Good
ChC3, ChD2	Poor	Fair	Good	Good
ChD3	Not suited	Poor	Good	Good
Codorus Co	Fair	Good	Good	Good
Collington				
CsB2	Fair	Good	Good	Good
CsC3	Poor	Fair	Good	Good
CsD3	Not suited	Poor	Good	Good
Comus Cu	Good	Good	Good	Good
Delanco:				
DeA	Fair	Good	Good	Good
DeB2	Fair	Good	Good	Good
Elioak				
EaB2	Fair	Good	Good	Good
EkC3	Poor	Fair	Good	Good
EkD3	Not suited	Fair	Good	Good
Elkton				
ElA, EmA	Poor	Fair	Fair	Good
EmB	Poor	Fair	Fair	Good
Elsinboro EnB2, EnC2	Fair	Good	Good	Good
Fallsington Fa, Fs	Poor	Fair	Fair	Good
Glenelg and Manor.				
GmB2, GmC2	Fair	Good	Good	Good
GmC3, GmD2	Poor	Fair	Good	Good
GmD3	Not suited	Poor	Good	Good
GmE	Not suited	Fair	Good	Good
Glenville				
GnA	Fair	Good	Good	Good
GnB2	Fair	Good	Good	Good
Hatboro:				
Ha, HbA	Poor	Fair	Fair	Good
HbC	Poor	Fair	Fair	Good
Johnston Jo	Not suited	Poor	Poor	Good
Keyport				
KeA	Fair	Good	Good	Good
KeB2, KeC2	Fair	Good	Good	Good
KpC3	Poor	Fair	Good	Good
Kinkora:				
KrA	Poor	Fair	Fair	Good
KrB	Poor	Fair	Fair	Good

of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Continued				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Poor	Poor	Poor	Poor	Good	Good	Poor
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Good	Good	Good	Good	Poor	Good	Good
Poor	Poor	Poor	Poor	Good	Good	Poor
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited
Poor	Poor	Poor	Poor	Good	Good	Poor.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Poor	Poor	Poor	Good	Good	Poor
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited
Fair	Good	Good	Good	Fair	Good	Good
Fair	Poor	Not suited	Poor	Fair	Good	Poor
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Fair	Good	Good	Good	Fair	Good	Good.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited
Poor	Poor	Poor	Poor	Good	Good	Poor
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Fair	Fair	Fair	Not suited	Fair	Good	Fair.
Fair	Poor	Not suited	Not suited	Fair	Good	Not suited.
Good	Good	Fair	Not suited	Poor	Good	Poor
Poor	Poor	Poor	Poor	Good	Good	Poor.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Fair	Good	Good	Good	Fair	Good	Good.
Fair	Poor	Not suited	Not suited	Fair	Good	Not suited.

TABLE 3.—*Suitability of soils for elements of*

Soil and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Matapeake				
MeA	Good	Good	Good	Good
MeB2, MeC2	Fair	Good	Good	Good
MeC3, MeD2	Poor	Fair	Good	Good
MeD3	Not suited	Poor	Good	Good
MkA	Good	Good	Good	Good
MkB2, MkC2	Fair	Good	Good	Good
Mattapex:				
MtA	Fair	Good	Good	Good
MtB2, MtC2	Fair	Good	Good	Good
MtC3	Poor	Fair	Good	Good
Mixed alluvial land: Mv	Not suited	Poor	Poor	Good
Neshaminy and Montalto				
NmA	Good	Good	Good	Good
NmB2, NmC2	Fair	Good	Good	Good
NnC3	Poor	Fair	Good	Good
NnD3	Not suited	Poor	Good	Good
Neshaminy and Talleyville: NsE	Not suited	Poor	Good	Good
Othello: Ot	Poor	Fair	Fair	Good
Pocomoke: Po	Not suited	Poor	Poor	Good
Rumford: RuB2, RuC2	Fair	Fair	Fair	Fair
Sassafras				
SaA	Good	Good	Good	Good
SaB2, SaC2	Fair	Good	Good	Good
SaC3, SaD2	Poor	Fair	Good	Good
SaD3	Not suited	Poor	Good	Good
Sassafras and Matapeake: SmE	Not suited	Poor	Good	Good
Silty and clayey land				
StB	Fair	Good	Good	Good
StC	Poor	Fair	Fair	Fair
StE	Not suited	Poor	Fair	Fair
Talleyville: TaB2, TaC2	Fair	Good	Good	Good
Tidal marsh: Tm	Not suited	Not suited	Not suited	Not suited
Watchung: Wa	Not suited	Poor	Fair	Good
Watchung and Calvert:				
WcA	Poor	Fair	Fair	Good
WcB	Poor	Fair	Fair	Good
Woodstown:				
WoA	Fair	Good	Good	Good
WoB2	Fair	Good	Good	Good
WsA	Fair	Good	Good	Good
WsB2	Fair	Good	Good	Good

wildlife habitat and kinds of wildlife—Continued

Elements of wildlife habitat—Continued				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Poor	Poor	Poor	Good	Good	Poor.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Good	Good	Fair	Not suited	Poor	Good	Poor.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited.
Fair	Good	Good	Good	Fair	Good	Good.
Good	Good	Good	Good	Poor	Good	Good.
Fair	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Poor	Fair	Not suited.
Fair	Not suited	Not suited	Not suited	Good	Good	Not suited.
Fair	Not suited	Not suited	Not suited	Fair	Fair	Not suited.
Fair	Not suited	Not suited	Not suited	Poor	Fair	Not suited.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Not suited	Good	Poor	Not suited	Not suited	Not suited	Fair.
Fair	Good	Good	Good	Poor	Fair	Good.
Fair	Good	Good	Good	Fair	Good	Good
Fair	Poor	Not suited	Not suited	Fair	Good	Not suited.
Poor	Poor	Poor	Poor	Good	Good	Poor.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.
Poor	Poor	Poor	Poor	Good	Good	Poor.
Poor	Not suited	Not suited	Not suited	Good	Good	Not suited.

TABLE 4.—*Engineering*

[Tests performed by Delaware State Highway Department, Materials and Research Division, in

Soil name and location	Report number	Depth	Moisture density [1]	
			Maximum dry density	Optimum moisture
		Inches	*Lbs per cu ft*	*Percent*
Aldino silt loam				
1 mile north of Claymont on County Route 200. (Modal profile)	2609	0–8	101	20
	3255	19–36	112	16
	3073	36–48	114	15
On County Route 26 near Coochs Bridge (Sandier subsoil than modal)	2510	0–4	105	20
	2511	11–18	112	17
	2505	18–30	115	15
On County Route 227 near Talleyville. (Lower in clay than modal)	2994	0–6	99	19
	3253	16–30	110	17
	3249	30–40	114	16
Elkton silt loam.				
On County Route 432 near Mt Pleasant (Modal profile)	2286	0–5	99	22
	2504	11–17	106	19
	1342	17–36	105	19
On County Route 435 near Summit Bridge. (Sandy loam surface layer)	3109	0–7	104	18
	1361	11–21	103	21
	3120	30–40	126	10
Fallsington loam				
On County Route 440 near Thomas Corners (Modal profile)	2527	0–11	113	15
	3029	22–30	122	12
	2992	30–48	125	10
On County Route 435 near Summit Bridge. (Finer textured subsoil than modal)	3248	0–8	120	11
	1432	14–23	119	12
	2610	35–42	123	11
Keyport silt loam.				
On County Route 468, 2 miles northeast of Smyrna. (Modal profile)	3257	0–7	104	18
	3251	12–17	104	21
	1341	17–35	98	25
On County Route 489 near Brick Store. (Lower in clay content than modal)	3250	0–7	107	17
	2991	20–27	111	16
	2513	27–40	110	17
Montalto silt loam:				
On County Route 367 near Newark. (Modal profile)	3074	0–5	101	20
	3258	16–32	94	28
	3256	40–48	87	37
On County Route 389 near Newark. (Higher in plasticity than modal)	3252	0–6	106	17
	2993	17–28	101	23
	3075	28–40	100	26
Neshaminy silt loam.				
On County Route 228 near Talleyville. (Modal profile)	2506	0–9	105	18
	2526	18–28	110	18
	3254	32–42	111	18
Othello silt loam.				
On County Route 433 near Summit Bridge (Modal profile)	2512	0–7	118	13
	2524	21–30	102	19
	2525	30–36	121	12

[1] Based on AASHO Designation. T 99–57, Method C (*1*).

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

test data

accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—							
¾ in	⅜ in.	No 4 (4 7 mm)	No 10 (2 0 mm)	No. 40 (0 42 mm.)	No 200 (0.074 mm)	0 05 mm	0 02 mm.	0.005 mm.	0.002 mm.			AASHO [3]	Unified [4]
------	------	--------	100	98	93	80	47	20	18	31	5	A–4	ML
------	------	--------	100	99	98	80	36	24	19	29	6	A–4	ML or CL
------	------	--------	100	99	97	86	45	22	20	28	6	A–4	ML–CL
------	------	100	99	97	89	84	53	28	25	39	15	A–6	CL
------	------	--------	100	93	74	71	50	25	23	35	14	A–6	CL
------	------	100	99	91	70	65	45	22	20	33	16	A–6	CL
100	99	97	96	93	88	79	56	17	12	37	11	A–6	ML
100	99	98	98	96	93	58	34	21	18	30	6	A–4	ML
------	100	99	99	96	89	81	40	19	17	30	8	A–4	ML or CL
------	------	100	98	94	83	74	63	37	32	32	11	A–6	CL
------	------	--------	100	99	96	93	74	49	28	49	32	A–7–6	CL
------	------	100	99	99	97	87	55	38	35	41	21	A–7–6	CL
------	------	100	93	82	67	60	45	24	20	29	9	A–4	CL
------	------	100	99	99	96	84	57	37	35	36	15	A–6	CL
100	96	92	87	61	20	15	12	9	8	18	[5] NP	A–2–4	SM
------	100	97	96	72	46	40	26	14	11	32	8	A–4	SM
100	99	98	96	69	48	44	34	19	16	25	8	A–4	SC
------	100	99	98	50	20	16	13	10	9	23	8	A–2–4	SC
100	99	99	98	84	49	41	23	15	12	23	4	A–4	SM–SC
100	98	98	97	86	40	38	32	24	24	--------	NP	A–4	SM or SC
100	98	98	97	84	34	29	23	18	17	22	10	A–2–4	SC
100	99	99	99	98	91	78	49	25	22	33	9	A–4	ML or CL
100	99	98	98	97	92	83	69	47	43	42	19	A–7–6	CL
------	------	100	97	97	92	80	63	50	48	48	24	A–7–6	CL
------	------	--------	100	97	86	78	41	17	14	32	8	A–4	ML
------	------	--------	100	99	95	85	45	29	26	30	8	A–4	CL
------	------	--------	100	99	97	91	42	25	22	31	9	A–4	CL
[6] 93	89	87	85	78	65	55	34	18	15	50	19	A–7–5	ML or MH
100	97	97	96	90	69	68	63	50	49	52	20	A–7–5	MH
100	98	97	97	89	66	65	61	49	46	57	15	A–7–5	MH
------	100	99	98	94	83	69	31	19	16	29	5	A–4	ML
100	99	99	98	94	83	78	64	46	43	51	26	A–7–6	CH
------	100	98	98	93	78	69	55	42	40	51	29	A–7–6	CH
100	99	98	98	94	86	73	40	23	21	29	7	A–4	ML–CL
------	100	99	99	98	94	86	54	28	26	33	13	A–6	CL
100	95	94	93	83	61	54	45	30	28	37	11	A–6	ML
100	98	97	97	88	72	66	40	15	14	27	8	A–4	CL
------	------	--------	100	97	88	70	36	9	8	28	6	A–4	ML–CL
------	100	98	98	85	51	42	20	9	5	20	3	A–4	ML

[3] Based on AASHO Designation: M 145–49 (*1*)

[4] Based on the Unified Soil Classification System, Tech. Memo. No 3–357, v. 1, Corps of Engineers (*12*). SCS and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are ML–CL and SM–SC.

[5] NP=Nonplastic

[6] 93 percent of the material also passed the 1-inch sieve, 100 percent passed the 1½-inch sieve.

TABLE 5.—*Estimated*

[Absence of data indicates estimate was not made Properties were not estimated for Gravel pits and Quarries (Gp), Made

Soil and map symbols	Depth to seasonal high water table	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Aldino (AdA, AdB2)	[2] 1–2	4–6	0–8	Silt loam	ML, CL	A–4, A–6
			8–19	Silty clay loam	CL, ML	A–6, A–4
			19–36	Silt loam (fragipan)	ML, CL	A–4
			36–48	Silt loam	SM, ML, CL	A–2, A–4, A–5
Bayboro (Ba)	0	([3])	0–6	Silt loam	ML, MH	A–4, A–5
			6–16	Silty clay loam	CL, ML	A–6, A–7
			16–42	Silty clay	CH, ML, CL	A–7, A–4, A–6
Butlertown (BuA, BuB2, BuC2)	[2] 2–3	([3])	0–22	Silt loam	ML, CL	A–4
			22–38	Silty clay loam	CL–ML	A–6
			38–52	Silt loam (fragipan)	ML–CL	A–4
			52–60	Very fine sandy loam	SM, ML, CL	A–2, A–4
Calvert (mapped only with Watchung soils).	[2] 0	4–6	0–18	Silt loam	ML, CL	A–4, A–6
			18–30	Silty clay loam (fragipan)	CL, ML	A–6, A–4
			30–48	Silt loam	MH, CL, ML	A–5, A–4
Chester (ChA, ChB2, ChC2, ChC3, ChD2, ChD3)	>4	5–10	0–18	Loam	ML	A–4
			18–28	Clay loam	CL, ML	A–6, A–4
			28–60	Loam, silt loam, fine sandy loam.	SM, ML–CL	A–4, A–5
Codorus (Co)	1–2	6–20	0–24	Silt loam	ML	A–4
			24–52	Silty clay loam	ML, MH, CL	A–4, A–5, A–6
Collington (CsB2, CsC3, CsD3)	>5	([3])	0–15	Fine sandy loam	SM	A–2, A–4
			15–32	Sandy clay loam	SC, CL	A–4, A–6
			32–50	Sandy loam, loamy sand	SM	A–2
Comus (Cu)	3	6–20	0–35	Silt loam	ML	A–4
			35–42	Silty clay loam	ML, CL	A–4, A–6
			42–50	Fine sandy loam	SM, MH	A–4, A–5
Delanco (DeA, DeB2)	2	6–20	0–11	Silt loam	ML	A–4
			11–36	Silty clay loam	CL	A–6
			36–50	Very fine sandy loam	ML, MH	A–4, A–5
Elioak (EaB2, EkC3, EkD3)	>4	6–10	0–12	Silt loam, silty clay loam	ML, CL	A–4, A–6
			12–42	Silty clay	CL, CH, MH	A–6, A–7
			42–54	Fine sandy loam	SM, MH	A–4, A–5
Elkton						
(ElA)	0	([3])	0–14	Sandy loam	SM	A–2, A–4
			14–48	Silty clay, silty clay loam	CL, ML	A–6, A–7
(EmA, EmB)	0	([3])	0–14	Silt loam	ML, CL	A–4, A–6
			14–48	Silty clay, silty clay loam	CL, ML	A–6, A–7, A–4
Elsinboro (EnB2, EnC2)	>5	6–20	0–12	Silt loam	ML	A–4
			12–36	Silty clay loam, silt loam	ML, CL	A–4, A–6
			36–48	Fine sandy loam	SM, MH	A–4, A–5
Fallsington (Fa, Fs)	0	([3])	0–11	Loam	SM, ML	A–2, A–4
			11–30	Sandy clay loam	SM, ML	A–2, A–4
			30–48	Sandy loam	SM, SC, SP–SM	A–2

See footnotes at end of table.

engineering properties of soils

land and Urban land (Ma), Mixed alluvial land (Mv), Tidal marsh (Tm), and the seven complexes that include Urban land]

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction [1]	Moisture density		Shrink-swell potential	Corrosion potential for pipes	
No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				Optimum moisture	Maximum dry density		Untreated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Lbs. per cu. ft.*			
100	95–100	90–100	80–95	0.63–6.3	0.18–0.24	5.1–6.0			Moderate	Low	Moderate.
95–100	90–100	85–100	60–95	0.63–2.0	0.18–0.24	4.5–5.5	13–20	105–120	Moderate	High	High.
85–100	80–100	65–100	50–100	<0.20	0.12–0.18	4.5–5.0	12–20	100–115	Moderate	High	High.
85–100	80–100	65–100	30–100	0.20–2.0	0.12–0.18	4.5–5.0	11–15	110–120	Moderate	High	High.
100	95–100	90–100	75–100	0.63–2.0	0.18–0.25	4.0–5.5			High	High	High.
100	95–100	95–100	75–100	<0.20	0.18–0.24	4.0–5.5	14–18	100–110	High	High	High.
100	95–100	95–100	85–100	<0.20	0.15–0.18	4.0–4.5	16–20	90–100	High	High	High.
90–100	85–95	80–95	75–95	2.0–6.3	0.18–0.24	5.0–6.0			Low	Moderate	High.
90–100	90–100	80–100	75–100	0.63–2.0	0.15–0.18	5.0–5.5	14–18	100–110	Low	Moderate	High.
90–100	90–100	80–100	80–100	0.20–0.63	0.18–0.24	4.5–5.5	14–18	100–110	Low	Moderate	High.
90–100	90–100	75–90	30–70	0.63–2.0	0.12–0.18	4.5–5.5	10–15	110–120	Low	Moderate	High.
95–100	95–100	95–100	90–100	0.20–0.63	0.18–0.24	4.5–5.5			Moderate	High	High.
95–100	95–100	90–100	80–100	<0.20	0.12–0.18	5.0–5.5	10–15	110–120	Moderate	High	High.
85–95	75–90	70–90	60–85	0.20–0.63	0.15–0.22	5.0–6.0	14–18	100–120	Low	High	High.
90–100	90–100	75–90	55–75	0.63–2.0	0.18–0.24	5.0–6.0			Low	Moderate	Moderate.
85–100	85–100	65–95	55–80	0.63–2.0	0.18–0.24	5.0–5.5	13–19	110–120	Moderate	Low	Moderate.
85–100	85–100	75–95	40–65	0.63–2.0	0.12–0.18	4.5–5.5	13–23	100–120	Low	Low	Moderate.
95–100	90–100	85–100	75–90	0.20–0.63	0.18–0.24	4.5–5.5			Low	Moderate	Low.
95–100	90–100	85–100	80–100	0.20–0.63	0.18–0.24	4.5–5.0	16–20	100–110	Moderate	Moderate	Low.
100	100	90–100	20–45	0.63–6.3	0.12–0.18	5.0–5.5			Low	Moderate	High.
100	100	90–100	40–60	0.63–2.0	0.18–0.24	5.0–5.5	12–18	110–125	Low	Moderate	High.
100	100	85–100	15–30	0.63–6.3	0.08–0.12	4.5–5.0	10–15	110–120	Low	Moderate	High.
95–100	90–100	80–95	60–80	0.63–2.0	0.18–0.24	4.5–5.5			Low	Moderate	Moderate.
95–100	90–100	80–95	70–95	0.63–2.0	0.18–0.24	4.5–5.0	12–18	100–110	Moderate	Moderate	Moderate.
85–100	85–100	75–95	40–65	0.63–2.0	0.12–0.18	4.5–5.0	13–23	100–110	Low	Low	Moderate.
90–100	85–95	75–90	65–85	0.63–2.0	0.18–0.24	5.0–5.5			Low	Low	High.
90–100	85–100	80–100	70–95	0.20–0.63	0.18–0.24	4.5–5.5	12–18	100–110	Moderate	Moderate	High.
75–85	65–85	55–75	50–70	0.63–2.0	0.15–0.22	4.5–5.0	16–20	100–110	Low	Moderate	High.
95–100	95–100	90–100	70–100	0.20–2.0	0.18–0.24	5.0–5.5			Low	Moderate	Moderate.
95–100	95–100	95–100	75–100	0.20–0.63	0.16–0.20	5.0–5.5	18–22	95–110	Moderate	Moderate	Moderate.
85–100	85–100	75–95	40–65	0.63–2.0	0.12–0.18	5.0–5.5	16–20	100–110	Low	Low	Moderate.
95–100	90–100	75–90	25–45	0.2–6.3	0.12–0.18	4.5–5.5			Low	High	High.
95–100	90–100	90–100	70–90	<0.20	0.18–0.24	4.0–5.0	12–18	100–110	Moderate	High	High.
95–100	90–100	80–100	65–90	0.20–2.0	0.18–0.27	4.5–5.5			Moderate	High	High
95–100	90–100	90–100	70–100	<0.20	0.18–0.24	4.0–5.0	12–20	100–110	Moderate	High	High.
90–100	90–100	75–90	55–75	0.63–2.0	0.18–0.24	5.0–5.5			Low	Moderate	High.
85–100	85–100	65–95	55–80	0.63–2.0	0.18–0.24	5.0–5.5	13–19	100–110	Moderate	Moderate	High.
85–100	85–100	65–95	40–65	0.63–2.0	0.12–0.18	4.5–5.0	13–23	100–120	Low	Moderate	High.
95–100	95–100	70–100	30–55	2.0–6.3	0.12–0.24	5.0–5.5			Low	High	High.
95–100	95–100	55–100	30–55	0.63–2.0	0.18–0.24	5.0–5.5	10–14	110–125	Low	High	High.
95–100	95–100	45–100	10–35	0.63–6.3	0.04–0.10	4.5–5.0	10–14	100–125	Low	High	High.

TABLE 5.—*Estimated engineering*

Soil and map symbols	Depth to seasonal high water table	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Glenelg (GmB2, GmC2, GmC3, GmD2, GmD3, GmE). (For properties of the Manor soils in these mapping units, refer to the Manor series.)	>4	4–10	0–10	Loam	ML	A-4
			10–26	Silt loam, silty clay loam	CL, ML, SM	A-6, A-4
			26–42	Loam, fine sandy loam	SM, ML	A-4
Glenville (GnA, GnB2)	1–2	5–10	0–8	Silt loam	ML	A-4
			8–30	Silty clay loam	ML, CL	A-4, A-6
			30–48	Silty clay loam (fragipan)	ML, CL	A-4, A-6
			48–54	Silt loam	SM, ML, SC	A-4
Hatboro (Ha, HbA, HbC)	0	6–20	0–42	Silt loam	ML, MH	A-4, A-5
			42–48	Loamy fine sand	SM, SP-SM	A-2, A-3
Johnston (Jo)	0	(3)	0–24	Loam	SM, OL	A-5
			24–42	Sand	SM, SP	A-2, A-3
Keyport (KeA, KeB2, KeC2, KpC3)	1–2	(3)	0–7	Silt loam	ML	A-4
			7–60	Silty clay, silty clay loam, clay	CL, CH	A-6, A-7, A-4
Kinkora (KrA, KrB)	0	6–20	0–12	Silt loam	ML	A-4
			12–30	Silty clay loam	CL, CH	A-6, A-7
			30–36	Silt loam	ML, MH	A-4, A-5
			36–48	Fine sandy loam	SM, MH	A-4, A-5
Manor (mapped only with Glenelg soils).	>20	6–10	0–15	Loam	ML, MH	A-4, A-5
			15–60	Loam	SM, MH	A-4, A-5
Matapeake:						
MeA, MeB2, MeC2, MeC3, MeD2, MeD3).	>5	(3)	0–11	Silt loam	ML, ML-CL	A-4
			11–26	Silt loam, silty clay loam	ML-CL, CL	A-4, A-6
			26–32	Very fine sandy loam	SM, ML	A-4
			32–50	Fine sandy loam	SM	A-2
(MkA, MkB2, MkC2)	>5	(3)	0–11	Silt loam	ML	A-4
			11–50	Silt loam, silty clay loam	ML, CL	A-4, A-6
			50–72	Silt loam	ML	A-4
Mattapex (MtA, MtB2, MtC2, MtC3)	2	(3)	0–12	Silt loam	ML	A-4
			12–48	Silt loam, silty clay loam	CL	A-4, A-6
			48–54	Sandy loam	SM, SC	A-2
Montalto (mapped only with Neshaminy soils).	>4	5–12	0–16	Silt loam, silty clay loam	ML, MH	A-4, A-7
			16–40	Silty clay, silty clay loam	MH, CH	A-7
			40–48	Silty clay loam	MH, CH	A-7
Neshaminy (NmA, NmB2, NmC2, NnC3, NnD3, NsE) (For properties of the Montalto soils in mapping units NmA, NmB2, NmC2, NnC3, and NnD3, refer to the Montalto series. For properties of the Talleyville soil in mapping unit NsE, refer to the Talleyville series.)	>4	6–10	0–11	Silt loam	ML	A-4
			11–40	Silty clay loam	CL, ML	A-6, A-7
			40–50	Silt loam	ML, MH, CL	A-4, A-5, A-6, A-7

See footnotes at end of table.

properties of soils—Continued

Percentage passing sieve—No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction [1]	Moisture density—Optimum moisture	Maximum dry density	Shrink-swell potential	Corrosion potential for pipes—Untreated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Lbs. per cu. ft.*			
90–100	90–100	75–90	55–75	0.63–2.0	0.18–0.24	5.0–5.5	----------	----------	Low----------	Moderate----	Moderate
85–100	85–100	65–95	40–80	0.63–2.0	0.18–0.24	5.0–5.5	13–19	110–120	Low----------	Low----------	Moderate.
85–100	85–100	75–95	40–65	0.63–2.0	0.12–0.18	4.5–5.5	13–23	100–120	Low----------	Low----------	Moderate.
85–100	85–95	75–85	65–80	0.63–2.0	0.18–0.24	5.0–5.5	----------	----------	Low----------	High----------	Moderate.
85–100	85–100	80–95	65–90	0.20–0.63	0.18–0.24	5.0–5.5	14–18	100–110	Moderate----	High----------	High.
85–100	85–100	80–95	65–90	0.20–0.63	0.18–0.24	5.0–5.5	14–18	100–110	Moderate----	High----------	High
75–90	75–90	65–80	40–75	0.63–2.0	0.12–0.18	4.5–5.0	13–23	100–120	Low----------	High----------	High.
95–100	90–100	80–95	75–95	0.20–0.63	0.18–0.24	4.5–5.5	15–23	100–110	Low----------	High----------	High
85–100	85–100	65–95	10–20	2.0–6.3	0.04–0.10	4.5–5.0	10–14	100–110	Low----------	High----------	High.
90–100	90–100	65–95	35–50	0.20–0.63	0.18–0.24	4.5–5.0	13–23	100–120	Moderate----	High----------	High
90–100	90–100	65–95	5–15	0.63–6.3	0.04–0.10	4.0–4.5	8–12	100–110	Low----------	High----------	High
95–100	95–100	90–100	65–95	0.20–2.0	0.18–0.24	5.0–5.5	----------	----------	Low----------	High----------	High.
95–100	95–100	95–100	80–95	<0.20	0.18–0.24	4.5–5.5	12–18	95–110	Moderate----	High----------	High.
95–100	90–100	90–100	50–90	0.20–2.0	0.18–0.27	5.0–5.5	----------	----------	Moderate----	High----------	High
95–100	95–100	95–100	80–90	<0.20	0.18–0.24	4.5–5.0	12–18	100–110	Moderate----	High----------	High
85–100	85–100	85–100	60–85	0.63–2.0	0.18–0.24	4.5–5.0	13–19	100–110	Moderate----	High----------	High.
85–100	85–100	75–95	40–65	0.63–6.3	0.12–0.18	4.5–5.0	13–23	100–120	Low----------	High----------	High
80–100	80–100	70–90	50–65	0.63–2.0	0.14–0.20	5.0–5.5	13–23	100–110	Low----------	Low----------	Moderate.
80–100	60–100	50–85	35–60	0.63–6.3	0.12–0.18	5.0–5.5	13–23	100–110	Low----------	Low----------	Moderate.
95–100	90–100	90–100	60–95	0.63–2.0	0.18–0.27	4.5–5.5	----------	----------	Low----------	Low----------	Moderate.
95–100	95–100	90–100	60–95	0.20–0.63	0.18–0.24	4.5–5.5	12–18	100–110	Moderate----	Moderate----	Moderate.
90–100	85–100	80–100	40–60	0.63–2.0	0.14–2.0	4.5–5.5	10–15	110–120	Low----------	Low----------	High.
90–100	85–100	80–100	15–35	0.63–6.3	0.12–0.18	4.5–5.5	8–15	110–120	Low----------	Low----------	High.
95–100	95–100	90–100	65–95	0.63–2.0	0.18–0.27	4.5–5.5	----------	----------	Low----------	Low----------	Moderate.
95–100	95–100	90–100	65–95	0.20–0.63	0.18–0.24	4.5–5.5	12–18	100–110	Low----------	Moderate----	Moderate.
95–100	95–100	90–100	65–95	0.63–2.0	0.18–0.27	4.5–5.5	12–18	100	Low----------	Low----------	High.
95–100	95–100	90–100	55–75	0.20–2.0	0.18–0.27	4.5–5.5	----------	----------	Low----------	Moderate----	Moderate.
95–100	95–100	90–100	60–90	0.20–0.63	0.18–0.24	4.5–5.5	12–18	100–110	Moderate----	High----------	High.
90–100	90–100	40–60	15–35	0.63–6.3	0.12–0.18	4.5–5.5	10–15	110–120	Low----------	High----------	High.
85–100	85–100	70–95	60–90	0.63–2.0	0.18–0.24	5.0–5.5	----------	----------	Moderate----	Moderate----	Moderate.
95–100	90–100	85–100	65–95	0.20–0.63	0.18–0.24	5.0–5.5	24–30	90–100	High	Moderate----	Moderate.
85–100	80–100	60–90	50–80	0.63–2.0	0.18–0.24	5.0–6.0	25–40	85–100	High----------	Moderate----	Moderate.
90–100	90–100	75–95	55–90	0.63–2.0	0.18–0.24	5.0–6.0	----------	----------	Low----------	Moderate----	Moderate.
85–100	85–100	65–100	55–95	0.20–0.63	0.18–0.24	5.0–6.0	13–19	110–120	Moderate----	Moderate----	Moderate.
85–100	85–100	75–95	55–75	0.63–2.0	0.12–0.18	5.5–6.0	13–23	100–110	Moderate----	Moderate----	Moderate.

TABLE 5.—*Estimated engineering*

Soil and map symbols	Depth to seasonal high water table	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Othello (Ot)	0	(3)	0–10	Silt loam, very fine sandy loam	ML, CL	A–4
			10–30	Silt loam	ML, CL	A–4, A–6
			30–50	Very fine sandy loam	ML, CL, SM	A–2, A–4
Pocomoke (Po)	0	(3)	0–18	Loam	SM, ML, CL	A–2, A–4
			18–32	Sandy clay loam	SM–SC, ML–CL	A–2, A–6
			32–42	Fine sand	SP, SM	A–3, A–2
Rumford (RuB2, RuC2)	>5	(3)	0–12	Loamy sand	SM, SP	A–2, A–3
			12–36	Sandy loam, sandy clay loam	SC	A–2, A–4
			36–48	Loamy sand	SM, SP	A–2, A–3
Sassafras (SaA, SaB2, SaC2, SaC3, SaD2, SaD3, SmE) (For properties of the Metapeake soil in mapping unit SmE, refer to the Metapeake series)	>5	(3)	0–17	Sandy loam	SM	A–2
			17–37	Sandy loam, sandy clay loam	SC, ML, CL	A–2, A–4
			37–50	Sand, loamy sand	SM, SP	A–2, A–3
Silty and clayey land (StB, StC, StE)	>4	(3)	(4)	Variable	ML, CL	A–4, A–6
			(4)	Clay	CH	A–7
Talleyville (TaB2 TaC2)	>6	6–10	0–10	Silt loam	ML	A–4
			10–44	Heavy silt loam	ML, CL	A–4, A–6
			44–51	Silty clay loam	CL	A–6
			51–64	Clay	MH, CH	A–7
			64–72	Sandy clay	CH, MH	A–7
Watchung (Wa, WcA, WcB) (For properties of Calvert soils in mapping units WcA and WcB, refer to the Calvert series)	0	5–10	0–8	Silt loam	ML	A–4
			8–30	Silty clay, silty clay loam	CL, CH	A–6, A–7
			30–48	Silt loam	MH	A–7
Woodstown (WoA, WoB2, WsA, WsB2).	1–2	(3)	0–10	Loam	SM, ML	A–2, A–4
			10–36	Sandy clay loam, sandy loam	SC, ML	A–4
			36–48	Sandy loam, loamy sand	SM	A–2

[1] Reaction is for unlimed soils, where soils have been limed, the pH is higher.
[2] Perched water table.

properties of soils—Continued

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction[1]	Moisture density		Shrink-swell potential	Corrosion potential for pipes	
No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				Optimum moisture	Maximum dry density		Untreated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Lbs. per cu. ft.*			
95–100	95–100	85–100	70–95	0.20–2.0	0.18–0.27	5.0–5.5	----------	----------	Low	High	High.
95–100	90–100	85–100	70–95	0.20–0.63	0.18–0.24	5.0–5.5	12–20	100–110	Moderate	High	High
85–100	80–100	75–95	20–55	0.63–2.0	0.12–0.18	4.5–5.0	10–16	110–125	Low	High	High.
95–100	95–100	80–100	25–55	0.63–2.0	0.18–0.27	4.5–5.0	----------	----------	Low	High	High
95–100	95–100	80–100	30–65	0.63–2.0	0.18–0.24	4.5–5.0	10–14	110–125	Low	High	High
95–100	90–100	70–90	5–20	2.0–6.3	0.04–0.10	4.5–5.0	12–14	100–110	Low	High	High.
85–100	80–100	50–85	10–20	2.0–6.3	0.06–0.08	5.0–5.5	----------	----------	Low	Low	High
85–100	80–100	65–90	25–40	0.63–2.0	0.12–0.18	5.0–5.5	7–12	110–125	Low	Low	High
80–100	75–100	30–85	5–20	2.0–6.3	0.06–0.08	5.0–5.5	9–15	100–110	Low	Low	High.
85–100	75–100	45–80	15–30	2.0–6.3	0.12–0.18	5.0–5.5	----------	----------	Low	Low	High.
85–100	75–100	65–90	30–55	0.63–2.0	0.18–0.24	5.0–5.5	7–18	110–125	Low	Low	High.
75–100	75–100	30–85	10–25	2.0–6.3	0.06–0.08	4.5–5.0	9–15	100–110	Low	High	High.
90–100	90–100	----------	60–90	0.20–0.63	0.18–0.24	4.5–5.0	----------	----------	Low	Low	Moderate.
90–100	90–100	----------	85–100	<0.20	0.18–0.24	4.0–5.0	18–24	85–100	Moderate	Moderate	High.
95–100	95–100	90–100	65–95	0.63–2.0	0.18–0.27	4.5–5.5	----------	----------	Low	Low	Moderate.
95–100	95–100	90–100	65–90	0.20–0.63	0.18–0.24	4.5–5.0	12–18	100–110	Low	Moderate	Moderate.
95–100	95–100	90–100	65–95	0.20–0.63	0.18–0.24	5.0–5.5	12–18	100–110	Moderate	Moderate	Moderate
95–100	90–100	85–100	65–95	0.20–0.63	0.18–0.24	5.0–5.5	24–30	90–100	High	Moderate	Moderate
85–100	80–95	60–80	50–80	0.20–0.63	0.18–0.24	5.0–5.5	10–18	100–120	High	Moderate	Moderate.
90–100	90–100	85–95	60–75	0.20–0.63	0.18–0.27	5.0–5.5	----------	----------	Low	Moderate	Moderate.
90–100	90–100	85–95	65–90	<0.20	0.18–0.24	5.0–6.0	18–24	100–110	High	Moderate	Moderate
85–100	80–100	75–95	60–75	<0.20	0.18–0.24	5.0–6.0	18–24	100–110	High	Moderate	High.
95–100	95–100	75–95	30–65	2.0–6.3	0.14–0.19	5.0–5.5	----------	----------	Low	Low	High
95–100	95–100	75–100	35–65	0.63–2.0	0.14–0.21	5.0–5.5	7–18	110–125	Moderate	Moderate	High.
95–100	95–100	40–70	10–25	2.0–6.3	0.06–0.10	5.0–5.5	9–15	100–120	Low	Moderate	High

[3] Bedrock is at a great, but unknown, depth

[4] Variable. The first layer ranges from 6 inches to 36 inches or more in thickness, the second layer extends to a depth of several feet.

TABLE 6.—*Engineering*

[Interpretations were not made for Gravel pits and Quarries (Gp), Made

Soil series and map symbols	Susceptibility to frost action	Suitability as source of—			Soil features affecting—	
		Topsoil [1]	Sand and gravel	Road fill	Pipeline location	Highway location
Aldino (AdA, AdB2)	High	Fair	Not suitable	Fair	1 to 2 feet to perched water table, fair stability, 4 to 6 feet to bedrock	1 to 2 feet to perched water table, fair stability, severe frost action, 4 to 6 feet to bedrock.
Bayboro (Ba)	High	Good [4]	Not suitable	Not suitable wet and plastic	Permanent high water table, poor stability	Permanent high water table, poor stability, very severe frost action, plastic when wet
Butlertown (BuA, BuB2, BuC2)	High	Good	Not suitable	Fair	2 to 3 feet to perched water table, fair stability	2 to 3 feet to perched water table, fair stability, severe frost action
Calvert (mapped only with Watchung soils).	High	Fair	Not suitable	Poor to fair: wet	Perched water table, poor stability, 4 to 6 feet to hard bedrock	Perched water table, poor stability, severe frost action, 4 to 6 feet to hard bedrock.
Chester (ChA, ChB2, ChC2, ChC3, ChD2, ChD3).	Moderate	Good	Not suitable	Fair to good: micaceous.	Good stability, 5 to 10 feet or more to bedrock.	Good stability, moderate frost action, 5 to 10 feet or more to bedrock, elastic material
Codorus (Co)	High	Fair to good.	Not suitable for sand, locally fair for gravel	Fair	1 to 2 feet to high water table, poor stability, flood hazard.	1 to 2 feet to high water table, poor stability, severe frost action
Collington (CsB2, CsC3, CsD3)	Moderate	Good	Fair for sand: glauconite, 15 to 60 percent fines Poor for gravel	Good	Good stability, substratum contains greensand	Good stability; moderate frost action, substratum contains greensand
Comus (Cu)	Moderate	Good	Locally fair	Fair wet below a depth of 3 feet	3 feet to high water table, fair stability, flood hazard	3 feet to high water table, fair stability, flood hazard; moderate frost action.
Delanco (DeA, DeB2)	High	Fair	Not suitable for sand, locally good for gravel	Fair	2 feet to high water table, fair stability	2 feet to high water table, fair stability, severe frost action

See footnotes at end of table

interpretations of the soils

land and Urban land (Ma), and the seven complexes that include Urban land]

Soil features affecting—Continued					
Sites for ponds and reservoirs	Dikes, levees, dams, and other embankments [2]	Drainage systems	Irrigation	Terraces and diversions	Waterways [3]
Very slow seepage; 4 to 6 feet to bedrock.	Fair stability; highly erodible, medium to high density	Slow permeability, highly erodible, 1 to 2 feet to perched water table.	High available moisture capacity, moderate to moderately rapid infiltration, impeded drainage.	Highly erodible, fair stability; perched water table	High available moisture capacity; moderate fertility.
Slow seepage, permanent high water table.	Poor stability, highly erodible; low to medium density, plastic when wet	Slow permeability, highly erodible, outlets lacking in some places	High available moisture capacity, slow infiltration, poor drainage.	Highly erodible, poor stability, high water table.	High available moisture capacity, moderate fertility.
Slow seepage in subsoil, moderate seepage in substratum	Fair stability, highly erodible, medium to high density.	Moderately slow permeability in fragipan, highly erodible.	High available moisture capacity, moderate infiltration, impeded drainage	Highly erodible; fair stability.	High available moisture capacity, moderate fertility.
Slow seepage, 4 to 6 feet to pervious bedrock.	Poor stability, highly erodible, low to medium density.	Slow permeability, highly erodible.	High available moisture capacity, slow infiltration; poor drainage.	Highly erodible, poor stability	High available moisture capacity, moderate fertility.
Moderate seepage, 5 to 10 feet or more to pervious bedrock.	Good stability, moderately erodible, medium density, micaceous	Not needed	High available moisture capacity; medium infiltration.	Moderately erodible, good stability.	High available moisture capacity, moderate fertility.
Slow seepage; flood hazard.	Poor stability, highly erodible, low density	Moderately slow permeability, highly erodible, flood hazard.	High available moisture capacity, moderately slow infiltration, impeded drainage	Highly erodible, poor stability, 1 to 2 feet to high water table	High available moisture capacity; moderate fertility
Moderate seepage	Good stability; moderately erodible, medium to high density	Not needed	Moderate available moisture capacity; medium infiltration.	Moderately erodible, good stability	Moderate available moisture capacity, moderate fertility.
Moderate seepage, flood hazard	Fair stability, highly erodible, low density.	Not needed	High available moisture capacity, medium infiltration.	Highly erodible; fair stability.	High available moisture capacity, moderate fertility.
Slow to moderate seepage.	Fair stability, moderately erodible, low density	Moderately slow permeability, moderately erodible.	High available moisture capacity, moderately slow infiltration, impeded drainage	Moderately erodible, fair stability.	High available moisture capacity, moderate fertility

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Susceptibility to frost action	Suitability as source of—			Soil features affecting—	
		Topsoil [1]	Sand and gravel	Road fill	Pipeline location	Highway location
Elioak (EaB2, EkC3, EkD3).	Moderate	Good	Not suitable	Fair: micaceous.	Fair stability; 6 to 10 feet or more to micaceous bedrock	Fair stability, moderate frost action, 6 to 10 feet or more to micaceous bedrock.
Elkton (ElA, EmA, EmB).	High	Poor	Not suitable	Poor to fair. wet.	High water table, poor stability.	High water table; poor stability, severe frost action.
Elsinboro (EnB2, EnC2)	Moderate	Good	Locally fair	Fair to good: micaceous	Fair stability	Fair stability; moderate frost action.
Fallsington (Fa, Fs)	High	Fair	Fair for sand. 10 to 55 percent fines. Not suitable for gravel.	Fair: wet	High water table; fair stability.	High water table, fair stability; severe frost action.
Glenelg (GmB2, GmC2, GmC3, GmD2, GmD3, GmE).	Moderate	Good	Not suitable	Fair· micaceous.	Fair stability; 4 to 10 feet to hard micaceous bedrock.	Fair stability; moderate frost action, 4 to 10 feet to micaceous bedrock.
Glenville (GnA, GnB2)	High	Fair	Not suitable	Fair. micaceous, plastic	1 to 2 feet to perched water table; fair stability; 5 to 10 feet or more to bedrock.	1 to 2 feet to perched water table, fair stability, severe frost action; 5 to 10 feet or more to bedrock; micaceous, elastic.
Hatboro (Ha, HbA, HbC).	High	Fair	Not suitable for sand, locally fair for gravel	Fair below a depth of 42 inches, wet.	High water table; very poor stability, flood hazard in some areas.	High water table, very poor stability, severe frost action; flood hazard in some areas
Johnston (Jo)	High	Good [4]	Locally fair	Not suitable. organic material	High water table; poor stability; flood hazard, flowing pond below a depth of 2 feet.	High water table, poor stability, severe frost action; flood hazard, seepage
Keyport (KeA, KeB2, KeC2, KpC3).	High	Fair	Not suitable	Poor wet, plastic.	1 to 2 feet to seasonal high water table, poor stability, severe frost action; plastic when wet.	1 to 2 feet to seasonal high water table, poor stability, severe frost action; plastic when wet.

See footnotes at end of table.

of the soils—Continued

Soil features affecting—Continued					
Sites for ponds and reservoirs	Dikes, levees, dams, and other embankments [2]	Drainage systems	Irrigation	Terraces and diversions	Waterways [3]
Slow to moderate seepage, 6 to 10 feet or more to pervious bedrock.	Fair stability; moderately erodible, low density.	Not needed	High available moisture capacity; moderately slow infiltration	Moderately erodible; fair stability.	High available moisture capacity; moderate fertility.
Slow to very slow seepage, high water table	Poor stability, highly erodible, low density; high water table, difficult to compact	High water table, slow permeability, highly erodible	Moderate to high available moisture capacity, slow infiltration; poor drainage	Erodible, poor stability.	Moderate to high available moisture capacity, low fertility.
Moderate seepage	Fair stability, moderately erodible; low to medium density, micaceous.	Not needed	High available moisture capacity, medium infiltration.	Moderately erodidle, fair to good stability.	High available moisture capacity; moderate fertility.
Seepage moderate in subsoil, rapid in substratum, high water table	Fair stability, moderately erodible, medium to very high density.	Moderately permeable, moderately erodible, high water table	Moderate available moisture capacity, medium infiltration, poor drainage	Moderately erodible, fair stability, high water table.	Moderate available moisture capacity, low fertility
Moderate seepage, 4 to 10 feet to pervious bedrock	Fair stability, moderately erodible, low to medium density.	Not needed	High available moisture capacity, medium infiltration, moderately erodible	Moderately erodible, fair stability.	High available moisture capacity; moderate fertility
Seepage slow in subsoil, moderate in substratum, 5 to 10 feet or more to pervious bedrock, 1 to 2 feet to perched water table	Fair stability; moderately erodible, low to medium density, plastic when wet; 1 to 2 feet or more to perched water table	Moderately slow permeability, moderately erodible, seasonal high water table.	High available moisture capacity, moderately slow infiltration; impeded drainage	Moderately erodible; fair stability.	High available moisture capacity; moderate fertility
Slow seepage, flood hazard, permanent high water table	Very poor stability, moderately erodible, low density, difficult to compact	Moderately slow permeability; moderately erodible, high water table, flood hazard in some areas.	High available moisture capacity, moderately slow infiltration; poor drainage.	Moderately erodible; very poor stability, high water table	High available moisture capacity, moderate fertility, high water table.
Seepage moderate in subsoil, rapid in substratum, permanent high water table; flood hazard	Poor stability, moderately erodible, low to medium density; highly organic surface layer, loose sand in substratum	Moderately slow permeability, moderately erodible, outlets lacking in some places, permanent high water table.	Moderate to high available moisture capacity, moderately slow infiltration, very poor drainage.	Moderately erodible, poor stability, permanent high water table.	Moderate to high available moisture capacity, moderate fertility, permanent high water table
Very slow seepage, seasonal high water table.	Poor stability, highly erodible, low density.	Slow permeability highly erodible; seasonal high water table	High available moisture capacity, slow infiltration, impeded drainage, seasonal high water table	Highly erodible; poor stability, seasonal high water table.	High available moisture capacity, low fertility

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Susceptibility to frost action	Suitability as source of—			Soil features affecting—	
		Topsoil [1]	Sand and gravel	Road fill	Pipeline location	Highway location
Kinkora (KrA, KrB)	High	Fair	Not suitable for sand, locally fair for gravel.	Poor: wet, micaceous.	High water table, poor stability.	High water table, poor stability, severe frost action.
Manor (mapped only with Glenelg soils).	Moderate	Fair to good.	Not suitable	Poor: micaceous.	Poor stability	Poor stability, moderate frost action, 6 to 10 feet or more to micaceous bedrock, elastic.
Matapeake (MeA, MeB2, MeC2, MeC3, MeD2, MeD3, MkA, MkB2, MkC2)	Moderate	Good	Locally fair for sand: very fine sand is at a depth of more than 32 inches, 15 to 35 percent fines. Not suitable for gravel.	Fair to a depth of 36 inches; good below a depth of 36 inches.	Fair stability	Fair stability; moderate frost action.
Mattapex (MtA, MtB2, MtC2, MtC3).	High	Good	Locally fair for sand: coarse sand is at a depth of more than 48 inches, 15 to 35 percent fines. Not suitable for gravel.	Fair	2 feet to seasonal high water table, fair stability.	2 feet to seasonal high water table, fair stability, severe frost action
Mixed alluvial land (Mv)	High	Poor to fair.	Locally fair	Variable	High water table, variable stability, flood hazard	High water table, variable stability severe frost action flood hazard.
Montalto (mapped only with Neshaminy soils).	Moderate	Good	Not suitable	Poor: plastic	Good stability, 5 to 12 feet to hard diabase bedrock.	Good stability, moderate frost action, 5 to 12 feet to hard diabase bedrock.
Neshaminy (NmA, NmB2, NmC2, NnC3, NnD3, NsE). (For interpretations of Talleyville soil in mapping unit NsE, refer to the Talleyville series.)	Moderate	Good	Not suitable	Fair	Fair stability, 6 to 10 feet to hard bedrock; stones abundant in some places	Fair stability, moderate frost action, 6 to 10 feet to hard bedrock stones abundant in some places
Othello (Ot)	High	Fair	Locally fair very fine sand below a depth of 30 inches, 20 to 25 percent fines.	Fair: wet	High water table, poor stability.	High water table, poor stability, severe frost action

See footnotes at end of table.

of the soils—Continued

Soil features affecting—Continued					
Sites for ponds and reservoirs	Dikes, levees, dams, and other embankments [2]	Drainage systems	Irrigation	Terraces and diversions	Waterways [3]
Seepage very slow in subsoil, rapid in substratum, high water table	Poor stability, highly erodible, low to medium density, micaceous, wet.	Slow permeability, highly erodible, high water table	High available moisture capacity, slow infiltration, poor drainage	Highly erodible, poor stability, high water table.	High available moisture capacity, moderate fertility
Moderate to rapid seepage, 6 to 10 feet or more to pervious bedrock.	Poor stability, highly erodible, low density, micaceous	Not needed	Moderate available moisture capacity; medium infiltration	Highly erodible, poor stability.	Moderate available moisture capacity, moderate fertility
Seepage slow in subsoil, moderate to high in substratum.	Fair stability, moderately erodible, low to medium density.	Not needed	High available moisture capacity, moderately slow infiltration.	Moderately erodible, fair stability.	High available moisture capacity, moderate fertility.
Seepage slow in subsoil, moderate in substratum, seasonal high water table	Fair stability; moderately erodible, low to medium density.	Moderately slow permeability, moderately erodible, seasonal high water table.	High available moisture capacity, moderately slow infiltration.	Moderately erodible, fair stability, seasonal high water table.	High available moisture capacity, moderate fertility
Variable seepage, constant source of water	Variable stability, erodibility, and density.	Not feasible in most places	Not feasible in most places	Variable erodibility and stability.	Variable available moisture capacity, low fertility
Slow to moderate seepage, 5 to 12 feet to bedrock.	Good stability; plastic, moderately erodible; low to very low density.	Not needed	High available moisture capacity, moderate infiltration.	Moderately erodible, good stability.	High available moisture capacity, high fertility
Slow to moderate seepage, 6 to 10 feet to bedrock, stones abundant in some places.	Fair stability, moderately erodible, low to medium density, stones abundant in some places	Not needed	High available moisture capacity; moderate infiltration; stones abundant in some places.	Moderately erodible, fair stability, stones abundant in some places	High available moisture capacity, high fertility, stones abundant in some places.
Seepage slow in subsoil, moderate in substratum, high water table	Poor stability; moderately erodible; low to medium density.	Moderately slow permeability, moderately erodible, high water table	High available moisture capacity, moderately slow infiltration; poor drainage.	Moderately erodible, poor stability.	High available moisture capacity, moderate fertility.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Susceptibility to frost action	Suitability as source of—			Soil features affecting—	
		Topsoil [1]	Sand and gravel	Road fill	Pipeline location	Highway location
Pocomoke (Po)	High	Good [2]	Locally fair find sand below a depth of 32 inches, 5 to 20 percent fines.	Good	High water table; fair stability.	High water table, fair stability; severe frost action.
Rumford (RuB2, RuC2)	Low	Fair	Fair 5 to 40 percent fines.	Good	Fair stability	Fair stability, erodible.
Sassafras (SaA, SaB2, SaC2, SaC3, SaD2, SaD3, SmE) (For interpretations of the Matapeake soil in mapping unit SmE, refer to the Matapeake series)	Moderate	Good	Fair for sand below a depth of 37 inches. 10 to 25 percent fines. Locally fair for gravel.	Good	Good stability	Good stability, moderate frost action.
Silty and clayey land (StB, StC, StE)	Moderate	Poor	Not suitable	Not suitable	Extremely poor stability.	Extremely poor stability, moderate frost action
Talleyville (TaB2, TaC2)	Moderate	Good	Not suitable	Fair	Good stability, 6 to 10 feet or more to hard bedrock; stones abundant in some places	Good stability, moderate frost action, 6 to 10 feet or more to hard bedrock; stones abundant in some places
Tidal marsh (Tm)	High	Not suitable.	Not suitable	Not suitable	Tidal flooding, extremely poor stability.	Tidal flooding, extremely poor stability, severe frost action
Watchung (Wa, WcA, WcB).	High	Fair	Not suitable	Poor. wet, plastic; micaceous.	High water table, very poor stability, 5 to 10 feet to hard bedrock, stones abundant in some places	High water table, very poor stability, severe frost action, 5 to 10 feet to hard bedrock, stones abundant in some places.
Woodstown (WoA, WoB2, WsA, WsB2)	High	Good	Locally fair for sand below a depth of 36 inches 10 to 25 percent fines Not suitable for gravel	Good	1 to 2 feet to seasonal high water table, good stability, sand below a depth of 3 feet	1 to 2 feet to seasonal high water table, good stability, severe frost action

[1] Rating is for surface layer only, or an average depth of 10 inches, whichever is less All severely eroded soils are considered poor to unsuitable as a source of topsoil.

[2] It is assumed that soil material having a high content of organic matter will not be used.

of the soils—Continued

Soil features affecting—Continued					
Sites for ponds and reservoirs	Dikes, levees, dams, and other embankments [2]	Drainage systems	Irrigation	Terraces and diversions	Waterways [3]
Seepage moderate in subsoil, rapid in substratum, high water table	Fair stability; moderately erodible; low to very high density.	Moderate permeability, moderately erodible, high water table	Moderate available moisture capacity; medium infiltration; very poor drainage	Moderately erodible; fair stability	Moderate available moisture capacity; moderate fertility
Pervious substratum.	Fair stability; low to very high density.	Not needed	Low available moisture capacity; rapid infiltration	Fair stability	Low available moisture capacity, low fertility
Pervious substratum.	Good stability; low to very high density; moderately erodible.	Not needed	Moderate available moisture capacity, medium to moderately rapid infiltration	Moderately erodible; good stability.	Moderate available moisture capacity; moderate fertility.
Slow to very slow seepage	Extremely poor stability; very low density.	Not needed	High available moisture capacity, variable infiltration	Very highly erodible, extremely poor stability.	High available moisture capacity, low to very low fertility
Slow seepage, 6 to 10 feet or more to hard bedrock; stones abundant in some places	Good stability, moderately erodible, very low to medium density, stones abundant in some places	Not needed	Very high available moisture capacity, moderately slow infiltration, stones abundant in some places	Moderately erodible, good stability, stones abundant in some places.	Very high available moisture capacity, high fertility, stones abundant in some places.
Seepage is variable but is slow in most places	Extremely poor stability, highly erodible; very low density.	Not feasible	Not feasible	Not feasible	Not feasible.
Very slow seepage, 5 to 10 feet to bedrock, stones abundant in some places	Very poor stability, highly erodible, low density, stones abundant in some places	Slow permeability, highly erodible, stones abundant in some places.	High available moisture capacity, slow infiltration, stones abundant in some places.	Highly erodible, very poor stability, high water table, stones abundant in some places.	High available moisture capacity, high fertility, stones abundant in some places.
Seepage moderate in subsoil, rapid in substratum.	Good stability, moderately erodible; low to very high density	Moderately permeable, moderately erodible, seasonal high water table.	Moderate available moisture capacity, medium to moderately rapid infiltration.	Moderately erodible, good stability	Moderate available moisture capacity, moderate fertility

[3] Features listed are those of surface layer only

[4] Surface layer has a high content of organic matter. Rating applies only where such topsoil is desirable.

Engineering classification systems

Two systems of classifying soils are in general use among engineers. Both are used in this soil survey.

The Unified classification system was established by the Waterways Experiment Station, U.S. Corps of Engineers (*12*). In this system soil material is identified as coarse grained, fine grained, and highly organic. The coarse-grained soils are subdivided into sand (S) and gravel (G). The soils in each of these groups are classified on the basis of the amount of fines they contain. Fine-grained soils are subdivided into silts (M) and clays (C), depending on their liquid limit and plasticity index. Each of these groups is further classified on the basis of whether the soils have a low (L) or high (H) liquid limit. Silts and clays that have a low liquid limit are identified by the symbols ML and CL, and silts and clays that have a high liquid limit are identified by the symbols MH and CH. Soils on the borderline between the two classifications are given a joint classification, for example, ML–CL. Table 5 shows the estimated Unified classification of the soils in New Castle County.

Many highway engineers classify soil material according to the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system, the soils having about the same general load-carrying capacity are grouped together in seven major groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, consisting of clay soils having low strength when wet. The estimated AASHO classification of the soils in this county is given in table 5.

Soil test data

To help evaluate the soils for engineering purposes, samples were taken from the soils of the Aldino, Elkton, Fallsington, Keyport, Montalto, Neshaminy, and Othello series and were tested in accordance with standard procedures of the American Association of State Highway Officials (AASHO). The results of these tests and the classification of each sample according to both the AASHO and Unified systems are given in table 4.

The engineering soil classifications in table 4 are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by the combined sieve and hydrometer methods. The percentage of clay obtained by the hydrometer method should not be used in naming the textural classes of soils.

The relationship between moisture and density is 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, the density decreases with increase in moisture. The highest dry density obtained in the compaction test is termed maximum dry density. As a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The liquid limit and the plasticity index given in table 4 indicate the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Engineering properties of soils

Table 5 shows some estimated soil properties that are important in engineering, and it gives estimated engineering and textural classifications for the soils. The data in table 5 are based partly on the results of soil tests shown in table 4. Color and other characteristics that are not important in engineering have been omitted from table 5 but they are given in the section "Descriptions of the Soils."

Depth to a seasonal high water table refers to the highest level at which the ground water stands for a significant period of time.

Bedrock normally is at a depth of at least 4 feet in the soils of this county, though some soils on the Piedmont Plateau are severely eroded and are less than 4 feet deep to bedrock. On the Coastal Plain the soils are underlain by bedrock at a great depth, but this depth has not been determined.

The column headed "Depth from surface" indicates the depth and thickness of the layers for which estimates were made. The thickness of the layers varies somewhat from place to place, but the thickness and other properties described in table 4 are those that actually exist in a specific profile of the soil described; they are not averages obtained from a number of profiles. Some of the layers reported in the table have been combined and are generally thicker than those in the detailed profiles described in the section "Descriptions of the Soils." In table 5 the thickness of the surface layer applies only to soils that are slightly or moderately eroded. The original surface layer of severely eroded soils is thinner or may be completely removed, and the underlying layers are closer to the surface than is indicated in the table.

Listed for the layers in table 5 are the USDA textural classification, the Unified and AASHO engineering classifications, and the estimated percentages of material that pass Nos. 4, 10, 40, and 200 sieves. The amount of material passing a No. 200 sieve determines whether soil material is coarse grained or fine grained.

Permeability refers to the rate that water moves through saturated, undisturbed soil material. It depends mainly on the texture and structure of the soil.

The available moisture capacity is the approximate amount of water that a soil can hold available for plants. It is the water held in the range between field capacity and the wilting point of plants.

Reaction is given in pH values and indicates the degree of acidity or alkalinity of the soil material. Higher values indicate alkaline material and lower values acid material, as defined in the Glossary. The pH values given in table 5 are for unlimed soils. In fields where the soil has been limed, the pH value is higher, particularly in the surface layer.

Optimum moisture content is the percentage of moisture at which the soil material can be compacted by standard methods to maximum density. This percentage is estimated on the basis of the dry weight of the soil. Maximum dry density, expressed in table 5 in pounds per cubic foot, is the density that can be expected when soil material is compacted by standard procedures at optimum moisture content.

Shrink-swell potential indicates the volume change to be expected with a change in moisture content. The ratings were estimated primarily on the basis of the kind and amount of clay that a soil contains. Most of the soils in this county have low shrink-swell potential.

Corrosion potential refers to the deterioration of concrete or untreated steel pipelines as a result of exposure to oxygen and moisture and to chemical and electrolytic reactions.

Engineering interpretations of soils

In table 6, most of the soils of New Castle County are rated according to their susceptibility to frost action and their suitability as a source of topsoil, sand and gravel, and road fill. In addition, the table lists soil features that affect the location of pipelines and of highways and the construction and maintenance of ponds and reservoirs; dikes, levees, and other embankments; drainage systems; irrigation systems; terraces and diversions; and waterways. The interpretations are based on the test data shown in table 4, the estimated soil properties shown in table 5, and experience in using the soils in this county and in other parts of Delaware. The interpretations in table 6 are general, but they point out what the engineer may expect to find in any area of soil that is shown on the detailed soil map. However, the interpretations do not give exact soil properties and evaluations at the precise point where an engineering project may be planned. Those who use this table should determine the specific suitability and limitation of the soil at the site of the proposed engineering work.

A soil that is suitable for one engineering purpose may be poor or even unsuitable for some other use. The Elkton soils, for example, are well suited as sites for reservoirs but are not suitable as a source of gravel. In contrast, the Rumford soils are a good source of sand and locally are a fair source of gravel, but they generally are not suitable for reservoir sites, because they are subject to excessive seepage.

The susceptibility of the soils to frost action is based on the texture and natural drainage of the soil. Soils that have a high content of silt are moderately susceptible to damaging frost action because they are more likely to heave as a result of freezing and thawing. Silty soils that have impeded drainage are highly susceptible to damaging frost action.

Table 6 indicates both the good and the undesirable features of a soil that may require special consideration before a structure is planned, designed, and constructed. A subsoil of silty clay, such as that of the Elkton soils, has characteristics that make it poor for an earthen embankment or dam. Such a subsoil is unstable and highly erodible, and it cannot be compacted to a suitable dry density. Because the subsoil material is very slowly permeable, however, it may be suitable as a core of a dam, used to reduce seepage. Fine texture and slow permeability in a subsoil increase the difficulty of providing adequate drainage for such soils, and they limit the suitability of the soils for irrigation.

The choice of a soil suitable for laying a pipeline is determined primarily by the natural stability of the soil, the height of the water table, the depth to and kind of bedrock, and the corrosion potential of the soil material. If the water table is high, laying a line for sewer, water, or gas in wet soils is difficult because ditchbanks are likely to collapse. In some soils ditchbanks are unstable even when the water table is not high and the soil is not wet. If bedrock is close to the surface and very hard, time and expense can be saved by locating the pipeline in nearby areas where bedrock is deep or is relatively soft or rippable.

The choice of a soil on which to locate a highway is affected mainly by the height of the water table, the hazard of flooding, the stability of the soil material, particularly under heavy loads or pressure, the expected severity of frost action, and the depth to and kind of bedrock. Also affecting highway and pipeline location are the degree of slope and changes in slope, but these features are not shown in table 6.

The choice of a site for a pond or reservoir depends largely on the amount or rate of seepage that can be expected, particularly at the bottom of the reservoir. The amount of seepage depends on whether the reservoir floor consists of subsoil material or substratum material, as these layers commonly differ greatly in seepage characteristics. The depth to bedrock and the nature of the bedrock also are important. The most nearly ideal soil material for a reservoir floor is one that permits little seepage but has considerable strength or stability and a high water table. Also desirable is a constant or reliable source of water from the ground water, from impounded runoff, or from a stream. Such a source is especially important if seepage or other water losses are rapid.

Stability, erodibility, and the probable maximum density affect the choice of a soil for building dikes, levees, dams, or other embankments. The maximum density to which soil material can be compacted in a dam or other embankment particularly affects the strength and permeability of the structure. All earthen dams allow some seepage, but it is desirable to keep such water loss to a minimum. Generally, soils that can be compacted to the greatest maximum density lose the least water through seepage and also have the greatest strength and stability.

The ease or difficulty with which a soil can be drained artificially is determined mainly by the permeability of the least permeable layer, which normally is the subsoil; by the height and fluctuation of the water table; and by the erodibility of the bottom and banks of ditches and canals.

Some of the features considered in evaluating a soil for irrigation are the slope, the rate at which water infiltrates the soil, the capacity of the soil to retain moisture, and the degree of natural drainage. Soils that have impeded drainage should be thoroughly drained artificially before an irrigation system is installed. In New Castle County, irrigation is mainly by the sprinkler method.

In planning and designing terraces and diversions, the stability and the erodibility of the soil are of special concern. These features, as well as the available moisture capacity and the natural fertility of the surface layer, strongly influence the design of waterways and the kinds of grasses or other plants used for sodding the waterways.

Nonfarm Uses of Soils

The expanding metropolitan areas of Wilmington and Newark have affected the land use in New Castle County. About one-sixth of the acreage of the county is now used for residential or other nonfarm purposes. Most of this acreage is occupied by the cities of Wilmington and Newark and the area that extends from Wilmington northeastward almost to the Pennsylvania State line, southwestward to Newark, and southeastward to New Castle. An effect of this expansion is the increasing demand for information about soil conditions that influence nonfarm uses. The most urgent need is for information about the limitations of soils that affect the disposal of sewage effluent from septic tanks. Less common are requests for information about the use of soils as foundations for buildings, as recreational areas, for sanitary land fills, for streets and parking lots, and the like.

Table 7 gives the degree and kinds of limitations of most of the soils in the county for some selected nonfarm uses. These limitations are rated *slight*, *moderate*, or *severe*. If the rating is *moderate* or *severe*, the main limiting properties are given. The ratings are based on the degree of the greatest single limitation. For example, if a high water table severely limits the use of a soil in the disposal of sewage effluent from septic tanks, the limitation is rated severe for that use, though the soil is well suited to that use in all other respects.

A rating of *slight* indicates that a soil has no important limitation to the specified use, though most soils in the county are at least slightly limited in use. A rating of *moderate* shows that the soil has some limitations to the specified use, but these limitations are not difficult or expensive to overcome. A rating of *severe* indicates that the soil has limitations that are difficult and expensive to overcome. A severe rating, however, does not mean that the soil cannot be used for the specific purpose. For example, a soil having a very high water table is severely limited in its use for homes with basements, but it still can be used for them if measures are taken to improve drainage or to lower the water table permanently and if the basement is completely and permanently sealed. Likewise, a soil that is very steep can be used as a site for a parking lot if it can be graded and stabilized without too much expense.

Discussed in the following paragraphs are the properties considered in rating the limitations to each of the nonfarm uses given in table 7.

Disposal of sewage effluent from septic tanks.—The suitability of a soil for disposing of effluent from septic tanks depends on permeability, depth to the water table in the wettest part of the year, natural drainage, depth to and kind of bedrock, slope, degree of stoniness, and the hazard of flooding. On some soils in the county there is also a hazard of polluting nearby springs, lakes, or streams.

Sewage lagoons.—Sewage lagoons are shallow ponds built to dispose of sewage through oxidation. Among the features that affect the degree of limitation are permeability of soil material in the floor of the lagoon, the degree of slope, depth to bedrock, the content of gravel and stones, the kind of soil material underlying the dam or embankment, the hazard of flooding, and the content of organic matter in the soil below the surface layer.

Homes with basements.—The ratings in table 7 are for houses of three stories or less that have a basement. The main features that limit the use of soils as homesites are depth to the water table, natural drainage, slope, the depth to and kind of bedrock, the degree of stoniness, and the hazard of flooding. For homes without basements, the limitations caused by a high water table and natural drainage are less severe than those given in table 7. Also, the depth to bedrock in New Castle County causes practically no limitations for homes without basements. For industrial or commercial buildings and for homes of more than three stories, detailed investigations should be made at each site.

Streets and parking lots.—The features affecting the use of the soils for streets and parking lots are the depth to the water table in the wettest part of the year, natural drainage, slope, depth to and kind of bedrock, degree of stoniness, and the hazard of flooding.

Sanitary landfill.—The suitability of a soil for the trench type of sanitary landfill depends on the depth to the water table in the wettest part of the year, natural drainage, permeability, slope, depth to and kind of bedrock, degree of stoniness, texture of the material, and the hazard of flooding.

Cemeteries.—Among the features that affect use of soils as cemeteries are depth to the water table during the wettest part of the year, natural drainage, permeability of the most slowly permeable layer, depth to and kind of bedrock, particularly the ease or difficulty of excavation, degree of stoniness, texture of the surface layer, degree of erosion of the surface soil, and the hazard of flooding. The degree of erosion affects the ease or difficulty of establishing and maintaining sod or other close-growing ground cover.

Campsites.—The properties that affect the use of soils as sites for tents and for trailers are depth to water table during the season of most intensive use, natural drainage, permeability of the most slowly permeable layer, slope, depth to and kind of bedrock, degree of stoniness, texture of the surface layer, and hazard of flooding during the period of heavy use. These sites are subject to heavy foot and vehicular traffic, and they are large enough to provide picnic areas, fireplaces, and unsurfaced parking areas. Sites for tents provide platforms. For tents, the limitation caused by the slope is generally less severe than for trailers. Limitations affecting the use for seasonal cottages or for service buildings in camping or other recreational areas generally are the same as those for homes without basements.

Athletic fields and other intensive play areas.—These are areas used for baseball, football, volleyball, soccer, and other games. Areas used for these purposes are assumed to be level or nearly level and subject to extremely heavy foot traffic. The use of topsoil from other areas is not considered in the ratings. Properties to consider when selecting sites to be used as athletic fields and other intensive play areas are depth to the water table and the hazard of flooding during the period of heavy use, natural drainage, permeability of the most slowly permeable layer of the soil, the slope, depth to and kind of bedrock, degree of stoniness, and texture of the surface soil.

Picnic areas, parks, and other extensive play areas.—These are areas that are used for picnicking and similar recreational activities. These areas are subject to much less intensive foot traffic than areas used as athletic fields. The major features considered in rating the soils are the depth to the water table and the hazard of flooding, during the period of heavy use, natural drainage, the slope, the depth to and kind of bedrock, degree of stoniness, the texture of the surface layer, gravel, and cobblestones.

LAWNS AND GOLF FAIRWAYS.—Soil properties that determine whether a good lawn or golf fairway can be established are depth to the water table, natural drainage, degree of slope, depth to and kind of bedrock, degree of stoniness, texture of the surface layer (including gravel or cobblestones), degree of erosion of the surface layer, and the hazard of flooding. The degree of erosion affects the ease or difficulty of establishing and maintaining grasses, shrubs, and other plants used in landscaping. Where grading or filling is needed, it is assumed that the soil material is stored and saved until construction and grading are completed, and then returned. In rating the soils for golf fairways suitability for putting greens, traps, and roughs is not rated.

Home gardens and paths and trails, for recreational use, are also important locally, but the soils have not been rated for these purposes in table 7. Home gardens are small areas used for vegetables, flowers, small ornamental shrubs, and similiar plants. For suitability of the soils for home gardens, refer to the section "Capability Groups of Soils."

Soil features affecting the use of soils for paths and trails are similar to those for lawns and fairways given in table 7. Slope is a less serious limitation for paths and trails than for lawns and fairways. Where the slope is the only limiting feature, the limitation is slight for slopes of 0 to 15 percent, moderate for slopes of 15 to 25 percent, and severe for slopes of more than 25 percent.

Formation, Morphology, and Classification of Soils

In this section the factors that affected the formation and morphology of the soils in New Castle County are discussed. Then the current system of soil classification is explained, and the soil series are placed in some classes of that system and in great soil groups of an older system. The soil series in the county, including a profile typical for each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soils are the products of soil-forming processes acting upon materials formed, deposited, or accumulated by geologic forces. The five major factors of soil formation are climate, plants and animals, parent material, relief, and time. Climate and plants and animals, particularly vegetation, are the active forces in soil formation. Their effect on parent material is modified by relief and by the length of time the parent material has been in place. The relative importance of each factor differs from place to place. In some places one factor may dominate in the formation of a soil and determine most of its properties. Normally, however, the interaction of all of the factors determines the kind of soil that develops in any given place.

Climate

New Castle County has the humid, temperate climate that is typical of coastal areas of the Middle Atlantic States. Facts about the temperature and precipitation are given in tables 9 and 10 in the section "General Nature of the County."

The climate is nearly uniform throughout the county. Rainfall is less, however, in the southern part of the county than in the other parts. This is because thunderstorms tend to divide and follow the Chesapeake Bay to the west and the Delaware Bay to the east. Winds generally are from the south and southwest in summer and from the north and northwest in winter.

Because precipitation exceeds evapotranspiration, the humid, temperate climate has caused the soils to be strongly leached. Most of the soluble materials that were originally present or that were released through weathering have been removed from most of the soils in the county. Largely for this reason, most of the soils are strongly acid and low in fertility; exceptions are the Aldino, Calvert, Montalto, Neshaminy, and Watchung soils. These soils developed in material having a high conten of basic plant nutrients.

Precipitation is chiefly responsible for the subsoil that characterizes most soils in the county. In addition to leaching soluble minerals, water that percolates through the soil moves clay from the surface layer to a subsoil layer. Except for soils formed in recent alluvium, most of the soils in the county have a subsoil that contains more clay than the surface layer.

Also influenced by climate is the formation of blocky structure in the subsoil of well-developed soils. The development of aggregates (peds) in the subsoil is caused by changes in volume of the soil mass that are primarily the result of wetting and drying and of freezing and thawing.

Weathering of minerals occurs at a rate that is related to temperature and moisture supply. In New Castle County most of the soils are relatively low in weatherable minerals. No free carbonates are in them, and most of the bases have been leached out. Because the soils of the Coastal Plain formed in transported parent materials that previously had undergone one or more cycles of erosion, their materials may have been highly weathered and leached at the time they were deposited.

Plants and animals

The native vegetation had a major influence on the development of the soils before the county was settled. Little is known about the effects of micro-organisms, earthworms, and other forms of animal life, but the activities of these animals were important in the cycle of decay and regeneration of plants.

Early settlers found a dense forest that consisted mainly of hardwoods. Oaks were the dominant trees. Tulip-poplar, gum, and yellow pine also were important, but there probably were few pure stands of pine. The fairly pure stands of pine that now exist generally are in areas that were once cleared and cultivated.

Most hardwoods use large amounts of calcium and other bases if they are available. Soils that are normally high in bases remain so under a cover of hardwoods because a large part of the bases are returned to the soil each year. When

TABLE 7.—*Estimated degree and kind of*

[Not rated in this table are Gravel pits and Quarries (Gp), Made land

Soil series and map symbol	Disposal of sewage effluent from septic tanks	Sewage lagoons	Homes with basements (3 stories or less)	Streets and parking lots
Aldino (AdA, AdB2)	Severe: seasonal high water table, slow permeability	Slight on AdA. Moderate on AdB2: 3 to 8 percent slopes	Moderate: 4 to 6 feet to bedrock, impeded drainage.	Moderate: 4 to 6 feet to bedrock, impeded drainage.
Bayboro (Ba)	Severe: high water table, slow permeability.	Slight [1]	Severe: high water table.	Severe: high water table
Butlertown (BuA, BuB2)	Moderate: moderate to moderately slow permeability.	Slight on BuA. Moderate on BuB2: 2 to 5 percent slopes	Moderate: seasonal high water table.	Moderate: seasonal high water table.
(BuC2)	Moderate: moderate to moderately slow permeability.	Severe: 5 to 10 percent slopes.	Moderate: seasonal high water table.	Moderate: seasonal high water table, 5 to 10 percent slopes
Calvert (Mapped in undifferentiated units with Watchung soils).				
Chester (ChA, ChB2)	Slight	Moderate on ChA: moderate permeability. Moderate on ChB2: moderate permeability, 3 to 8 percent slopes	Slight	Slight
(ChC2, ChC3)	Moderate: 8 to 15 percent slopes.	Severe: 8 to 15 percent slopes.	Moderate: 8 to 15 percent slopes.	Moderate: 8 to 15 percent slopes.
(ChD2, ChD3)	Severe: 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes.
Codorus (Co)	Severe: flood hazard.[4]	Severe: flood hazard.[4]	Severe: flood hazard.[4]	Severe: flood hazard [4]
Collington: (CsB2)	Slight	Moderate: moderate permeability, 2 to 5 percent slopes.	Slight	Slight
(CsC3)	Slight	Severe: 5 to 10 percent slopes	Slight	Moderate: 5 to 10 percent slopes.
(CsD3)	Moderate to severe: 10 to 25 percent slopes.	Severe: 10 to 25 percent slopes	Moderate to severe: 10 to 25 percent slopes.	Moderate to severe: 10 to 25 percent slopes.
Comus (Cu)	Severe: flood hazard [4]	Severe: flood hazard [4]	Severe: flood hazard [4]	Severe: flood hazard [4]

See footnotes at end of table

limitations for specified nonfarm uses

and Urban land (Ma), and the seven complexes that include Urban land]

Sanitary land fills (trench method)	Cemeteries	Campsites (intensive use)	Athletic fields and other intensive play areas	Picnic areas, parks, and other extensive play areas	Lawns and golf fairways
Severe: perched water table, seepage.	Severe: slow permeability.	Severe: slow permeability	Severe: slow permeability.	Slight	Slight.
Severe: high water table	Severe: high water table, slow permeability	Severe: high water table, slow permeability.	Severe: high water table, slow permeability	Severe: high water table.	Severe: high water table
Moderate: perched water table, seepage	Moderate: moderate to moderately slow permeability.	Moderate: moderate to moderately slow permeability, impeded drainage.	Moderate: moderate to moderately slow permeability, impeded drainage.	Slight	Slight.
Moderate: perched water table, seepage	Moderate: moderate to moderately slow permeability.	Moderate: moderate to moderately slow permeability, impeded drainage, 5 to 10 percent slopes [2]	Severe: 5 to 10 percent slopes.	Slight	Slight.
Slight	Slight	Slight [3]	Slight on ChA. Moderate on ChB2: 3 to 8 percent slopes	Slight	Slight.
Moderate: 8 to 15 percent slopes.	Moderate on ChC2: 8 to 15 percent slopes. Severe on ChC3: 8 to 15 percent slopes, severely eroded	Moderate: 8 to 15 percent slopes [2]	Severe: 8 to 15 percent slopes	Moderate: 8 to 15 percent slopes	Moderate on ChC2: 8 to 15 percent slopes. Severe on ChC3: 8 to 15 percent slopes; severely eroded.
Severe: 15 to 25 percent slopes.	Severe on ChD2: 15 to 25 percent slopes. Severe on ChD3: 15 to 25 percent slopes, severely eroded.	Severe: 15 to 25 percent slopes	Severe: 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes	Severe on ChD2: 15 to 25 percent slopes. Severe on ChD3: 15 to 25 percent slopes, severely eroded
Severe: flood hazard [4]	Severe: flood hazard [4]	Moderate: flood hazard. [5]	Moderate: flood hazard [5]	Moderate: flood hazard [5]	Moderate: flood hazard [5]
Slight	Slight	Slight [3]	Moderate: 2 to 5 percent slopes	Slight	Slight.
Slight	Moderate: 5 to 10 percent slopes, severely eroded.	Moderate: 5 to 10 percent slopes [2]	Severe: 5 to 10 percent slopes	Slight	Moderate: 5 to 10 percent slopes; severely eroded
Moderate to severe: 10 to 15 percent slopes.	Severe: 10 to 25 percent slopes, severely eroded.	Moderate to severe: 10 to 25 percent slopes [2]	Severe: 10 to 25 percent slopes.	Moderate to severe: 10 to 25 percent slopes.	Severe: 10 to 25 percent slopes, severely eroded.
Severe: flood hazard [4]	Severe: flood hazard [4]	Slight [6]	Slight [6]	Slight [6]	Slight [6]

TABLE 7.—*Estimated degree and kind of*

Soil series and map symbol	Disposal of sewage effluent from septic tanks	Sewage lagoons	Homes with basements (3 stories or less)	Streets and parking lots
Delanco (DeA, DeB2)	Severe: moderately slow permeability; impeded drainage	Slight on DeA Moderate on DeB2. 3 to 8 percent slopes	Moderate impeded drainage	Moderate impeded drainage
Elioak (EaB2)	Moderate moderate to moderately slow permeability.	Moderate 3 to 8 percent slopes	Slight	Slight
(EkC3)	Severe· moderately slow permeability.	Severe· 8 to 15 percent slopes.	Moderate 8 to 15 percent slopes	Moderate 8 to 15 percent slopes
(EkD3)	Severe 15 to 25 percent slopes	Severe 15 to 25 percent slopes	Severe. 15 to 25 percent slopes	Severe 15 to 25 percent slopes.
Elkton (ElA, EmA, EmB)	Severe high water table, slow permeability	Slight on ElA and EmA [1] Moderate on EmB· 2 to 5 percent slopes	Severe. high water table	Severe· high water table.
Elsinboro (EnB2)	Slight	Moderate moderate permeability, 3 to 8 percent slopes	Slight	Slight
(EnC2)	Moderate 8 to 15 percent slopes	Severe 8 to 15 percent slopes.	Moderate 8 to 15 percent slopes	Moderate 8 to 15 percent slopes
Fallsington (Fa, Fs)	Severe high water table	Moderate moderate permeability	Severe high water table	Severe high water table
Glenelg (GmB2)	Slight	Moderate moderate permeability, 3 to 8 percent slopes.	Slight	Slight
(GmC2, GmC3)	Moderate 8 to 15 percent slopes	Severe 8 to 15 percent slopes	Moderate 8 to 15 percent slopes	Moderate 8 to 15 percent slopes
(GmD2, GmD3, GmE) (Limitations to use of Manor soils in mapping units GmB2, GmC2, GmC3, GmD2, GmD3, and GmE are the same as for Glenelg)	Severe on GmD2 and GmD3 15 to 25 percent slopes Severe on GmE 25 to 45 percent slopes	Severe on GmD2 and GmD3 15 to 25 percent slopes Severe on GmE 25 to 45 percent slopes	Severe on GmD2 and GmD3 15 to 25 percent slopes Severe on GmE 25 to 45 percent slopes.	Severe on GmD2 and GmD3 15 to 25 percent slopes Severe on GmE: 25 to 45 percent slopes

See footnotes at end of table.

limitations for specified nonfarm uses—Continued

Sanitary land fills (trench method)	Cemeteries	Campsites (intensive use)	Athletic fields and other intensive play areas	Picnic areas, parks, and other extensive play areas	Lawns and golf fairways
Moderate moderately high water tables.	Moderate moderately slow permeability, impeded drainage.	Moderate moderately slow permeability, impeded drainage	Moderate on DeA: moderately slow permeability; impeded drainage Moderate on DeB2: moderately slow permeability, impeded drainage, 3 to 8 percent slopes.	Slight	Slight.
Slight	Moderate moderately slow permeability.	Moderate moderately slow permeability	Moderate moderately slow permeability; 3 to 8 percent slopes	Slight	Slight
Moderate silty clay loam surface layer, slope.	Severe. 8 to 15 percent slopes; severely eroded	Moderate moderately slow permeability, 8 to 15 percent slopes.[2]	Severe 8 to 15 percent slopes	Moderate 8 to 15 percent slopes, sticky	Severe 8 to 15 percent slopes; severely eroded
Severe 15 to 25 percent slopes	Severe 15 to 25 percent slopes, severely eroded	Severe 15 to 25 percent slopes	Severe: 15 to 25 percent slopes	Severe 15 to 25 percent slopes	Severe 15 to 25 percent slopes, severely eroded
Severe high water table, slow permeability.	Severe high water table, slow permeability.	Severe high water table, slow permeability.	Severe high water table, slow permeability	Severe: high water table.	Severe high water table.
Slight	Slight	Slight [3]	Moderate 3 to 8 percent slopes	Slight	Slight.
Moderate: 8 to 15 percent slopes.	Moderate 8 to 15 percent slopes.	Moderate: 8 to 15 percent slopes [2]	Severe 8 to 15 percent slopes	Moderate 8 to 15 percent slopes	Moderate: 8 to 15 percent slopes.
Severe high water table.	Severe: high water table	Severe high water table	Severe high water table	Severe high water table	Severe high water table
Slight	Slight	Slight [3]	Moderate 3 to 8 percent slopes	Slight	Slight.
Moderate 8 to 15 percent slopes	Moderate on GmC2: 8 to 15 percent slopes Severe on GmC3 8 to 15 percent slopes, severely eroded	Moderate: 8 to 15 percent slopes [2]	Severe 8 to 15 percent slopes	Moderate 8 to 15 percent slopes.	Moderate on GmC2 8 to 15 percent slopes Severe on GmC3. 8 to 15 percent slopes; severely eroded.
Severe on GmD2 and GmD3 15 to 25 percent slopes Severe on GmE 25 to 45 percent slopes	Severe on GmD2 and GmD3 15 to 25 percent slopes Severe on GmE 25 to 45 percent slopes	Severe on GmD2 and GmD3. 15 to 25 percent slopes Severe on GmE 25 to 45 percent slopes	Severe on GmD2 and GmD3 15 to 25 percent slopes Severe on GmE 25 to 45 percent slopes	Severe on GmD2 and GmD3: 15 to 25 percent slopes. Severe on GmE. 25 to 45 percent slopes	Severe on GmD2 and GmD3 15 to 25 percent slopes. Severe on GmE: 25 to 45 percent slopes.

TABLE 7.—*Estimated degree and kind of*

Soil series and map symbol	Disposal of sewage effluent from septic tanks	Sewage lagoons	Homes with basements (3 stories or less)	Streets and parking lots
Glenville (GnA, GnB2)	Severe moderately slow permeability, impeded drainage	Slight on GnA Moderate on GnB2 3 to 8 percent slopes	Moderate. impeded drainage	Moderate impeded drainage
Hatboro:				
(Ha)	Severe. flood hazard [4]	Severe: flood hazard [4]	Severe: flood hazard [4]	Severe: flood hazard [4]
(HbA, HbC)	Severe. high water table· moderately slow permeability.	Slight on HbA [1] Moderate to severe on on HbC. 3 to 12 percent slopes.	Severe high water table.	Severe. high water table.
Johnston (Jo)	Severe. flood hazard [4]	Severe. flood hazard [4]	Severe. flood hazard [4]	Severe. flood hazard [4]
Keyport:				
(KeA, KeB2)	Severe slow permeability	Slight on KeA. Moderate on KeB2 2 to 5 percent slopes	Moderate. impeded drainage	Moderate impeded drainage.
(KeC2, KpC3)	Severe slow permeability	Severe. 5 to 10 percent slopes	Moderate impeded drainage.	Moderate· impeded drainage.
Kinkora (KrA, KrB)	Severe high water table, slow permeability	Slight on KrA. [1] Moderate on KrB 3 to 8 percent slopes [1]	Severe: high water table.	Severe. high water table.
Manor (Mapped in undifferentiated units with Glenelg soils).				
Matapeake				
(MeA, MeB2)	Slight to moderate: moderate to moderately slow permeability.	Slight on MeA Moderate on MeB2 2 to 5 percent slopes.	Slight	Slight
(MeC2, MeC3)	Slight to moderate. moderate to moderately slow permeability	Severe: 5 to 10 percent slopes.	Slight	Moderate: 5 to 10 percent slopes.
(MeD2, MeD3)	Moderate moderate to moderately slow permeability.	Severe. 10 to 15 percent slopes.	Moderate· 10 to 15 percent slopes	Moderate: 10 to 15 percent slopes
(MkA, MkB2)	Moderate moderate to moderately slow permeability	Slight on MkA Moderate on MkB2. 2 to 5 percent slopes	Slight	Slight
(MkC2)	Moderate moderate to moderately slow permeability.	Severe: 5 to 10 percent slopes.	Slight	Moderate: 5 to 10 percent slopes.

See footnotes at end of table.

limitations for specified nonfarm uses—Continued

Sanitary land fills (trench method)	Cemeteries	Campsites (intensive use)	Athletic fields and other intensive play areas	Picnic areas, parks, and other extensive play areas	Lawns and golf fairways
Moderate seasonal wetness	Moderate moderately slow permeability, impeded drainage	Moderate: moderately slow permeability, impeded drainage	Moderate on GnA moderately slow permeability, impeded drainage Moderate on GnB2 moderately slow permeability, impeded drainage, 3 to 8 percent slopes.	Slight	Slight
Severe flood hazard [4] Severe high water table	Severe flood hazard.[4] Severe high water table	Severe flood hazard [7] Severe. high water table	Severe. flood hazard.[7] Severe on HbA high water table. Severe on HbC. high water table, 3 to 12 percent slopes.	Severe: flood hazard [7] Severe. high water table.	Severe: flood hazard.[7] Severe high water table.
Severe flood hazard [4]	Severe flood hazard.[4]	Severe: flood hazard [7]	Severe flood hazard.[7]	Severe. flood hazard [7]	Severe: flood hazard.[7]
Severe moderately high water table, clayey	Severe slow permeability	Severe slow permeability	Severe slow permeability	Slight	Slight.
Severe moderately high water table, clayey	Severe slow permeability.	Severe slow permeability.	Severe slow permeability, 5 to 10 percent slopes.	Slight on KeC2. Moderate on KpC3: sticky.	Slight on KeC2 Moderate on KpC3 severely eroded.
Severe high water table.	Severe high water table, slow permeability	Severe high water table, slow permeability	Severe: high water table, slow permeability.	Severe. high water table.	Severe: high water table.
Slight	Moderate moderately slow permeability	Moderate moderately slow permeability.	Moderate on MeA moderately slow permeability. Moderate on MeB2 moderately slow permeability; 2 to 5 percent slopes.	Slight	Slight
Slight	Moderate moderately slow permeability	Moderate moderately slow permeability, 5 to 10 percent slopes [2]	Severe 5 to 10 percent slopes.	Slight	Slight on MeC2 Moderate on MeC3: 5 to 10 percent slopes, severely eroded.
Moderate 10 to 15 percent slopes.	Moderate on MeD2: moderately slow permeability, 10 to 15 percent slopes Severe on MeD3 10 to 15 percent slopes, severely eroded	Moderate: moderately slow permeability, 10 to 15 percent slopes [2]	Severe: 10 to 15 percent slopes	Moderate: 10 to 15 percent slopes	Moderate on MeD2 10 to 15 percent slopes Severe on MeD3: 10 to 15 percent slopes, severely eroded.
Slight	Moderate moderately slow permeability	Moderate moderately slow permeability	Moderate: moderately slow permeability	Slight	Slight.
Slight	Moderate: moderately slow permeability.	Moderate moderately slow permeability, 5 to 10 percent slopes.	Severe 5 to 10 percent slopes	Slight	Slight.

TABLE 7.—*Estimated degree and kind of*

Soil series and map symbol	Disposal of sewage effluent from septic tanks	Sewage lagoons	Homes with basements (3 stories or less)	Streets and parking lots
Mattapex (MtA, MtB2)	Severe moderately slow permeability, impeded drainage	Slight on MtA. Moderate on MtB2 2 to 5 percent slopes	Moderate. impeded drainage	Moderate impeded drainage.
(MtC2, MtC3)	Severe moderately slow permeability, impeded drainage	Severe: 5 to 10 percent slopes	Moderate impeded drainage	Moderate. impeded drainage, 5 to 10 percent slopes
Mixed alluvial land (Mv)	Severe flood hazard [4]	Severe flood hazard [4]	Severe flood hazard [4]	Severe flood hazard [4]
Montalto (Mapped in undifferentiated units with Neshaminy soils)				
Neshaminy. (NmA, NmB2)	Severe moderately slow permeability	Slight on NmA. Moderate on NmB2 3 to 8 percent slopes.	Slight	Slight
(NmC2, NnC3)	Severe. moderately slow permeability	Severe: 8 to 15 percent slopes	Moderate 8 to 15 percent slopes	Moderate 8 to15 percent slopes
(NnD3) (Limitations to use of Montalto soils in mapping units NmA, NmB2, NmC2, NnC3, and NnD3 are the same as for Neshaminy.)	Severe 15 to 25 percent slopes	Severe: 15 to 25 percent slopes.	Severe 15 to 25 percent slopes	Severe 15 to 25 percent slopes.
(NsE) (Limitations to use of Talleyville soils in this mapping unit are the same as for Neshaminy.)	Severe: moderately slow permeability, 3 to 35 percent slopes	Moderate to severe, 3 to 35 percent slopes	Moderate to severe: 3 to 35 percent slopes, very stony.	Slight to severe 3 to 35 percent slopes.

See footnotes at end of table

limitations for specified nonfarm uses—Continued

Sanitary land fills (trench method)	Cemeteries	Campsites (intensive use)	Athletic fields and other intensive play areas	Picnic areas, parks, and other extensive play areas	Lawns and golf fairways
Moderate: moderately high water table.	Moderate: moderately slow permeability, impeded drainage.	Moderate: moderately slow permeability, impeded drainage	Moderate on MtA: moderately slow permeability, impeded drainage. Moderate on MtB2: moderately slow permeability; impeded drainage, 2 to 5 percent slopes	Slight	Slight
Moderate: moderately high water table.	Moderate: moderately slow permeability; impeded drainage	Moderate: moderately slow permeability, impeded drainage, 5 to 10 percent slopes [2]	Severe: 5 to 10 percent slopes	Slight	Slight on MtC2. Moderate on MtC3: 5 to 10 percent slopes, severely eroded
Severe: flood hazard.[4]	Severe: flood hazard [4]	Severe: flood hazard [7]	Severe: flood hazard [7]	Severe: flood hazard.[7]	Severe: flood hazard [7]
Slight	Moderate: moderately slow permeability	Moderate: moderately slow permeability.	Moderate on NmA: moderately slow permeability. Moderate on NmB2: moderately slow permeability, 3 to 8 percent slopes	Slight	Slight.
Moderate: 8 to 15 percent slopes	Moderate on NmC2: moderately slow permeability, 8 to 15 percent slopes. Severe on NnC3: 8 to 15 percent slopes, severely eroded	Moderate: moderately slow permeability, 8 to 15 percent slopes [2]	Severe: 8 to 15 percent slopes	Moderate on NmC2: 8 to 15 percent slopes. Moderate on NnC3: 8 to 15 percent slopes, sticky.	Moderate on NmC2: 8 to 15 percent slopes. Severe on NnC3: 8 to 15 percent slopes, severely eroded
Severe: 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes, severely eroded	Severe: 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes.	Severe: 15 to 25 percent slopes	Severe: 15 to 25 percent slopes, severely eroded
Moderate to severe: 3 to 35 percent slopes, very stony.	Severe: 3 to 35 percent slopes, very stony.	Moderate to severe: 3 to 35 percent slopes [2]	Moderate to severe: 3 to 35 percent slopes	Moderate to severe: 3 to 35 percent slopes, very stony	Moderate to severe: 3 to 35 percent slopes, very stony.

TABLE 7 —*Estimated degree and kind of*

Soil series and map symbol	Disposal of sewage effluent from septic tanks	Sewage lagoons	Homes with basements (3 stories or less)	Streets and parking lots
Othello (Ot)	Severe: high water table, moderately slow permeability.	Slight [1]	Severe: high water table.	Severe: high water table.
Pocomoke (Po)	Severe: high water table	Moderate: moderate permeability [1]	Severe: high water table	Severe: high water table
Rumford (RuB2, RuC2)	Slight	Severe: moderately rapid to moderate permeability, some slopes more than 7 percent.	Slight	Slight on RuB2. Moderate on RuC2. 5 to 10 percent slopes.
Sassafras. (SaA, SaB2)	Slight	Moderate on SaA: moderate permeability. Moderate on SaB2: moderate permeability; 2 to 5 percent slopes	Slight	Slight
(SaC2, SaC3)	Slight	Severe: 5 to 10 percent slopes.	Slight	Moderate: 5 to 10 percent slopes.
(SaD2, SaD3)	Moderate: 10 to 15 percent slopes.	Severe: 10 to 15 percent slopes	Moderate: 10 to 15 percent slopes	Moderate: 10 to 15 percent slopes
(SmE) (Limitations to use of Matapeake soils in this mapping unit is the same as for Sassafras.)	Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.
Silty and clayey land (StB)	Severe: slow permeability	Moderate: 2 to 5 percent slopes	Severe: clay is unstable	Severe: clay is unstable
(StC)	Severe: slow permeability.	Severe: 5 to 10 percent slopes	Severe: clay is unstable	Severe: clay is unstable.
(StE)	Severe: slow permeability, 10 to 35 percent slopes	Severe: 10 to 35 percent slopes.	Severe: clay is unstable, 10 to 35 percent slopes.	Severe: clay is unstable, 10 to 35 percent slopes.
Talleyville (TaB2)	Severe: moderate to moderately slow permeability.	Moderate: 2 to 5 percent slopes.	Slight	Slight
(TaC2)	Severe: moderate to moderately slow permeability.	Severe: 5 to 10 percent slopes.	Slight	Moderate: 5 to 10 percent slopes

See footnotes at end of table

limitations for specified nonfarm uses—Continued

Sanitary land fills (trench method)	Cemeteries	Campsites (intensive use)	Athletic fields and other intensive play areas	Picnic areas, parks, and other extensive play areas	Lawns and golf fairways
Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Slight	Moderate: loamy sand surface layer.	Slight on RuB2 [3] Moderate on RuC2: 5 to 10 percent slopes.[2]	Moderate on RuB2: 2 to 5 percent slopes. Severe on RuC2: 5 to 10 percent slopes.	Slight	Moderate: loamy sand surface layer.
Slight	Slight	Slight [3]	Slight on SaA. Moderate on SaB2: 2 to 5 percent slopes.	Slight	Slight.
Slight	Slight on SaC2. Moderate on SaC3: 5 to 10 percent slopes, severely eroded.	Moderate: 5 to 10 percent slopes.[2]	Severe: 5 to 10 percent slopes.	Slight	Slight on SaC2. Moderate on SaC3: 5 to 10 percent slopes, severely eroded.
Moderate: 10 to 15 percent slopes.	Moderate on SaD2: 10 to 15 percent slopes. Severe on SaD3: 10 to 15 percent slopes, severely eroded.	Moderate: 10 to 15 percent slopes.[2]	Severe: 10 to 15 percent slopes.	Moderate: 10 to 15 percent slopes.	Moderate on SaD2: 10 to 15 percent slopes. Severe on SaD3: 10 to 15 percent slopes, severely eroded.
Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.	Severe: 15 to 30 percent slopes.
Severe: clayey, unstable.	Severe: slow permeability, clay is unstable.	Severe: slow permeability.	Severe: slow permeability.	Slight	Severe: very low fertility.
Severe: clayey, unstable.	Severe: slow permeability, clay is unstable.	Severe: slow permeability.	Severe: slow permeability, 5 to 10 percent slopes.	Slight	Severe: very low fertility.
Severe: clayey, unstable, 10 to 35 percent slopes.	Severe: slow permeability, clay is unstable, 10 to 35 percent slopes.	Severe: slow permeability, 10 to 35 percent slopes.	Severe: slow permeability, 10 to 35 percent slopes.	Moderate to severe: 10 to 35 percent slopes.	Severe: very low fertility, 10 to 35 percent slopes.
Slight	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Moderate: moderately slow permeability, 2 to 5 percent slopes.	Slight	Slight.
Slight	Moderate: moderately slow permeability.	Moderate: moderately slow permeability, 5 to 10 percent slopes.[2]	Severe: 5 to 10 percent slopes.	Slight	Slight.

TABLE 7.—*Estimated degree and kind of*

Soil series and map symbol	Disposal of sewage effluent from septic tanks	Sewage lagoons	Homes with basements (3 stories or less)	Streets and parking lots
Tidal marsh (Tm)	Severe tidal flooding	Severe tidal flooding	Severe tidal flooding, marshy.	Severe: tidal flooding, marshy.
Watchung (Wa, WcA, WcB). (Limitations to use of Calvert soil in mapping units WcA and WcB are the same as for Watchung.)	Severe: high water table; slow permeability	Slight on Wa and WcA [1] Moderate on WcB 3 to 8 percent slopes.	Severe. high water table.	Severe high water table
Woodstown (WoA, WoB2, WsA, WsB2)	Moderate impeded drainage.	Moderate on WoA and WsA. moderate permeability Moderate on WoB2 and WsB2: moderate permeability, 2 to 5 percent slopes	Moderate impeded drainage	Moderate; impeded drainage

[1] It is assumed that any surface layer having a high organic-matter content will be removed, this layer generally is less than 18 inches thick

[2] Rating is severe for trailer camping on slopes exceeding about 8 percent

[3] Rating is moderate for trailer camping on slopes between 3 and 8 percent.

the leaves fall and then decompose, the bases reenter the soil and are again used by plants. Most of the soils in New Castle County, however, have never been high in bases; consequently, they are acid even under a cover of hardwoods. Soils that are strongly acid and low in fertility are better suited to pines than to most hardwoods. Pines do not require a large amount of calcium and other bases, and their needles do little to restore fertility to the soil.

As agriculture developed in the county, man became an important factor in the development of the soils. Through repeated clearing of the forests and cultivating of the soils, the introducing of new plant species, and the improving of natural drainage, man continues to affect the development of the soils and will affect their development in the future.

The most important changes brought about by man are (1) mixing the upper horizons of the soil to form a plow layer; (2) plowing sloping soils, which has resulted in accelerated erosion; and (3) changing the content of plant nutrients, especially in the upper horizons, as a result of liming and fertilizing. The most obvious change in the vegetation has been the loss of the original plant cover through clearing of the forests. Today only a small part of the county is wooded, and there is a marked increase in the number of pines as compared to the number of hardwoods.

Parent material

New Castle County is located partly on the Piedmont Plateau and partly on the Atlantic Coastal Plain. Parent material accounts for many of the differences among the soils. Most of the soils on the Piedmont Plateau formed from parent material that weathered in place. Most of the soils on the Atlantic Coastal Plain formed in transported material, but a few formed in sediment that was deposited over material weathered from rock in place.

Highly micaceous metamorphic rock or dark-colored igneous rock that lacks mica is the parent material of the soils in the Piedmont Plateau. Some of the soils formed in material weathered directly from micaceous rock. Others formed in sediment washed or rolled from micaceous rock or soils in the upland and laid down along streams. Still others formed in a mantle of micaceous silt laid down on terraces over gravelly material. Among the soils on the Piedmont Plateau are those of the Chester, Elioak, Glenelg, Glenville, and Manor series, which formed in materials weathered in place from micaceous rock. The Aldino, Calvert, Montalto, Neshaminy, Talleyville, and Watchung series formed in material weathered from basic rock. Along the streams on recent sediment are soils of the Codorus, Comus, and Hatboro series. The Delanco, Elsinboro, and Kinkora soils lie on old gravelly terraces.

The parent material of most of the soils in the Coastal Plain part of the county consisted of sediment transported mainly by water, though part of it probably was transported by wind, and part by ice floes carried by glacial meltwater. Some of the sediments were the size of clay particles, but others were as large as pebbles. In places there were cobblestones and larger stones.

The texture of the soils is directly related to the parent material. Soils of the Collington, Fallsington, Pocomoke, Rumford, Sassafras, and Woodstown series, for example, formed in coarse-textured material consisting mainly of sand but that included variable amounts of silt and clay. The Butlertown, Matapeake, Mattapex, and Othello soils, however, formed in silt underlain by fine sand and sand. Clay, on the other hand, was the chief parent material of the finer textured Bayboro, Elkton, and Keyport soils.

Some sedimentary deposits in the county are recent. Soils of the Johnston series and Mixed alluvial land, a land type, occupy recent alluvial deposits on flood plains. Tidal marsh is made up of recently deposited clayey sediment that has been influenced by salt water and action of the tides.

limitations for specified nonfarm uses—Continued

Sanitary land fills (trench method)	Cemeteries	Campsites (intensive use)	Athletic fields and other intensive play areas	Picnic areas, parks, and other extensive play areas	Lawns and golf fairways
Severe: tidal flooding	Severe tidal flooding, marshy.	Severe: tidal flooding; marshy	Severe tidal flooding, marshy.	Severe tidal flooding; marshy.	Severe tidal flooding, marshy.
Severe high water table.	Severe. high water table, slow permeability, very stony	Severe high water table; slow permeability	Severe high water table, slow permeability	Severe· high water table.	Severe: high water table.
Moderate moderately high water table.	Moderate impeded drainage	Moderate impeded drainage	Moderate on WoA and WsA impeded drainage Moderate on WoB2 and WsB2 impeded drainage; 2 to 5 percent slopes.	Slight	Slight.

[4] Frequency of flooding is at least once in 5 to 10 years.
[5] Flooded during season of use about once in 5 years
[6] Flooded during season of use about once in 10 years.
[7] Flooding is likely during season of use every year.

More than one kind of soil commonly forms from the same general kind of parent material. Thus, it is evident that factors other than parent material have influenced the kinds of soils that have formed in the county.

Relief

Relief controls surface drainage and affects percolation of water through the soil and into the underlying material. It also affects depth of the soil. Steep soils generally are shallower than more level ones. This is because runoff is greater on steep slopes, and the soil material is washed away almost as fast as it forms.

The highest elevations in the county are in the Piedmont Plateau, where elevations range from 100 to 400 feet above sea level. Elevations in the Coastal Plain part range from sea level to only about 100 feet. In New Castle County the Piedmont Plateau tilts to the southeast. It consists of valleys that have strongly sloping walls and of narrow flood plains. The Coastal Plain part of the county is level to gently sloping, and most of the soils have slopes of less than 5 percent.

Time

Time accounts for some differences among soils. Thus, soils that have similar parent material and formed under similar vegetation and climate may differ greatly in characteristics because of the length of time the soil-forming processes have been active.

Most of the soils in the Piedmont Plateau have been in place long enough for well-defined horizons to form and are considered old, or mature soils. They matured fairly rapidly because of the moderately high rainfall and favorable relief and temperature. The soils on the flood plains of the Piedmont Plateau, however, are considered to be young. They are young because alluvium is still being deposited and well-defined horizons have not had time to form.

Geologically, the deposits of soil material in the Coastal Plain are fairly young. The soils are better developed, however, than those on the flood plains of the Piedmont Plateau. They occur where there has been little geologic erosion, and the products of the soil-forming processes have remained in place to form well-defined horizons.

Morphology of Soils

Most soils of the county have distinct to prominent horizons. The exceptions, in which horizonation is weak to very weak, are the young alluvial soils and the soils that formed in highly micaceous material in which there has been little if any movement or accumulation of clay minerals.

The differentiation of horizons in the soils is the result of several soil-forming processes. The most important of these are: (1) Accumulation of organic matter, (2) leaching of carbonates and salts more soluble than calcium carbonate, (3) chemical weathering of the primary minerals of the geologic material into silicate clay minerals, (4) translocation of the silicate clay minerals, and probably of some silt-sized particles, from one horizon to another, and (5) chemical changes (oxidation, reduction, and hydration) and transfer of iron.

In the formation of most soils in the county, several of these processes have interacted to a varying degree. For example, the interaction of the first, second, third, and fourth processes is reflected in the strongly expressed horizons of the well-drained Chester, Elioak, Neshaminy, and Sassafras soils, and all five processes have been active in the development of the Aldino, Keyport, Fallsington, and Bayboro soils. Only the first process has had a marked effect on the Comus soils, and only the first and fifth processes have had much effect on the Codorus and Hatboro soils.

Some organic matter has accumulated in all the soils to form an A1 horizon. In many places this horizon has been eroded away or has been mixed with material from underlying horizons through cultivation. The content of organic matter varies in the soils. Sandy soils, such as the Rumford, have a weak A1 horizon that contains little organic matter, but such soils as the Bayboro, Johnston, and Pocomoke have a distinctive, thick A1 horizon that is much higher in organic-matter content.

All of the soils in the county have been completely leached of carbonates and salts, and except for the Aldino, Calvert, Montalto, Neshaminy, and Watchung soils, most of them have been leached of much of their replaceable cations or bases. The leaching of the soils that formed in alluvium and other sediment probably took place in their parent material before the material was deposited. Some of the other processes may also have been active.

The weathering of primary minerals to silicate clay minerals, largely by the process of hydrolysis, results finally in the production of kaolinitic clays. No complete study of clay minerals has been made in New Castle County, but kaolinite is recognized as the most common clay mineral in the Elioak soils. Other clays, such as illite, montmorillonite, and probably halloysite, occur in smaller quantities in some of the soils. Most soils contain a mixture of clay minerals, and no one mineral is dominant. In a few soils siliceous material is dominant, and in the Glenelg and Manor soils, micaceous minerals are dominant.

The translocation and some development in place of silicate clay minerals have contributed strongly to the formation of horizons in most of the soils. Silicate clays formed in the A horizon have largely been translocated to the Bt horizon by percolation and have been at least partly immobilized. This process is responsible for the formation of a textural or a Bt horizon. The process may also be active to a limited degree in soils that do not have a distinct Bt horizon. Silicate clays may also develop within a Bt horizon and be partly or completely immobilized as they are formed. For example, translocation of silicate clays has occurred in the Montalto and Sassafras soils, and translocation and inplace development of silicate clays probably have taken place in the Delanco and Watchung soils.

Gleying, or the process of chemical reduction and transfer of iron, occurs in the soils that have impeded drainage. Gleying is most evident in the Elkton, Bayboro, Fallsington, Pocomoke, Calvert, and Watchung soils. Soils that are strongly gleyed are those in which the water table is at or near the surface for long periods. The high water table tends to inhibit oxidation and promote reduction of iron, which is the primary chemical process of gleying.

Excessive accumulation of clay minerals and of silt in the lower part of the subsoil may result in the formation of a dense, compact layer commonly called a fragipan. This fragipan is a part of the B horizon and is designated by the symbol Bx. It may extend into the underlying C horizon, where it is designated by the symbol Cx. Because a fragipan generally is slowly permeable, a temporary perched water table can form above it and the deeper horizons of the soil contain much less water. In this county, the Aldino, Butlertown, Calvert, and Glenville soils have a fragipan.

Iron that has been reduced in areas where the soil is poorly aerated generally becomes mobile and may be removed from the soil entirely. In the soils of this county, however, iron has moved either within the horizon where it originated or to another horizon nearby. Part of this iron may become reoxidized and segregated to form the reddish-yellow, yellowish-red, yellowish-brown, or strong-brown mottles that indicate impeded drainage and are common in a gleyed horizon.

When silicate clay forms from primary minerals, some iron generally is freed as hydrated oxide. Depending on the degree of oxidation and hydration, these oxides are more or less red. Even a small amount of these oxides will cause the subsoil to have a reddish color. The Bt horizon of the Elioak and Montalto soils and the lower part of the Bt horizon of the Talleyville soils are redder than corresponding horizons in any other soils in the county, and they presumably contain the largest amounts of free iron oxide.

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.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing residential, industrial, and recreational 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.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*3*) and later revised (*7*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. It is under continual study. Therefore, readers interested in developments of this system should refer to the latest literature available (*5*, *10*). In table 8, soil series of New Castle County are placed in some categories of the current system and in the great soil groups of the older system.

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 soil properties that are observable and measurable are used as a basis for classification. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The classes that make up the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized in this system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions are the Entisols and Histosols, which oc-

TABLE 8.—*Soil series classified according to the current system of classification and the 1938 system with its later revisions*

Series	Current classification [1]			1938 classification with later revisions
	Family	Subgroup	Order	Great soil group
Aldino	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols	Gray-Brown Podzolic soils.
Bayboro [2]	Clayey, mixed, thermic	Typic Umbraquults	Ultisols	Humic Gley soils.
Butlertown	Fine-silty, mixed, mesic	Typic Fragiudults	Ultisols	Gray-Brown Podzolic soils.
Calvert	Fine-silty, mixed, mesic	Typic Fragiaqualfs	Alfisols	Planosols
Chester	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils.
Codorus	Fine-loamy, mixed, mesic	Aquic Fluventic Dystrochrepts.	Inceptisols	Alluvial soils
Collington	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils.
Comus	Coarse-loamy, mixed, mesic	Fluventic Dystrochrepts	Inceptisols	Alluvial soils
Delanco	Fine-loamy, mixed, mesic	Aquic Hapludults	Ultisols	Red-Yellow Podzolic soils
Elioak	Clayey, kaolinitic, mesic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils
Elkton	Clayey, mixed, mesic	Typic Ochraquults	Ultisols	Low-Humic Gley soils
Elsinboro	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils
Fallsington	Fine-loamy, mixed, mesic	Typic Ochraquults	Ultisols	Low-Humic Gley soils
Glenelg	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils.
Glenville	Fine-loamy, mixed, mesic	Aquic Fragiudults	Ultisols	Red-Yellow Podzolic soils.
Hatboro	Fine-loamy, mixed, acid, mesic	Fluventic Haplaquepts	Inceptisols	Alluvial soils
Johnston [2]	Coarse-loamy, siliceous, acid, thermic	Cumulic Humaquepts	Inceptisols	Humic Gley soils
Keyport	Clayey, mixed, mesic	Aquic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Kinkora	Clayey, mixed, mesic	Typic Ochraquults	Ultisols	Low-Humic Gley soils
Manor	Coarse-loamy, micaceous, mesic	Typic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Matapeake	Fine-silty, mixed, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils.
Mattapex	Fine-silty, mixed, mesic	Aquic Hapludults	Ultisols	Gray-Brown Podzolic soils.
Montalto	Fine, mixed, mesic	Ultic Hapludalfs	Alfisols	Red-Yellow Podzolic soils.
Neshaminy	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols	Red-Yellow Podzolic soils
Othello	Fine-silty, mixed, mesic	Typic Ochraquults	Ultisols	Low-Humic Gley soils
Pocomoke [2]	Coarse-loamy, siliceous, thermic	Typic Umbraquults	Ultisols	Humic Gley soils.
Rumford [2]	Coarse-loamy, siliceous, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Sassafras	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils.
Talleyville	Fine-silty, mixed, mesic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Watchung	Fine, mixed, mesic	Typic Ochraqualfs	Alfisols	Low-Humic Gley soils
Woodstown	Fine-loamy, mixed, mesic	Aquic Hapludults	Ultisols	Gray-Brown Podzolic soils.

[1] Placement of some series in the current system of classification, particularly in families and subgroups, may change as more precise information becomes available

[2] This soil is a taxadjunct to the series because soil temperature is a few degrees cooler than is defined for the series. A taxadjunct is a soil named for the series it strongly resembles It differs from that series in ways too small to be of consequence in interpreting usefulness or behavior.

cur in many different climates. Three of the soil orders are represented in New Castle County. They are Inceptisols, Alfisols, and Ultisols.

Inceptisols are mineral soils in which horizons have definitely started to develop. They generally are on young, but not recent, land surfaces.

Alfisols are soils containing a clay-enriched B horizon that has medium or high base saturation.

Ultisols are mineral soils that have a clay-enriched B horizon in which base saturation is low, generally less than 35 percent.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP: Suborders are separated into great groups according to the presence or absence of genetic horizons and the arrangement of these horizons. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that have pans that interfere with the growth of roots or the movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 8, because it is the last word in the name of the subgroup.

SUBGROUP: Each great group is subdivided into subgroups. One of these subgroups represents the central, or typic, segment of a group, and the others, called intergrades, contain those soils that have properties mostly of one great group, but also one or more properties of soils in 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.

FAMILY: Each subgroup is divided into families, primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

General Nature of the County

This section describes the physiography, geology, and drainage of the county and discusses the climate and water supply.

New Castle County was organized in 1682, though settlement began in 1638 along the Delaware River near the present city of Wilmington. The first settlers were of Swedish descent, but people of Dutch descent settled in the area near the present town of New Castle in 1651.

The population of New Castle County is steadily increasing, particularly in areas north of the Chesapeake and Delaware Canal where much of the acreage is used for nonfarm purposes. According to reports of the U.S. Bureau of the Census, the population of the county was 218,879 in 1950 and had increased to 307,446 by 1960. Wilmington, the county seat and the largest city in the State, had a population of 95,827 in 1960.

Physiography, Geology, and Drainage

Two physiographic provinces, the Atlantic Coastal Plain and the Piedmont Plateau, cross New Castle County from southwest to northeast. The main fall line that separates the plain from the plateau is between Newark and Wilmington approximately paralleling State Route 2. The Piedmont Plateau is north of the fall line, and the Atlantic Coastal Plain is south of it. A secondary fall line occurs between Wilmington and the Pennsylvania State line along U.S. Highway No. 202.

The Piedmont Plateau part of the county is mostly hilly, though slopes are gentle near the main fall line. Elevations range from about 100 to 400 feet above sea level. The area is underlain by igneous and metamorphic rocks. The Coastal Plain part of the county ranges from level to gently rolling. Elevations range from sea level to about 100 feet above sea level. This part of the county is on sediment consisting chiefly of sand, clay, and gravel. Near the main fall line silty material from the Coastal Plain overlies gravelly material washed from terraces along streams of the Piedmont Plateau. The area near the secondary fall line is underlain by dark-colored basic rock of Piedmont origin capped with silt from the Coastal Plain.

New Castle County is drained mainly by streams that flow eastward into the Delaware River, but small areas are drained by streams that flow westward into Chesapeake Bay. Most of the soils in the Piedmont Plateau part of the county are well drained. Drainage in the Coastal Plain part varies. The soils in the northern part are level to gently rolling and are well drained and moderately well drained. In the southwestern part of the Coastal Plain are basins underlain by sandy material and surrounded by low rims; these are called whale wallows. Here the soils are well drained. The soils in the southeastern part of the plain, however, are underlain by clayey material and are moderately well drained to poorly drained.

TABLE 9.—*Temperature and*

[Elevation

Month	Temperature									Precipitation		
	Average			Extremes				Two years in 10 will have at least 4 days with—		Average	Greatest daily	Year
	Daily maximum	Daily minimum	Monthly	Highest on record	Year	Lowest on record	Year	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—			
	°F	°F	°F	°F		°F		°F.	°F.	Inches	Inches	
January	41 3	25 5	33 4	75	1950	−4	1957	55	8	3 40	1. 60	1962
February	42 4	25 2	33 8	74	[3] 1954	−4	1961	58	12	2 95	1 90	1952
March	50 5	32 0	41. 3	86	1948	9	1960	68	21	4 02	2 75	1958
April	62 5	41 6	52 1	89	1960	22	1965	80	31	3 33	2 56	1961
May	73 4	52 0	62 7	95	1962	34	1957	87	40	3 53	2 01	1952
June	81 8	61 0	71 4	99	1952	44	1958	93	52	4 07	2 67	1955
July	86 2	65 8	76 0	102	[3] 1957	50	1952	95	58	4 25	6 24	1952
August	84 2	64 3	74 3	101	[3] 1955	46	1965	93	54	5 59	4 00	1955
September	77 9	57 3	67 6	100	1953	37	[3] 1963	89	45	3 95	5. 62	1960
October	67 3	45 9	56 6	91	1951	26	1952	81	34	2 91	2 94	1953
November	55 1	35 7	45 4	85	1950	14	1955	68	25	3 53	3 83	1956
December	43 5	26 7	35 1	71	1951	3	1962	59	13	3 03	1 99	1948
Year	63 8	44. 4	54 1	102	[3] 1957	−4	[3] 1961			44 56	6 24	1952

[1] Averages for the period 1931–60 All other data for the period 1948–65.
[2] Less than one-half day

Climate [3]

New Castle County has a humid, continental climate that is modified because the county is near the Atlantic Ocean. The general flow of air is from west to east, but alternating high and low pressure systems dominate the climate during the colder half of the year. High pressure systems generally bring westerly or northwesterly winds, cooler temperatures, and clearing weather. Low pressure systems bring southerly and easterly winds, warmer temperatures, cloudiness, and rain or snow according to the season and the temperature. This pattern breaks down in summer, when warm, moist air spreads northward from the south and southwest and remains over the area much of the time.

The nearby Atlantic Ocean modifies masses of air that pass over it before reaching the county. Easterly winds, associated with a low pressure system and moving northward along the coast, bring much of the precipitation to the county. These winds also raise the temperature in winter and lower it in summer.

Temperature and precipitation data for the county are give in table 9. The data are from the weather station at the Greater Wilmington Airport and are quite representative of the county.

The average annual temperature at Wilmington is about 54° F. The warmest time of the year is the last half of July when the maximum temperature in the afternoon averages about 87°. A temperature of more than 100° occurs about once every 5 or 6 years. The highest temperature recorded was 107° at the Wilmington Porter Reservoir on August 7, 1918. The coldest period of the year is the latter part of January and the first part of February when the minimum temperature ranges between 22 and 25 degrees early in the morning. Temperatures of zero or lower occur about once in 3 to 5 years. During an average winter, the temperature is 32° or lower on about 100 days. The lowest temperature recorded in the county was —15° on February 9, 1934 at the Wilmington Porter Reservoir.

Table 10 shows the probability of freezing temperatures at three stations in the county on or after given dates in spring and on or before given dates in fall. The data are from records kept at Wilmington at the Newark University Farm, the Greater Wilmington Airport, and the Wilmington Porter Reservoir. The average growing season, or frost-free period, in Wilmington extends from the middle of April to the end of October. In other parts of the county, the average growing season differs somewhat. It is 175 to 185 days in the western and northwestern parts and is 195 to 205 days in the eastern and southeastern parts.

The annual precipitation at Wilmington averages about 45 inches, but extremes range from near 32 inches in 1930 to a little more than 61 inches in 1945. Precipitation generally is fairly well distributed throughout the year. It ranges from less than 3 inches to slightly more than 4 inches a month from September through July. Only in August is the average monthly amount more than 5 inches.

[3] By W. J. MOYER, State climatologist, Weather Bureau, ESSA, U S Department of Commerce

precipitation at Wilmington, Del.[1]

78 feet]

Precipitation—Continued							Average number of days with—				
One year in 10 will have—		Snow, sleet					Precipitation of 0 10 inch or more	Temperature			
								Maximum		Minimum	
Less than—	More than—	Average	Maximum monthly	Year	Greatest daily	Year		90° and above	32° and below	32° and below	0° and below
Inches	Inches	Inches	Inches		Inches						
1 7	6 0	5 8	16 5	1961	10 9	1961	7	0	6	26	(2)
1 8	4 2	5 6	14 9	1964	9 8	1958	6	0	4	22	(2)
2 1	6 0	4 8	20 3	1958	15 6	1958	8	0	1	17	0
1 8	6 2	1	1 1	1959	1 1	1959	7	0	0	3	0
1 3	7 1	(4)	(4)	1963	(4)	1963	6	1	0	0	0
1 4	6 3	0	0	0	0	----	6	5	0	0	0
1 3	7 5	0	0	0	0	----	5	8	0	0	0
2 3	10 7	0	0	0	0	----	7	5	0	0	0
9	7 1	0	0	0	0	----	5	2	0	0	0
1 6	5 7	(4)	. 3	[3] 1962	(4)	[3] 1960	5	(2)	0	2	0
1 0	7. 1	1 2	11 9	1953	11 9	1953	6	0	(2)	11	0
1 4	5 3	3 9	13 2	1960	11 1	1960	6	0	5	24	0
33 7	51 5	21 4	20 3	1958	15 6	1958	74	21	16	105	(2)

[3] Also on earlier dates, months, or years.
[4] Trace.

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

[Data from records kept at Wilmington at the Newark University of Delaware Farm, at the Greater Wilmington Airport, and at the Wilmington Porter Reservoir]

Probability	Dates for given probability at temperature of—								
	32° F or lower at—			24° F or lower at—			16° F or lower at—		
	Newark University Farm	Airport	Porter Reservoir	Newark University Farm	Airport	Porter Reservoir	Newark University Farm	Airport	Porter Reservoir
Spring									
9 years in 10 later than	Apr 6	Mar 30	Mar. 28	Mar 15	Feb 28	Feb 27	Feb 6	Feb. 3	Feb. 2
3 years in 4 later than	Apr 14	Apr 4	Apr. 4	Mar 20	Mar. 9	Mar. 8	Feb. 14	Feb 12	Feb 11
2 years in 3 later than	Apr 17	Apr 6	Apr. 6	Mar 22	Mar 12	Mar 11	Feb 17	Feb 15	Feb. 14
1 year in 2 later than	Apr 23	Apr 10	Apr 11	Mar 25	Mar 18	Mar 17	Feb 23	Feb. 21	Feb 20
1 year in 3 later than	Apr 29	Apr 14	Apr. 16	Mar 28	Mar 24	Mar 23	Mar 1	Feb 27	Feb 26
1 year in 4 later than	May 2	Apr 16	Apr. 18	Mar 30	Mar. 27	Mar 26	Mar 4	Mar 2	Mar 1
1 year in 10 later than	May 10	Apr 21	Apr 25	Apr. 4	Apr 5	Apr 4	Mar 12	Mar 11	Mar. 10
Fall									
1 year in 10 earlier than	Oct 3	Oct 13	Oct. 18	Oct 30	Nov. 5	Nov. 16	Nov 27	Dec. 9	Dec. 3
1 year in 4 earlier than	Oct 9	Oct 20	Oct 24	Nov. 5	Nov 23	Nov 23	Dec 3	Dec 13	Dec 11
1 year in 3 earlier than	Oct. 12	Oct 23	Oct. 26	Nov 8	Nov. 14	Nov 26	Dec 6	Dec 15	Dec 14
1 year in 2 earlier than	Oct 16	Oct. 28	Oct. 31	Nov 12	Nov 19	Dec 1	Dec 10	Dec 18	Dec. 19
2 years in 3 earlier than	Oct 20	Nov. 2	Nov 5	Nov 16	Nov 24	Dec. 6	Dec 14	Dec 21	Dec. 24
3 years in 4 earlier than	Oct 23	Nov 5	Nov 7	Nov 19	Nov 26	Dec 9	Dec 17	Dec. 23	Dec. 27
9 years in 10 earlier than	Oct 29	Nov 12	Nov. 13	Nov 25	Dec 3	Dec 16	Dec 23	Dec 27	Jan. 4

Precipitation is likely to be heavy in any one month, but it varies more in summer. In summer precipitation occurs mostly in showers and thunderstorms, and these may bring heavy rain to one area and only a sprinkle to another. In winter precipitation most often comes in general storms that cover a large area and last for several days.

Drought may occur at any time of the year, but a serious drought affecting farm crops is most likely in summer. The rainfall and the moisture stored in the soil generally are adequate for good growth of crops. In some years, however, showers are unevenly distributed in summer, dry periods occur at critical stages of plant growth, and the rate of evaporation is high. As a result, crops may be severely damaged.

The average annual snowfall at Wilmington is about 21.4 inches, but the annual total varies from year to year. It has ranged from as little as 1 inch to as much as about 50 inches. The snow is often mixed with rain and sleet.

Thunderstorms occur on an average of 30 days a year, and 60 percent of these storms come in June, July, and August. Crops and other property occasionally are damaged by wind, hail, or flooding. Hail falls during these storms only once or twice a year, most generally in the period from May through August.

Tornadoes are rare and have caused little damage. The effects of tropical storms or hurricanes are felt in the county about once a year, generally in August or September. Most of these storms cause minor damage, and the rainfall that accompanies them is beneficial.

The prevailing wind is from the west to northwest, except in summer when the prevailing wind is more southerly. The average windspeed is about 9 miles an hour, but winds of 50 to 60 miles per hour, or even stronger, sometimes accompany hurricanes, severe thunderstorms in summer, or general storms in winter.

Relative humidity generally is lowest in February, March, and April and is highest in August, September, and October. It varies during the day and generally decreases with increasing temperature. On a normal day the highest relative humidity occurs early in the morning; at this time relative humidity ranges from 80 to 90 percent in summer and from 70 to 80 percent in winter. In the afternoon humidity, as a rule, is about 55 percent in summer and about 60 percent in winter.

In an average year, there are about 99 clear days and 160 cloudy days at Wilmington. About 61 percent of the days are cloudy, but the range is from 52 percent in October to 66 percent in January. On clear days the cloud cover ranges from none to 30 percent, but on cloudy days the cloud cover ranges from 80 to 100 percent.

Water Supply

The supply of water in New Castle County is abundant, but shortages occur locally in areas where population or industry is concentrated (*6*). In 1955 it was estimated that 72 million gallons of water was used daily in the county and that 140 million gallons of water a day was available from all sources. About 30 million gallons of water a day is available from ground water in the Delaware River Basin, and the potential amount of surface water is even greater. The county is underlain by 10 principal kinds of aquifers that are capable of producing 25 to 50 million gallons of good to excellent ground water a day. The water in the Delaware River is salty and is not suitable for domestic use.

Most streams in the county are polluted, though improvements are being made. The ground water in the Piedmont Plateau part of the county is moderately hard, and that in the Coastal Plain part contains iron in variable amounts. Deep wells that are under heavy use are likely to be contaminated by salt water.

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Glossary

Acidity, soil. See Reaction, soil.

Aeration, soil. The exchange of air in soil with air from the atmosphere The air in a well-aerated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available moisture capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Buried soil. A developed soil, once exposed but now overlain by more recently formed 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.

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

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together The composition of some concretions is unlike that of the surrounding soil Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic—When wet, readily deformed by moderate pressure but can be pressed into a lump, will form a "wire" when rolled between thumb and forefinger

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented—Hard and brittle; little affected by moistening

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

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

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Gleization. The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the lower horizons, as a result of waterlogging with poor aeration and drainage, expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains The distinction between gully and rill is one of depth A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

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

Mottled. Irregularly marked with spots of different colors that vary in number and size Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common*, and *many;* size—*fine, medium*, and *coarse;* and contrast—*faint, distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0 2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0 2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension

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

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

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

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

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

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottling below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils

Very poorly drained soils are wet nearly all the time They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile

Nutrient, plant. Any element that is taken in by a plant, is essential to its growth, and is used by the plant in the elaboration of its food and tissue Among the elements obtained from the soil are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc Plant nutrients obtained largely from air and water are carbon, hydrogen, and oxygen

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed, horizon C in the soil profile.

Permeability. The quality of a soil horizon that enables water or air to move through it Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid*, and *very rapid*.

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	Moderately alkaline	7 9 to 8. 4
Very strongly acid	4 5 to 5 0	Strongly alkaline	8 5 to 9. 0
Strongly acid	5 1 to 5 5	Very strongly alkaline	9. 1 and higher
Medium acid	5. 6 to 6. 0		
Slightly acid	6. 1 to 6. 5		
Neutral	6 6 to 7. 3		
Mildly alkaline	7. 4 to 7. 8		

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

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0 05 to 2 0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay

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.

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

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

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness The plowed layer

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide

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

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

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

Upland (geologic). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

V-ditches. Drainage ditches that are V-shaped and have smooth side slopes.

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.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. In referring to a capability unit or woodland suitability group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, p. 10.
Estimated yields, table 2, p. 47.
Suitability of soils for wildlife, table 3, p. 54.
Engineering uses of soils, tables 4, 5, and 6, pp. 58 through 73.
Use of soils for nonfarm purposes, table 7, p. 78.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group	
			Symbol	Page	Number	Page
AdA	Aldino silt loam, 0 to 3 percent slopes	11	IIw-3	42	12	52
AdB2	Aldino silt loam, 3 to 8 percent slopes, moderately eroded	12	IIe-13	41	12	52
Am	Aldino-Keyport-Mattapex-Urban land complex	12	------	---	---	---
Ba	Bayboro silt loam	13	IIIw-9	44	7	51
BuA	Butlertown silt loam, 0 to 2 percent slopes	13	IIw-1	42	7	51
BuB2	Butlertown silt loam, 2 to 5 percent slopes, moderately eroded	13	IIe-16	41	7	51
BuC2	Butlertown silt loam, 5 to 10 percent slopes, moderately eroded	13	IIIe-16	43	10	51
ChA	Chester loam, 0 to 3 percent slopes	15	I-4	40	4	50
ChB2	Chester loam, 3 to 8 percent slopes, moderately eroded	15	IIe-4	41	4	50
ChC2	Chester loam, 8 to 15 percent slopes, moderately eroded	15	IIIe-4	42	4	50
ChC3	Chester loam, 8 to 15 percent slopes, severely eroded	15	IVe-3	45	4	50
ChD2	Chester loam, 15 to 25 percent slopes, moderately eroded	15	IVe-3	45	4	50
ChD3	Chester loam, 15 to 25 percent slopes, severely eroded	15	VIe-2	45	4	50
Co	Codorus silt loam	16	IIw-7	42	9	51
CsB2	Collington fine sandy loam, 2 to 5 percent slopes, moderately eroded	17	IIe-5	41	5	51
CsC3	Collington fine sandy loam, 5 to 10 percent slopes, severely eroded	17	IVe-5	45	18	52
CsD3	Collington fine sandy loam, 10 to 25 percent slopes, severely eroded	17	VIe-2	45	18	52
Cu	Comus silt loam	18	I-6	41	9	51
DeA	Delanco silt loam, 0 to 3 percent slopes	19	IIw-1	42	7	51
DeB2	Delanco silt loam, 3 to 8 percent slopes, moderately eroded	19	IIe-16	41	7	51
EaB2	Elioak silt loam, 3 to 8 percent slopes, moderately eroded	19	IIe-4	41	11	51
EkC3	Elioak silty clay loam, 8 to 15 percent slopes, severely eroded	20	IVe-3	45	11	51
EkD3	Elioak silty clay loam, 15 to 25 percent slopes, severely eroded	20	VIe-2	45	11	51
ElA	Elkton sandy loam, 0 to 2 percent slopes	20	IIIw-11	44	14	52
EmA	Elkton silt loam, 0 to 2 percent slopes	21	IIIw-9	44	14	52
EmB	Elkton silt loam, 2 to 5 percent slopes	21	IIIw-9	44	14	52
EnB2	Elsinboro silt loam, 3 to 8 percent slopes, moderately eroded	21	IIe-4	41	11	51
EnC2	Elsinboro silt loam, 8 to 15 percent slopes, moderately eroded	21	IIIe-4	42	11	51
EuB	Elsinboro-Delanco-Urban land complex, 0 to 8 percent slopes	21	------	---	---	---
Fa	Fallsington sandy loam	22	IIIw-6	43	7	51
Fs	Fallsington loam	22	IIIw-7	43	7	51
GmB2	Glenelg and Manor loams, 3 to 8 percent slopes, moderately eroded	23	IIe-4	41	4	50
GmC2	Glenelg and Manor loams, 8 to 15 percent slopes, moderately eroded	23	IIIe-4	42	4	50
GmC3	Glenelg and Manor loams, 8 to 15 percent slopes, severely eroded	23	IVe-3	45	4	50
GmD2	Glenelg and Manor loams, 15 to 25 percent slopes, moderately eroded	23	IVe-3	45	11	51
GmD3	Glenelg and Manor loams, 15 to 25 percent slopes, severely eroded	23	VIe-2	45	11	51
GmE	Glenelg and Manor loams, 25 to 45 percent slopes	23	VIe-2	45	11	51
GnA	Glenville silt loam, 0 to 3 percent slopes	24	IIw-3	42	8	51
GnB2	Glenville silt loam, 3 to 8 percent slopes, moderately eroded	24	IIe-13	41	8	51
Gp	Gravel pits and Quarries	24	VIIIs-4	46	24	52

Map symbol	Mapping unit	Described on page	Capability unit Symbol	Capability unit Page	Woodland suitability group Number	Woodland suitability group Page
Ha	Hatboro silt loam	25	IIIw-7	43	3	50
HbA	Hatboro silt loam, local alluvium, 0 to 3 percent slopes	25	IIIw-7	43	3	50
HbC	Hatboro silt loam, local alluvium, 3 to 12 percent slopes	25	IIIw-7	43	3	50
Jo	Johnston loam	26	IIIw-7	43	7	51
KeA	Keyport silt loam, 0 to 2 percent slopes	26	IIw-8	42	14	52
KeB2	Keyport silt loam, 2 to 5 percent slopes, moderately eroded	26	IIe-13	41	14	52
KeC2	Keyport silt loam, 5 to 10 percent slopes, moderately eroded	27	IIIe-13	43	14	52
KpC3	Keyport silty clay loam, 5 to 10 percent slopes, severely eroded	27	VIe-2	45	10	51
KrA	Kinkora silt loam, 0 to 3 percent slopes	28	Vw-1	45	13	52
KrB	Kinkora silt loam, 3 to 8 percent slopes	28	VIw-2	45	13	52
Ma	Made land and Urban land	28	------	---	24	52
McB	Manor-Glenelg-Chester-Urban land complex, 0 to 8 percent slopes	28	------	---	---	---
MeA	Matapeake silt loam, 0 to 2 percent slopes	29	I-4	40	10	51
MeB2	Matapeake silt loam, 2 to 5 percent slopes, moderately eroded	29	IIe-4	41	10	51
MeC2	Matapeake silt loam, 5 to 10 percent slopes, moderately eroded	29	IIIe-4	42	10	51
MeC3	Matapeake silt loam, 5 to 10 percent slopes, severely eroded	29	IVe-3	45	18	52
MeD2	Matapeake silt loam, 10 to 15 percent slopes, moderately eroded	29	IVe-3	45	10	51
MeD3	Matapeake silt loam, 10 to 15 percent slopes, severely eroded	29	VIe-2	45	18	52
MkA	Matapeake silt loam, silty substratum, 0 to 2 percent slopes	30	I-4	40	10	51
MkB2	Matapeake silt loam, silty substratum, 2 to 5 percent slopes, moderately eroded	30	IIe-4	41	10	51
MkC2	Matapeake silt loam, silty substratum, 5 to 10 percent slopes, moderately eroded	30	IIIe-4	42	10	51
MsB	Matapeake-Sassafras-Urban land complex, 0 to 5 percent slopes	30	------	---	---	---
MtA	Mattapex silt loam, 0 to 2 percent slopes	31	IIw-1	42	14	52
MtB2	Mattapex silt loam, 2 to 5 percent slopes, moderately eroded	31	IIe-16	41	14	52
MtC2	Mattapex silt loam, 5 to 10 percent slopes, moderately eroded	31	IIIe-16	43	14	52
MtC3	Mattapex silt loam, 5 to 10 percent slopes, severely eroded	31	IVe-9	45	10	51
Mv	Mixed alluvial land	31	VIw-1	45	7	51
NmA	Neshaminy and Montalto silt loams, 0 to 3 percent slopes	32	I-4	40	4	50
NmB2	Neshaminy and Montalto silt loams, 3 to 8 percent slopes, moderately eroded	32	IIe-4	41	4	50
NmC2	Neshaminy and Montalto silt loams, 8 to 15 percent slopes, moderately eroded	33	IIIe-4	42	4	50
NnC3	Neshaminy and Montalto silty clay loams, 8 to 15 percent slopes, severely eroded	33	IVe-3	45	4	50
NnD3	Neshaminy and Montalto silty clay loams, 15 to 25 percent slopes, severely eroded	33	VIe-2	45	4	50
NsE	Neshaminy and Talleyville very stony silt loams, 3 to 35 percent slopes	33	VIs-3	46	4	50
NtB	Neshaminy-Talleyville-Urban land complex, 0 to 8 percent slopes	33	------	---	---	---
NtD	Neshaminy-Talleyville-Urban land complex, 8 to 25 percent slopes	33	------	---	---	---
Ot	Othello silt loam	34	IIIw-7	43	14	52
Ou	Othello-Fallsington-Urban land complex	34	------	---	---	---
Po	Pocomoke loam	35	IIIw-7	43	7	51
RuB2	Rumford loamy sand, 2 to 5 percent slopes, moderately eroded	35	IIs-4	42	10	51
RuC2	Rumford loamy sand, 5 to 10 percent slopes, moderately eroded	35	IIIe-33	43	10	51
SaA	Sassafras sandy loam, 0 to 2 percent slopes	36	I-5	41	10	51
SaB2	Sassafras sandy loam, 2 to 5 percent slopes, moderately eroded	36	IIe-5	41	10	51
SaC2	Sassafras sandy loam, 5 to 10 percent slopes, moderately eroded	36	IIIe-5	43	10	51

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group	
			Symbol	Page	Number	Page
SaC3	Sassafras sandy loam, 5 to 10 percent slopes, severely eroded	36	IVe-5	45	18	52
SaD2	Sassafras sandy loam, 10 to 15 percent slopes, moderately eroded	36	IVe-5	45	10	51
SaD3	Sassafras sandy loam, 10 to 15 percent slopes, severely eroded	36	VIe-2	45	18	52
SmE	Sassafras and Matapeake soils, 15 to 30 percent slopes	36	VIe-2	45	10	51
StB	Silty and clayey land, gently sloping	37	IIIe-42	43	17	52
StC	Silty and clayey land, sloping	37	IVe-3	45	17	52
StE	Silty and clayey land, steep	37	VIIe-2	46	17	52
TaB2	Talleyville silt loam, 2 to 5 percent slopes, moderately eroded	37	IIe-4	41	4	50
TaC2	Talleyville silt loam, 5 to 10 percent slopes, moderately eroded	37	IIIe-4	42	4	50
Tm	Tidal marsh	37	VIIIw-1	46	24	52
Wa	Watchung very stony silt loam	38	VIIs-4	46	13	52
WcA	Watchung and Calvert silt loams, 0 to 3 percent slopes	38	Vw-1	45	13	52
WcB	Watchung and Calvert silt loams, 3 to 8 percent slopes	38	VIw-2	45	13	52
WoA	Woodstown sandy loam, 0 to 2 percent slopes	39	IIw-5	42	7	51
WoB2	Woodstown sandy loam, 2 to 5 percent slopes, moderately eroded	39	IIe-36	42	7	51
WsA	Woodstown loam, 0 to 2 percent slopes	39	IIw-1	42	7	51
WsB2	Woodstown loam, 2 to 5 percent slopes, moderately eroded	39	IIe-16	41	7	51

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