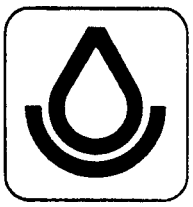
SOIL SURVEY

Stafford and King George Counties Virginia



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
VIRGINIA POLYTECHNIC INSTITUTE AND
STATE UNIVERSITY
Issued February 1974

Major fieldwork for this soil survey was done in the period 1963–68. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service and the Virginia Polytechnic Institute and State University. It is part of the technical assistance furnished to the Tri-County Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, 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 Stafford and King George Counties 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 woodland suitability group of each. It also shows the page where each soil is described and the page for the capability unit and woodland suitability group in which the soil has been placed.

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

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

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

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

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

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

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

Newcomers in Stafford and King George Counties will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They will also be interested in the section "Additional Facts about the Counties."

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Contents

Issued February 1974

SOIL SURVEY OF STAFFORD AND KING GEORGE COUNTIES, VIRGINIA

BY DAN ISGRIG AND ADOLPH STROBEL, JR., SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

STAFFORD AND KING GEORGE COUNTIES are in northeastern Virginia (fig. 1). The two counties have a combined area of 449 square miles or 287,360 acres. Of this Stafford County has an area of 271 square miles or 173,440 acres and King George County an area of 178 square miles or 113,920 acres.

About 75 percent of the land area of Stafford County and about 63 percent of the land area of King George County are in woodland. In the past, most of the lands were cleared and cultivated for such crops as corn, tobacco, small grains, and hays. As soils eroded, fertility decreased, and markets changed, the margin of profit became smaller and smaller, and much of the land was allowed to revert to woodland. The number of full-time farmers in the two-county area is low and decreasing each year. Many of the farms have become small, part-time enterprises, operated by persons whose chief livelihood is some other line of work.

Much of the farm income in the two counties comes from livestock, dairy products, and field crops. Beef cattle, the sale of whole milk, and the production of corn and soybeans are the main cash enterprises.

How This Survey Was Made

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

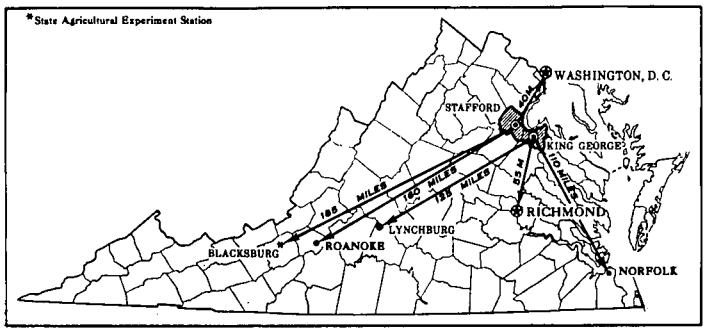

Figure 1.—**Location of Stafford and King George Counties in Virginia.**

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. Caroline and Cecil, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface 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. The name of a soil phase indicates a feature that affects management. For example, Caroline fine sandy loam, 2 to 6 percent slopes, eroded, is one of several phases within the Caroline series.

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

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

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 Stafford and King George Counties—soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled 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. Aura-Galestown-Sassafras complex, 6 to 15 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Susquehanna soils, 2 to 10 percent slopes, is an undifferentiated group.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land, wet, is a land type in Stafford and King George Counties.

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

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

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

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Stafford and King George Counties. 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 land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Stafford and King George Counties are discussed in the following pages.

1. Nason-Elioak-Manor Association

Deep, well-drained to somewhat excessively drained soils having dominantly clay or silt loam subsoil; on Piedmont uplands

This soil association occupies two areas in the western part of Stafford County. It is mostly undulating to steep but includes narrow to fairly broad ridges where slopes range from 2 to 6 percent on the tops and from 6 to 15 percent on the sides. The slopes along the larger drainageways and smaller streams commonly are 15 to 35 percent.

The soils in this association make up about 14 percent of Stafford County. About 40 percent is made up of Nason soils, about 30 percent of Elioak soils, and about 11 percent of Manor soils. The remaining 19 percent consists of minor soils. Nason and Elioak soils are on the tops and sides of ridges, and Manor soils are on steeper slopes along the larger drainageways and small streams.

Nason soils have a brown silt loam surface layer and a yellowish-red clay subsoil. These soils are deep, well drained, and moderately permeable. They are low in organic-matter content and natural fertility. They are strongly to very strongly acid.

Elioak soils have a silt loam surface layer and a red clay subsoil. These soils are deep, well drained, and moderately permeable. They are low in organic-matter content and natural fertility. They are strongly or very strongly acid.

Manor soils have a surface layer of brown silt loam and a yellowish-red silt loam subsoil. These soils are deep, well drained to somewhat excessively drained and have moderately rapid permeability. These soils are underlain

by strongly weathered micaceous schist. They are very strongly acid and low in natural fertility.

Minor soils in this association are mainly in the Appling, Cecil, Fairfax, Lignum, Meadowville, and Worsham series. The Appling, Cecil, and Fairfax soils are in positions similar to those occupied by the Nason and Elioak soils. The Lignum and Meadowville soils are at the heads of drainageways and in saddles or slight depressions. The Worsham soils are in drainageways.

Most of this association is wooded and the rest is in crops and pasture. Oak and hickory trees are predominant. Farmland reverting to woodland is covered by Virginia pine. Most of this association has moderate limitations for septic tank systems.

2. Appling-Cecil-Ashlar Association

Deep and moderately deep, well-drained to excessively drained soils having dominantly clay or fine sandy loam subsoil; on Piedmont uplands

This soil association occupies three large areas and one small area in the western part of Stafford County. It is undulating to steep, but it includes narrow to fairly broad ridges where slopes are 2 to 6 percent on the top and 6 to 15 percent on the sides. Slopes along the larger drainageways and smaller streams commonly are 15 to 35 percent. In many places outcrops of granite and gneiss are on the lower parts of these steep slopes.

The soils in this association make up about 20 percent of Stafford County. About 45 percent is Appling soils, 20 percent is Cecil soils, and 15 percent is Ashlar soils. The remaining 20 percent is minor soils. Appling and Cecil soils are on sides of ridges, and Ashlar soils are on the slopes along the larger drainageways and small streams.

Appling soils have a grayish-brown fine sandy loam surface layer and a dominantly yellowish-red clay subsoil. These soils are deep, well drained, and moderately permeable. They are low in organic-matter content and natural fertility, and they are very strongly acid.

Cecil soils have a dark-brown fine sandy loam surface layer and a dominantly red clay subsoil. These soils are deep, well drained, and moderately permeable. They are low in organic-matter content, low in natural fertility, and they are very strongly acid.

Ashlar soils have a dark-brown fine sandy loam surface layer and a yellowish-brown fine sandy loam subsoil. These soils are moderately deep and well drained to excessively drained. Permeability is moderately rapid on the steeper slopes. Ashlar soils are low in organic-matter content, low in natural fertility, and they are very strongly acid. They are underlain by strongly weathered granite and gneiss.

Minor soils of this association are mainly in the Cartecay, Colfax, Cullen, Mecklenburg, Nason, State, and Worsham series. The Cullen, Mecklenburg, and Nason soils are in positions similar to those occupied by the Appling and Cecil soils. Colfax soils are in saddles, in slight depressions, and on broader ridges. State soils are at the heads of drainageways, and Cartecay and Worsham soils are in drainageways.

Most of this association is wooded, and the rest is in crops. Oak and hickory trees are predominant. Farmland reverting to woodland is covered by Virginia pine. Most of this association has moderate limitations for septic tank systems. The number of small homesites along roads in this association is increasing.

3. Cullen-Mecklenburg-Orange Association

Deep, well-drained to somewhat poorly drained soils having dominantly clay subsoil; on Piedmont uplands

This soil association occupies areas in the west-central part of Stafford County. It is undulating to rolling, but it includes narrow ridges where slopes are 2 to 6 percent on the top and 6 to 15 percent on the sides. Slopes are generally complex and in places are severely eroded. Some of the less extensive soils of this association occupy areas along the smaller streams and drainageways where slopes range up to 35 percent.

The soils in this association make up about 15 percent of Stafford County. About 30 percent is Cullen soils, 10 percent is Mecklenburg soils, and 10 percent is Orange soils. The remaining 50 percent is minor soils. Cullen and Mecklenburg soils are on sides of ridges, and Orange soils are mostly on broader ridges and low areas.

Cullen soils have a dark-brown loam surface layer and a dominantly red clay subsoil. These soils are deep, well drained, and moderately permeable. They are low to medium in natural fertility, low in organic matter, and they are medium acid to very strongly acid.

Mecklenburg soils have a dark yellowish-brown loam surface layer and a dominantly yellowish-red clay subsoil. These soils are deep, well drained, and slowly permeable. They are medium in natural fertility and organic-matter content, and they are slightly acid to medium acid.

Orange soils have a dark grayish-brown loam surface layer and a dominantly yellowish-brown clay subsoil. These soils are deep, somewhat poorly drained to moderately well drained, and slowly permeable. They are medium in natural fertility and low in organic matter. Orange soils are commonly medium acid to strongly acid in the upper subsoil and neutral in the lower subsoil.

Minor soils of this association are mainly in the Appling, Bremo, Cecil, Elbert, Meadowville, Nason, Watt, Worsham, and Zion series. Appling, Cecil, Nason, and Zion soils are in positions similar to those occupied by the Cullen and Mecklenburg soils. Bremo and Watt soils are on sides of narrow ridges. Meadowville soils are at the heads of drainageways, and Elbert and Worsham soils are in drainageways.

This association is in crops, pasture, and woods. Oak and hickory trees are predominant, but Virginia pine is on farmland that is reverting to woodland. Cullen soils are among the better soils in Stafford County for farming, but they are erodible and unstable in cuts. Most of this association has moderate to severe limitations for septic tank systems. The number of small homesites along roads in this association is increasing.

4. Sassafras-Aura-Caroline Association

Deep, well-drained soils having sandy clay loam, heavy clay loam, or clay subsoil; on Coastal Plain uplands

This association occupies one large area in Stafford County and one small area in King George County. It is undulating to hilly, but it includes narrow ridges where slopes are 2 to 10 percent on the top and 10 to 35 percent on the sides.

The soils in this association make up 25 percent of Stafford County and 8 percent of King George County. About 30 percent is Sassafras soils, 20 percent is Aura soils, and 16 percent is Caroline soils. The remaining 34 percent is minor soils. These soils are on the top and sides of ridges throughout the association, and in many places they are intricately mixed.

Sassafras soils have a dark-brown fine sandy loam surface layer and a brown, dominantly sandy clay loam subsoil. These soils are deep, well drained, and moderately permeable. They are low in natural fertility and organic-matter content, and they are strongly acid. The steeper Sassafras soils in many places are intricately mixed with Aura and Caroline soils.

Aura soils have a grayish-brown gravelly fine sandy loam surface layer and a strong-brown to yellowish-red gravelly sandy clay loam subsoil. These soils are deep, well drained, and moderately permeable. They are low in organic-matter content and natural fertility, and they are strongly acid. The steeper Aura soils in many places are intricately mixed with Sassafras and Galestown soils.

Caroline soils have a brown fine sandy loam surface layer and a yellowish-red and strong-brown heavy clay loam or clay subsoil. These soils are deep and well drained. Permeability is moderately slow. They are low in natural fertility and organic-matter content, and they are very strongly acid.

Minor soils of this association are mainly in the Bourne, Bibb, Craven, Galestown, Iuka, Kempsville, Susquehanna, Tetotum, and Turbeville series. Bourne, Kempsville, Susquehanna, and Turbeville soils are in positions similar to those ocupied by Sassafras and Caroline soils. Bibb soils are along the smaller streams. Craven and Tetotum soils are in depressions or in low areas. The steeper Galestown soils occur in complex with Sassafras soils. Iuka soils are at the heads of drainageways.

Most of this association is wooded. Oak, hickory, and yellow-poplar are predominant, but Virginia pine and loblolly pine are on farmland that is reverting to woodland. Some areas are in crops and pasture. Most of this association has moderate to severe limitations for septic tank systems. The number of small homesites along roads in this association is increasing.

5. Marr-Westphalia Association

Deep, well-drained soils having sandy clay loam or very fine sandy loam subsoil; on Coastal Plain uplands

This soil association occupies small areas in southeastern Stafford County and western King George County. It is rolling to hilly but includes narrow ridges where slopes are 2 to 10 percent on the top and 10 to 30 percent on the sides. This association is underlain by thick deposits of very fine sands and a few small areas of silt.

The soils in this association make up 3 percent of Stafford County and 2 percent of King George County. About 45 percent is Marr soils and 15 percent is Westphalia soils. The remaining 40 percent is minor soils. These soils are on the tops and sides of ridges.

Marr soils have a dark-brown very fine sandy loam surface layer and a strong-brown sandy clay loam subsoil. These soils are deep, well drained, and moderately permeable. They are low in natural fertility and organic-matter content, and they are very strongly acid.

Westphalia soils have a brown loamy very fine sand surface layer and a dominantly brown very fine sandy loam subsoil. These soils are deep and well drained. Permeability is moderately rapid. They are low in natural fertility and organic-matter content, and they are very strongly acid.

Minor soils in this association are mainly in the Aura, Bibb, Caroline, Iuka, Sassafras, and Woodstown series. Aura, Caroline, and Sassafras soils are in positions similar to those occupied by the Marr and Westphalia soils. Bibb soils are along the smaller streams. Iuka soils are at the heads of drainageways. Woodstown soils are in slight depressions and on low-lying areas.

Most of the association is wooded, and the rest is in crops, pasture, and small homesites. Oak, hickory, yellow-poplar, and gum are predominant. Farmland reverting to woodland is in Virginia pine. Most of this association has moderate to severe limitations for septic tank systems.

6. Sassafras-Galestown-Kempsville Association

Deep, well-drained to somewhat excessively drained soils having sandy clay loam or loamy fine sand subsoil; on Coastal Plain uplands

This association occupies an area of broad, nearly level to gently sloping tops of ridges and steep sides of ridges. Slopes are predominantly 0 to 6 percent on the top and 15 to 45 percent on the sides. Alluvial areas along the small streams in the association are wet and swampy.

The soils in this association make up 30 percent of King George County. About 40 percent is Sassafras soils, 15 percent is Galestown soils, and 8 percent Kempsville soils. The remaining 37 percent is minor soils.

Sassafras soils have a dark-brown fine sandy loam surface layer and a brown, dominantly sandy clay loam subsoil. These soils are deep, well drained, and moderately permeable. They are low in natural fertility and organic-matter content, and they are strongly acid.

Galestown soils have a dark-brown loamy fine sand surface layer and a yellowish-brown to brown loamy fine sand subsoil. These soils are deep, somewhat excessively drained, and rapidly permeable. They are low in natural fertility and organic-matter content, and they are very strongly acid. The steeper Galestown soils are intricately mixed with Sassafras soils.

Kempsville soils have a dark-brown fine sandy loam surface layer and a brown sandy clay loam to sandy loam subsoil. These soils are deep, well drained, and moderately permeable. They are low in natural fertility and

organic-matter content, and they are strongly acid. Kempsville soils are mainly on broad ridges.

Minor soils of this association are mainly in the Atlee, Bourne, Bibb, Craven, Iuka, and Woodstown series. Bibb soils are along the smaller streams. Craven and Woodstown soils are on low areas. Iuka soils are at the heads of drainageways.

Most of the nearly level to gently sloping ridges are in crops and pasture. The steeper sloping soils and some of the ridges are wooded. Oak, hickory, and yellow-poplar are predominant. The number of small homesites along roads of this association is increasing. Most of this association has only slight limitations for septic tank systems.

7. Bourne-Caroline Association

Deep, moderately well drained to well drained soils having a fragipan or having heavy clay loam and clay subsoil; on Coastal Plain uplands

This soil asociation occupies a long, narrow area across southern Stafford County and extends a short distance into western King George County. It is undulating to rolling, but it includes broad ridges where slopes are 0 to 6 percent on the top, and 6 to 18 percent on the sides. The part of this association that is east of Interstate 95 is on the Coastal Plain, and the part west of Interstate 95 consists of thick beds of fluvial sediment overlying Piedmont rock formations.

The soils in this association make up about 18 percent of Stafford County and 2 percent of King George County. About 46 percent is Bourne soils and 31 percent is Caroline soils. The remaining 23 percent is minor soils. Bourne and Caroline soils are on the tops and sides of ridges.

Bourne soils have a dark-brown fine sandy loam surface layer, a yellowish-brown sandy clay loam subsoil, and a fragipan at a depth of 18 to 24 inches. These soils are moderately well drained, and the fragipan is slowly permeable to very slowly permeable. They are low in natural fertility and organic-matter content, and they are strongly acid.

Caroline soils have a brown fine sandy loam surface layer and a yellowish-red and strong-brown heavy clay loam or clay subsoil. These soils are deep and well drained. Permeability is moderately slow. They are low in natural fertility and organic-matter content, and they are very strongly acid.

Minor soils of this association are mainly in the Aura, Craven, Galestown, Kempsville, Sassafras, Tetotum, Turbeville, and Wehadkee series. The Aura, Kempsville, Sassafras, and Turbeville soils generally are on the narrower, gently sloping tops of ridges and the steeper sides of ridges. The Craven and Tetotum soils are in slight depressions and on low areas. The Galestown soils are in intricately mixed patterns with Sassafras soils. The Wehadkee soils are along streams.

Most of this association is in crops and pasture. It has severe limitations for septic tank disposal systems. The number of small homesites in this association is increasing rapidly.

8. Craven-Caroline Association

Deep, well drained to moderately well drained soils having heavy clay loam and clay subsoil; on Coastal Plain uplands

This association occupies a small area in the eastern part of King George County. It is nearly level to gently sloping, but includes short, sharp slopes along the larger drainageways and small streams. Generally, slopes range from 0 to 6 percent on the broad areas, and from 6 to 18 percent on the short, sharp slopes.

The soils in this association make up about 5 percent of King George County. About 35 percent is Craven soils and 32 percent is Caroline soils. The remaining 33 percent is minor soils. Craven soils are on the nearly level to gently sloping areas, and Caroline soils are on the short, sharp slopes along drainageways and small streams.

Craven soils have a pale-brown loam surface layer and a yellowish-brown and strong-brown clay subsoil. The subsoil is mottled with gray at a depth of about 24 inches. These soils are deep, moderately well drained, and slowly permeable. They are low in natural fertility and organic-matter content, and they are very strongly acid.

Caroline soils have a brown fine sandy loam surface layer and a yellowish-red and strong-brown heavy clay loam or clay subsoil. These soils are deep and well drained. Permeability is moderately slow. They are low in organic-matter content and natural fertility, and they are very strongly acid.

Minor soils of this association are mainly in the Bertie, Bourne, Pooler, and Tetotum series. Bourne soils are nearly level to gently sloping. Bertie and Pooler soils are in slight depressions and on low-lying areas. Tetotum soils are nearly level to gently sloping.

Most of this association is wooded. Oak and hickory are predominant. Virginia pine and loblolly pine are on cut and burned areas, and on farmland that is reverting to woodland. Most of this association has severe limitations for septic tank systems.

9. Tetotum-Bladen-Bertie Association

Deep, moderately well drained to poorly drained soils having clay loam, sandy clay loam, or clay subsoil; in broad low-lying areas

This soil association occupies areas in northern King George County and in northeastern Stafford County. Slopes are dominantly 0 to 10 percent, but some of the minor soils have slopes of 6 to 15 percent. Steep banks along the Potomac River have active shoreline erosion (fig. 2).

The soils in this association make up 2 percent of Stafford County and 13 percent of King George County. About 32 percent is Tetotum soils, 25 percent Bladen soils, and 21 percent Bertie soils. The remaining 22 percent is minor soils.

Tetotum soils have a dark grayish-brown fine sandy loam surface layer and a yellowish-brown, mainly clay loam subsoil. The subsoil is mottled with gray at a depth of about 23 inches. These soils are deep, moderately well

Figure 2.—**Banks along Potomac River that are actively eroding.**

drained, and moderately permeable. They are low in natural fertility, low to moderate in organic-matter content, and they are strongly acid.

Bladen soils have a gray loam surface layer and a gray clay subsoil. These soils are deep, poorly drained, and slowly permeable. They are low in natural fertility, low to moderate in organic-matter content, and they are very strongly acid.

Bertie soils have a grayish-brown very fine sandy loam surface layer and a light olive-brown or yellowish-brown clay loam subsoil. The subsoil is mottled with gray. These soils are deep and somewhat poorly drained. They are low in natural fertility and organic-matter content, and they are very strongly acid.

Minor soils of this association are mainly in the Caroline, Fallsington, Pooler, Sassafras, Turbeville, and Woodstown series. The Caroline, Sassafras, and Turbeville soils are on higher areas throughout the association. Pooler, Fallsington, and Woodstown soils are throughout the association. Areas of Tidal marsh are along the Potomac River and along the large streams that enter the Potomac River.

Most of this association is wooded. Mixtures of oak, hickory, gum, sycamore, maple, birch, and willow are predominant, but Virginia pine and loblolly pine are on farmland that is reverting to woodland. Tetotum soils have moderate limitations for septic tank systems, and Bladen and Bertie soils have severe limitations. Small homesites are developing in several parts of the association. Larger homesites and some boating and recreation facilities are along the larger streams and the Potomac River.

10. Wickham-Altavista-Dogue Association

Deep, well drained to moderately well drained soils having sandy clay loam, clay loam, or clay subsoil; on stream terraces

This soil association occupies river terraces along the Rappahannock River, in Stafford County and King George County. Slopes are mostly 0 to 6 percent, but range from 0 to 12 percent.

The soils in this association make up about 3 percent of Stafford County and 25 percent of King George

County. About 30 percent is Wickham soils, 17 percent is Altavista soils, and 10 percent is Dogue soils. The remaining 43 percent is minor soils.

Wickham soils have a dark-brown fine sandy loam surface layer and a reddish-brown clay loam or sandy clay loam subsoil. These soils are deep, well drained, and moderately permeable. Occurring with these soils are soils that have a thinner subsoil and a coarser texture. Wickham soils are moderate in natural fertility and organic-matter content, and they are strongly acid.

Altavista soils have a grayish-brown fine sandy loam surface layer and a yellowish-brown sandy clay loam or clay loam subsoil. The subsoil is mottled with gray at a depth of about 22 to 30 inches. These soils are deep, moderately well drained, and moderately permeable. They are moderate in natural fertility and organic-matter content, and they are strongly acid.

Dogue soils have a dark grayish-brown loam surface layer and a yellowish-brown clay or clay loam subsoil. The subsoil is mottled with gray in the lower part. These soils are deep and moderately well drained. Permeability is moderately slow. They are low in organic-matter content and natural fertility, and they are very strongly acid.

Minor soils of this association are mainly in the Augusta, Cartecay, Congaree, Roanoke, Wahee, and Wehadkee series. The Augusta, Roanoke, and Wahee soils are nearly level and are on low terraces. Cartecay, Congaree, and Wehadkee soils are on stream flood plains. Sand and gravel pits and Tidal marsh along the Rappahannock River also make up significant areas of this association.

Most of this association is in crops. A few areas are pastured and wooded. Most of this association has slight or moderate limitations for septic tank systems. Small homesites occur along the major roads of the association.

11. Turbeville-Kempsville Association

Deep, well-drained soils having sandy clay loam, heavy clay loam, or clay subsoil; on stream terraces and Coastal Plain uplands

This association occupies a small area in the west-central part, and a larger, narrow belt in the eastern part of King George County. It is rolling, but it includes ridges where slopes are 2 to 6 percent on the top and 6 to 18 percent on the sides. Along drainageways and small streams, slopes are steeper and the ridges are narrower.

The soils in this association make up about 15 percent of King George County. About 33 percent is Turbeville soils and 15 percent is Kempsville soils. The remaining 52 percent is minor soils. Turbeville and Kempsville soils are on the ridges and slopes.

Turbeville soils have a dark-brown loam surface layer and a red or dark-red clay loam or clay subsoil. These soils are deep, well drained, and moderately permeable. They are low in natural fertility and organic-matter content, and they are strongly acid.

Kempsville soils have a dark-brown fine sandy loam surface layer and a brown sandy clay loam to sandy loam subsoil. These soils are deep, well drained, and moderately permeable. They are low in natural fertility and organic-matter content, and they are strongly acid.

Minor soils of this association are mainly of the Atlee, Bourne, Caroline, Galestown, and Sassafras series. Sassafras soils make up about 12 percent of the association. Atlee and Bourne soils are on broader ridges. Caroline soils are in positions similar to those occupied by the Kempsville and Turbeville soils. Galestown soils are on the steep slopes in intricately mixed patterns with Sassafras soils.

Most of this association is wooded. Oak, hickory, and yellow-poplar are predominant, but Virginia pine and loblolly pine are on farmland that is reverting to woodland. Moderate areas are in crops and pasture. Most of this association has moderate or slight limitations for septic tanks.

Descriptions of the Soils

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

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless otherwise stated all color terms are for moist soil.

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

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

The acreage and proportionate extent of each mapping unit are shown in table 1. Some of the terms used in describing soils are defined in the section "How This Survey Was Made" and many can be found in the Glossary at the end of this survey. More detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).[1]

[1] Italic numbers in parentheses refer to Literature Cited, p. 123.

460-460—74——2

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

Soil	Stafford County		King George County		Total	
	Acres	Percent	Acres	Percent	Acres	Percent
Alluvial land, sandy and gravelly	225	0.1	214	0.2	439	0.2
Alluvial land, wet	3,957	2.2	5,080	4.5	9,037	3.1
Altavista fine sandy loam, 0 to 2 percent slopes	699	.4	2,736	2.4	3,435	1.2
Altavista fine sandy loam, 2 to 6 percent slopes	439	.3	1,336	1.2	1,775	.6
Altavista fine sandy loam, 6 to 10 percent slopes, eroded	39	(1)	339	.3	378	.1
Appling fine sandy loam, 2 to 6 percent slopes	9,378	5.3			9,378	3.3
Appling fine sandy loam, 6 to 15 percent slopes, eroded	5,337	3.1			5,337	1.9
Appling gravelly fine sandy loam, 2 to 6 percent slopes	317	.2			317	.1
Appling gravelly fine sandy loam, 6 to 10 percent slopes, eroded	283	.2			283	.1
Appling clay loam, 6 to 15 percent slopes, severely eroded	1,585	.9			1,585	.6
Ashlar fine sandy loam, 6 to 15 percent slopes	2,013	1.1			2,013	.7
Ashlar fine sandy loam, 15 to 25 percent slopes	1,929	1.1			1,929	.7
Ashlar fine sandy loam, 25 to 35 percent slopes	1,603	.9			1,603	.6
Atlee silt loam, 0 to 2 percent slopes			152	.1	152	.1
Atlee silt loam, 2 to 6 percent slopes			801	.7	801	.3
Augusta loam	418	.2	1,614	1.4	2,032	.7
Aura gravelly fine sandy loam, 2 to 6 percent slopes	1,451	.8	703	.6	2,154	.7
Aura gravelly fine sandy loam, 6 to 10 percent slopes, eroded	1,072	.6	662	.6	1,734	.6
Aura gravelly fine sandy loam, 10 to 18 percent slopes, eroded	891	.5	461	.4	1,352	.5
Aura gravelly fine sandy loam, 18 to 35 percent slopes, eroded	1,273	.7	436	.4	1,709	.6
Aura-Galestown-Sassafras complex, 6 to 15 percent slopes	1,964	1.1			1,964	.7
Aura-Galestown-Sassafras complex, 15 to 30 percent slopes	4,557	2.5			4,557	1.6
Bertie very fine sandy loam, 0 to 3 percent slopes	1,729	1.0	1,928	1.7	3,637	1.3
Bibb fine sandy loam	2,553	1.5	778	.7	3,331	1.2
Bladen loam	842	.5	3,576	3.1	4,418	1.5
Bourne fine sandy loam, 0 to 2 percent slopes	450	.3	502	.4	952	.3
Bourne fine sandy loam, 2 to 6 percent slopes	5,271	3.0	1,627	1.4	6,898	2.4
Bourne fine sandy loam, 6 to 10 percent slopes, eroded	1,234	.7	139	.1	1,373	.5
Bourne fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes	870	.5			870	.3
Bourne fine sandy loam, gravelly subsoil variant, 6 to 10 percent slopes, eroded	592	.4			592	.2
Bourne loam, rock substratum, 2 to 6 percent slopes	1,130	.7			1,130	.4
Bourne loam, rock substratum, 6 to 10 percent slopes, eroded	375	.2			375	.1
Bremo loam, 6 to 15 percent slopes	802	.5			802	.3
Bremo loam, 15 to 35 percent slopes	777	.4			777	.3
Caroline fine sandy loam, 2 to 6 percent slopes, eroded	4,633	2.6	1,996	1.6	6,629	2.3
Caroline fine sandy loam, 6 to 10 percent slopes, eroded	2,250	1.3	1,274	1.1	3,524	1.2
Caroline fine sandy loam, 10 to 18 percent slopes, eroded	1,685	1.0	439	.4	2,124	.7
Caroline clay loam, 6 to 10 percent slopes, severely eroded	968	.6	682	.6	1,650	.6
Caroline clay loam, 10 to 18 percent slopes, severely eroded	684	.4	327	.3	975	.3
Caroline-Sassafras complex, 10 to 15 percent slopes	115	.1	1,114	1.0	1,229	.4
Caroline-Sassafras complex, 15 to 30 percent slopes	5,839	3.4	4,624	4.1	10,463	3.6
Cartecay fine sandy loam	2,294	1.4	428	.4	2,722	.9
Cecil fine sandy loam, 2 to 6 percent slopes, eroded	2,804	1.6			2,804	1.0
Cecil fine sandy loam, 6 to 15 percent slopes, eroded	3,198	1.8			3,198	1.1
Cecil gravelly fine sandy loam, 2 to 6 percent slopes, eroded	988	.6			988	.3
Cecil clay loam, 6 to 15 percent slopes, severely eroded	1,051	.6			1,051	.4
Colfax fine sandy loam, 2 to 6 percent slopes	640	.4			640	.2
Colfax fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes	1,102	.7			1,102	.4
Congaree loam	1,231	.7	258	.2	1,489	.5
Craven loam, 0 to 2 percent slopes	180	.1	939	.8	1,119	.4
Craven loam, 2 to 6 percent slopes	385	.2	388	.3	773	.3
Cullen loam, 2 to 6 percent slopes, eroded	2,396	1.4			2,396	.8
Cullen loam, 6 to 15 percent slopes, eroded	1,834	1.1			1,834	.6
Cullen clay loam, 6 to 15 percent slopes, severely eroded	2,745	1.6			2,745	1.0
Cut and fill land	2,776	1.6	286	.3	3,062	1.1
Dogue loam, 0 to 2 percent slopes	157	.1	1,905	1.7	2,062	.7
Dogue loam, 2 to 6 percent slopes	83	(1)	714	.6	797	.3
Elbert silt loam, thin solum variant	946	.5			946	.3
Elioak silt loam, 2 to 6 percent slopes, eroded	2,730	1.6			2,730	1.0
Elioak silt loam, 6 to 15 percent slopes, eroded	3,527	1.9			3,527	1.2
Elioak silty clay loam, 6 to 15 percent slopes, severely eroded	1,449	.8			1,449	.5
Fairfax loam, 2 to 6 percent slopes	890	.5			890	.3
Fallsington very fine sandy loam	157	.1	480	.4	637	.2
Fresh water swamp	534	.3	1,723	1.5	2,257	.8
Galestown-Sassafras complex, 6 to 15 percent slopes	99	.1	7,395	6.5	7,494	2.6
Galestown-Sassafras complex, 15 to 30 percent slopes	34	(1)	11,040	9.8	11,074	3.9
Galestown-Sassafras complex, 30 to 45 percent slopes	449	.3	1,380	1.2	1,829	.6
Iuka fine sandy loam, local alluvium	1,642	.9	978	.9	2,620	.9

See footnote at end of table.

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

Soil	Stafford County		King George County		Total	
	Acres	Percent	Acres	Percent	Acres	Percent
Kempsville fine sandy loam, 0 to 2 percent slopes	-------	-------	351	0. 3	351	0. 1
Kempsville fine sandy loam, 2 to 6 percent slopes	-------	-------	1, 292	1. 1	1, 292	. 4
Kempsville fine sandy loam, gravelly substratum, 2 to 6 percent slopes	1, 170	0. 7	2, 920	2. 6	4, 090	1. 4
Kempsville fine sandy loam, gravelly substratum, 6 to 10 percent slopes, eroded	621	. 4	1, 000	. 9	1, 621	. 6
Kempsville fine sandy loam, gravelly substratum, 10 to 18 percent slopes, eroded	400	. 2	592	. 5	992	. 3
Lignum silt loam, 0 to 2 percent slopes	1, 083	. 6	-------	-------	1, 083	. 4
Lignum silt loam, 2 to 6 percent slopes	630	. 4	-------	-------	630	. 2
Manor silt loam, 6 to 15 percent slopes	583	. 3	-------	-------	583	. 2
Manor silt loam, 15 to 35 percent slopes	2, 145	1. 2	-------	-------	2, 145	. 7
Marr very fine sandy loam, 2 to 6 percent slopes	360	. 2	595	. 5	955	. 3
Marr very fine sandy loam, 6 to 10 percent slopes, eroded	250	. 1	464	. 4	714	. 2
Marr very fine sandy loam, 10 to 15 percent slopes, eroded	208	. 1	313	. 3	521	. 2
Marr very fine sandy loam, 15 to 30 percent slopes, eroded	263	. 2	787	. 7	1, 050	. 4
Meadowville silt loam	1, 609	. 9	-------	-------	1, 609	. 6
Mecklenburg loam, 2 to 6 percent slopes, eroded	895	. 5	-------	-------	895	. 3
Mecklenburg loam, 6 to 10 percent slopes, eroded	980	. 6	-------	-------	980	. 3
Mecklenburg clay loam, 6 to 10 percent slopes, severely eroded	467	. 3	-------	-------	467	. 2
Nason silt loam, 2 to 6 percent slopes	4, 797	2. 8	-------	-------	4, 797	1. 7
Nason silt loam, 6 to 15 percent slopes, eroded	6, 040	3. 5	-------	-------	6, 040	2. 1
Nason silty clay loam, 6 to 10 percent slopes, severely eroded	1, 403	. 9	-------	-------	1, 403	. 5
Orange loam, 0 to 2 percent slopes	186	. 1	-------	-------	186	. 1
Orange loam, 2 to 6 percent slopes	1, 664	1. 0	-------	-------	1, 664	. 6
Orange loam, 6 to 10 percent slopes, eroded	500	. 3	-------	-------	500	. 2
Pooler loam, thin solum variant	137	. 1	995	. 9	1, 132	. 4
Roanoke silt loam	750	. 4	1, 294	1. 1	2, 044	. 7
Sand and gravel pits	881	. 5	442	. 4	1, 323	. 5
Sandy and clayey land, steep, Sassafras and Caroline materials	3, 656	2. 1	1, 331	1. 2	4, 987	1. 7
Sassafras fine sandy loam, 0 to 2 percent slopes	78	(1)	1, 506	1. 3	1, 584	. 6
Sassafras fine sandy loam, 2 to 6 percent slopes	4. 105	2. 4	12, 540	11. 0	16, 645	5. 8
Sassafras fine sandy loam, 6 to 10 precent slopes, eroded	2, 983	1. 7	4, 976	4. 4	7, 959	2. 8
Sassafras fine sandy loam, 10 to 15 percent slopes, eroded	1, 688	1. 0	947	. 8	2, 635	. 9
Sassafras fine sandy loam, 15 to 35 percent slopes, eroded	2, 498	1. 4	1, 077	. 9	3, 575	1. 2
State fine sandy loam, local alluvium	1, 012	. 6	-------	-------	1, 012	. 4
Stony rolling land	213	. 1	-------	-------	213	. 1
Stony steep land	438	. 3	-------	-------	438	. 2
Susquehanna soils, 2 to 10 percent slopes	221	. 1	-------	-------	221	. 1
Tetotum fine sandy loam, 0 to 2 percent slopes	442	. 3	2, 795	2. 5	3, 237	1. 1
Tetotum fine sandy loam, 2 to 6 percent slopes	1, 320	. 8	1, 070	. 9	2, 390	. 8
Tetotum fine sandy loam, 6 to 10 percent slopes, eroded	498	. 3	444	. 4	942	. 3
Tidal marsh	1, 470	. 8	2, 183	1. 9	3, 653	1. 3
Turbeville loam, 0 to 2 percent slopes	-------	-------	378	. 3	378	. 1
Turbeville loam, 2 to 6 percent slopes	1, 599	. 9	1, 901	1. 7	3, 500	1. 2
Turbeville loam, 6 to 15 percent slopes, eroded	1, 008	. 6	650	. 6	1, 658	. 6
Wahee silt loam	58	(1)	1, 128	1. 0	1, 186	. 4
Watt silt loam, gray surface variant, 10 to 15 percent slopes	340	. 2	-------	-------	340	. 1
Watt silt loam, gray surface variant, 15 to 35 percent slopes	1, 234	. 7	-------	-------	1, 234	. 4
Wehadkee very fine sandy loam	4, 940	2. 9	450	. 4	5, 390	1. 9
Westphalia loamy very fine sand, 2 to 6 percent slopes	261	. 2	-------	-------	261	. 1
Westphalia loamy very fine sand, 6 to 15 percent slopes, eroded	325	. 2	-------	-------	325	. 1
Westphalia loamy very fine sand, 15 to 30 percent slopes, eroded	533	. 3	-------	-------	533	. 2
Wickham fine sandy loam, 0 to 2 percent slopes	673	. 4	2, 899	2. 5	3, 572	1. 2
Wichkam fine sandy loam, 2 to 6 percent slopes	1, 149	. 7	1, 014	. 9	2, 163	. 8
Wickham fine sandy loam, 6 to 12 percent slopes, eroded	467	. 3	537	. 5	1, 004	. 3
Wickham sandy loam, thin solum variant, 0 to 2 percent slopes	157	. 1	1, 415	1. 2	1, 572	. 5
Wickham sandy loam, thin solum, variant, 2 to 6 percent slopes	191	. 1	745	. 7	936	. 3
Wickham sandy loam, thin solum variant, 6 to 12 percent slopes	135	. 1	489	. 4	624	. 2
Woodstown fine sandy loam, 0 to 2 percent slopes	306	. 2	425	. 4	731	. 3
Woodstown fine sandy loam, 2 to 6 percent slopes	358	. 2	521	. 5	879	. 3
Worsham loam	2, 035	1. 2	-------	-------	2, 035	. 7
Zion loam, deep variant, 2 to 6 percent slopes	296	. 2	-------	-------	296	. 1
Zion loam, deep variant, 6 to 10 percent slopes, eroded	217	. 1	-------	-------	217	. 1
Total	173, 440	100. 0	113, 920	100. 0	287, 360	100. 0

[1] Less than 0.05 percent.

Alluvial Land, Sandy and Gravelly

Alluvial land, sandy and gravelly (Ad) is along larger drainageways and streams in the Coastal Plain of Stafford and King George Counties. The soil in this land type is on terraces and flood plains and consists of coarse-textured alluvium that is nearly level to sloping. In a few places steep breaks are between these areas and areas of surrounding soils. Texture is quite variable and in places changes within short distances, both vertically and horizontally. Very little silt or clay is present. The sand in this unit ranges from fine grained to coarse grained. Gravel content ranges from a low percentage to more than 80 percent, by volume.

In places a water table is at a depth of 3 to 5 feet, and low areas are subject to flooding during periods of high water. Runoff is slow, and permeability is rapid. A few of the more sandy areas are used for cropland, and a few small areas are used for urban development. Other areas are in brush or are wooded, and the stands are yellow-popular, maple, gum, river birch, and Virginia pine. Capability unit VIIs–1; woodland suitability group 13.

Alluvial Land, Wet

Alluvial land, wet (Ae) is nearly level to gently sloping and is on long, narrow areas of local alluvium deposited along drainageways and small streams. It is of moderate extent, but occurs throughout Stafford and King George Counties.

Surface color of this soil is quite variable, and texture ranges from loamy sand to sandy loam and loam. In places it changes within short distances, both vertically and horizontally. The substratum is gray and gleyed and it contains mottles of strong brown, yellowish brown, pale brown, and yellowish red.

This land is strongly acid to very strongly acid. It is low in natural fertility and organic-matter content. Permeability in the substratum is moderate to rapid. The seasonal high water table is at the surface for many months. Alluvial land, wet, is subject to very frequent flooding from adjacent drainageways and streams, and to very frequent runoff from soils on surrounding uplands. Seepage occurs where the Alluvial land, wet, adjoins the uplands.

This mapping unit is mostly in woodland. Wooded areas are comonly a mixture of oak, willow, gum, birch, elm, and maple. Capability unit VIw–1; woodland suitability group 5.

Altavista Series

The Altavista series consists of deep, moderately well drained, nearly level to sloping soils. These soils formed in loamy alluvium, mostly on the terraces along the Rappahannock River. The native vegetation is largely mixed hardwoods, but Virginia pine and loblolly pine are on farmland that is reverting to woodland.

In a representative profile the surface layer is grayish-brown fine sandy loam about 9 inches thick. The subsoil is about 35 inches thick. The upper 5 inches is yellowish-brown, friable sandy clay loam. The next 8 inches is yellowish-brown, firm clay loam. The next 12 inches is yellowish-brown, firm sandy clay loam that is mottled with gray and strong brown. The lower 10 inches is gray, firm sandy clay loam that is mottled with pale brown and strong brown. The substratum begins at a depth of about 44 inches, and continues to a depth of about 96 inches or more. It is gray, friable fine sandy loam that has lenses and thin strata of clay loam and clay, and is mottled with yellowish brown.

Altavista soils are medium acid to strongly acid except where they have been limed for farming purposes. They have moderate organic-matter content and moderate natural fertility. Permeability is moderate in the subsoil and available moisture capacity is moderate to high. The seasonal high water table is at a depth of 2½ to 3½ feet during wet periods, and persists for significant lengths of time.

Representative profile of Altavista fine sandy loam, 0 to 2 percent slopes, in a field 300 yards west of Route 631, one-quarter mile northwest of junction of Route 631 and Route 601, in King George County:

Ap—0 to 9 inches, grayish-brown (2.5Y 5/2) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many very fine and fine roots; a few, fine, rounded quartz pebbles; strongly acid; clear, smooth boundary.

B1t—9 to 14 inches, yellowish-brown (10YR 5/6) sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common, very fine and fine roots; a few, very fine, tubular pores; a few, thin, patchy clay films; a few, fine, rounded quartz pebbles; common fine flakes of mica; medium acid; clear, smooth boundary.

B21t—14 to 22 inches, yellowish-brown (10YR 5/6) clay loam; moderate, medium, subangular blocky structure; firm, sticky and plastic; common very fine and fine roots; a few, very fine, tubular pores; thin patchy clay films; few, fine, rounded quartz pebbles; common fine flakes of mica; medium acid; clear, smooth boundary.

B22t—22 to 34 inches, yellowish-brown (10YR 5/6) sandy clay loam; common, medium, distinct, gray (10YR 6/1) mottles and a few, fine, faint, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic; a few very fine and fine roots; common, very fine, tubular pores; a few, thin, patchy clay films; a few, fine, rounded quartz pebbles; common fine flakes of mica; strongly acid; clear, smooth boundary.

B3tg—34 to 44 inches, gray (10YR 6/1) sandy clay loam; many, coarse, distinct, pale-brown (10YR 6/3) mottles and a few, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; a few very fine roots; few, very fine, tubular pores; a few, thin, patchy, pale-brown (10YR 6/3) clay films; a few, fine, rounded quartz pebbles; common fine flakes of mica; strongly acid; gradual, smooth boundary.

Cg—44 to 96 inches, gray (10YR 6/1) fine sandy loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable, slightly sticky and slightly plastic; lenses and thin strata of gray (10YR 5/1) clay loam and clay; common fine flakes of mica; strongly acid.

The solum ranges from 42 to 52 inches in thickness. In many places fine rounded pebbles make up less than 1 percent to 5 percent, by volume, of the solum. The A horizon has hues of 2.5Y and 10YR, values of 4 and 5, and chromas of 2 to 4. It is commonly fine sandy loam, but it ranges

to sandy loam and loam. The Bt horizon, above a depth of 30 to 36 inches, has hues of 10YR, values of 4 and 5, and chromas of 4 to 8. Below a depth of 30 to 36 inches it has hues of 10YR and 2.5Y, values of 4 to 6, and chromas of 1 and 2. In places it has yellowish-brown, strong-brown, and pale-brown mottles. The Bt horizon is commonly sandy clay loam or clay loam. The C horizon is gray, and it contains mottles of yellowish brown, strong brown, or pale brown. It commonly is fine sandy loam, but it ranges from sand to sandy clay loam, and it includes strata of clay loam and clay.

Altavista soils commonly are near Augusta, Roanoke, and Wickham soils. They lack the gray mottles in the upper part of the subsoil that are characteristic of Augusta soils. They are better drained and are less clayey in the solum than Roanoke soils, and are not so well drained as Wickham soils.

Altavista fine sandy loam, 0 to 2 percent slopes (AfA).—This soil is on broad terraces. It has the profile described as representative of the Altavista series.

Included with this soil in mapping were a few small areas of Augusta, Dogue, and Wickham soils.

This soil has a seasonal high water table at a depth of 2½ to 3½ feet, and artificial drainage is needed if the soil is cultivated. Much of the acreage is used for farming. If this soil is adequately drained, limed, and fertilized, it is well suited to most locally grown crops. If alfalfa is grown, it generally is not long lived, because this soil is excessively wet in winter and early in spring. Capability unit IIw-1; woodland suitability group 6.

Altavista fine sandy loam, 2 to 6 percent slopes (AfB).—This soil is on terraces. It has a profile similar to the one described as representative of the Altavista series, except that in places its surface layer is slightly thinner.

Included with this soil in mapping were a few small areas of Dogue and Wickham soils.

Runoff is slow to medium on this soil, and erosion is a moderate hazard where the soil is clean tilled or exposed. This soil has a seasonal high water table at a depth of 2½ to 3½ feet, and artificial drainage is beneficial if the soil is cultivated. If this soil is adequately drained, limed, and fertilized, it is well suited to most locally grown crops. If alfalfa is grown, it generally is not long lived, because wetness is excessive in winter and early in spring. Capability unit IIe-4; woodland suitability group 6.

Altavista fine sandy loam, 6 to 10 percent slopes, eroded (AfC2).—This soil is on terraces. The surface layer generally is 6 or 7 inches thick, but in places it is 5 to 10 inches thick. Also, in places the subsoil is somewhat less gray than that in the profile described as representative of the Altavista series, but the two profiles otherwise are similar.

Included with this soil in mapping were some small areas of Wickham soil, a few small areas that have a clayey subsoil, and a few areas that have a gravelly subsoil.

Runoff is medium on this soil, and further erosion is a severe hazard if this soil is cultivated or is exposed. The seasonal high water table is at a depth of 2½ to 3½ feet, and small seeps occur on the lower slopes. If this soil is cultivated, artificial drainage is sometimes beneficial, especially on the lower slopes. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. Capability unit IIIe-2; woodland suitability group 6.

Appling Series

The Appling series consists of deep, well-drained, gently sloping to strongly sloping soils on the Piedmont uplands. These soils formed in material weathered from granite and gneiss. The native vegetation is largely mixed oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Large areas of these soils are wooded, and small areas are used for general farming.

In a representative profile the surface layer is grayish-brown fine sandy loam about 9 inches thick. The subsoil is about 37 inches thick. The upper 7 inches is strong-brown, friable clay loam. The next 22 inches is firm, yellowish-red clay. The lower 8 inches is friable clay loam that is mottled with yellowish red and strong brown. The substratum begins at a depth of about 46 inches and extends to a depth of 106 inches or more. It is friable fine sandy loam in the upper part and very strongly weathered granite at a depth of about 64 inches. It is yellowish red, brown, strong brown, reddish yellow, and white.

Appling soils have a strongly acid to very strongly acid subsoil. They are low in organic-matter content and natural fertility. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Appling fine sandy loam, 2 to 6 percent slopes, in a stand of young Virginia pine, 10 yards east of Route 654, one-half mile south of Route 655, in Stafford County:

Ap—0 to 9 inches, grayish-brown (10YR 5/2) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; a few fine flakes of mica; strongly acid; clear, smooth boundary.

B1t—9 to 16 inches, strong-brown (7.5YR 5/6) clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; a few, very fine, tubular pores; a few, thin, patchy clay films; a few fine flakes of mica; a few, fine, angular quartz pebbles; very strongly acid; clear, smooth boundary.

B21t—16 to 28 inches, yellowish-red (5YR 4/6) clay; moderate, fine, subangular blocky structure; firm, sticky and plastic; a few very fine and fine roots; a few, very fine, tubular pores; thin continuous clay films; few fine flakes of mica; a few, fine, angular quartz pebbles; very strongly acid; clear, smooth boundary.

B22t—28 to 38 inches, yellowish-red (5YR 4/6) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; a few very fine and fine roots; a few, very fine, tubular pores; thin, continuous clay films; a few fine flakes of mica; a few, fine, angular quartz pebbles; very strongly acid; gradual, smooth boundary.

B3t—38 to 46 inches, mottled yellowish-red (5YR 5/6) and strong-brown (7.5YR 5/6) clay loam; weak, medium, subangular blocky structure; friable, sticky and plastic; a few very fine and fine roots; a few, fine, tubular pores; thin patchy clay films; common fine flakes of mica; common, fine, angular quartz pebbles; very strongly acid; gradual, smooth boundary.

C1—46 to 64 inches, mottled yellowish-red (5YR 5/6), strong-brown (7.5YR 5/6), and reddish-yellow (7.5 YR 6/6) fine sandy loam; rock-controlled structure; friable, slightly sticky and slightly plastic; common fine flakes of mica; many, fine, angular quartz pebbles; very strongly acid; diffuse, wavy boundary.

C2—64 to 106 inches, very strongly weathered granite of brown, pale brown, and white; common fine flakes of mica; very strongly acid.

The solum ranges from 42 to 52 inches in thickness. Depth to bedrock is more than 5 feet. In many places fine to medium pebbles make up less than 1 percent to about 5 percent, by volume, of the solum. The A horizon has hues of 10YR, values of 4 and 5, and chromas of 2 to 4. It commonly is fine sandy loam, but it ranges from sandy loam and gravelly fine sandy loam to clay loam where the soil is severely eroded. The Bt horizon has hues of 5YR or 7.5YR, values of 4 to 6, and chromas of 6 to 8. It is clay or heavy clay loam. The C horizon is sandy loam and fine sandy loam to clay loam. It is mottled with yellowish red, strong brown, and brown.

Appling soils commonly are near Ashlar, Cecil, and Colfax soils. They have more clay in the subsoil and have a thicker solum than Ashlar soils. They lack the red subsoil of the Cecil soils. Appling soils are better drained than Colfax soils and lack the fragipan typical of those soils.

Appling fine sandy loam, 2 to 6 percent slopes (AlB).—This soil is on ridges. It has the profile described as representative of the Appling series.

Included with this soil in mapping were a few small areas of Caroline, Cecil, Colfax, and Nason soils. Also included were small areas where a thin, fluvial overlay has added fine, rounded, quartz pebbles to the surface layer.

Runoff is medium on this soil. Erosion is a moderate hazard where the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe–1; woodland suitability group 1.

Appling fine sandy loam, 6 to 15 percent slopes, eroded (AlC2).—This soil is on narrow ridges and side slopes. The surface layer generally is 5 to 6 inches thick, and in a few places it ranges from 4 to 8 inches in thickness, but the profile otherwise is similar to the one described as representative of the Appling series.

Included with this soil in mapping were some small areas of Ashlar, Cecil, Cullen, and Nason soils. Also included were a few small areas of Appling soils that have a clay loam surface layer. In a few places small outcrops of granite or gneiss are on lower slopes of this mapping unit.

Runoff is medium to rapid on this soil. Further erosion is a severe hazard if this soil is clean tilled or is exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–1; woodland suitability group 1.

Appling gravelly fine sandy loam, 2 to 6 percent slopes (AnB).—This soil is on ridges. The surface layer is a thin fluvial fine sandy loam overlay that is 15 to 35 percent fine, rounded, quartz pebbles, but the profile otherwise is similar to the one described as representative of the Appling series.

Included with this soil in mapping were a few small areas of Cecil and Cullen soils, and a few small areas of soils that have a gravelly clay loam subsoil.

Runoff is slow to medium on this soil. Erosion is a moderate hazard if this soil is clean tilled or is exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIe–1; woodland suitability group 1.

Appling gravelly fine sandy loam, 6 to 10 percent slopes, eroded (AnC2).—This soil is on side slopes. The surface layer generally is about 6 inches thick, but in places it ranges from 4 to 8 inches in thickness. The surface layer is a thin fluvial fine sandy loam overlay that is 20 to 35 percent fine, rounded, quartz pebbles, but the profile otherwise is similar to the one described as representative of the Appling series.

Included with this soil in mapping were a few small areas of Cecil and Cullen soils, and a few small areas of soils that have a gravelly clay loam subsoil.

Runoff is medium on this soil. Further erosion is a moderate hazard if this soil is clean tilled or is exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–1; woodland suitability group 1.

Appling clay loam, 6 to 15 percent slopes, severely eroded (ApC3).—This soil is on the sides of narrow ridges. The surface layer is a mixture of material from the remaining surface layer and the subsoil. Also, in places the soil profile is thinner than the one described as representative of the Appling series, but the two profiles otherwise are similar.

Included with this soil in mapping were a few small eroded areas of Cecil and Nason soils and some small areas of Ashlar soil.

Runoff is medium to rapid on this soil. Further erosion is a severe hazard if this soil is clean tilled or is exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to cultivated crops. Capability unit IVe–2; woodland suitability group 11.

Ashlar Series

The Ashlar series consists of moderately deep, well-drained to excessively drained, sloping to steep soils on the Piedmont uplands. These soils formed in material weathered from granite and gneiss. The native vegetation is largely oaks, hickory, and yellow-poplar. Most of the acreage of these soils is wooded.

In a representative profile about 2 inches of partly decayed organic material overlies a surface layer of fine sandy loam about 9 inches thick. The surface layer is very dark grayish brown in the upper 5 inches and dark brown in the lower 4 inches. The subsoil is yellowish-brown, friable fine sandy loam about 9 inches thick. The substratum begins at a depth of about 18 inches and extends to a depth of about 30 inches. It is yellowish-brown, friable gravelly fine sandy loam. Weathered granite gneiss is at a depth of about 30 inches.

Ashlar soils are strongly acid to very strongly acid. They are low in natural fertility and organic-matter content. Permeability is moderately rapid, and available moisture capacity is low.

Representative profile of Ashlar fine sandy loam, 15 to 25 percent slopes, in a wooded area 100 yards south of Route 663, 1 mile southwest of Route 655, in southwestern Stafford County:

O1—2 inches to 0, dark grayish-brown partly decayed leaves, twigs, and fine roots.

A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; moderate, fine, granular structure;

very friable, nonsticky and nonplastic; many very fine, fine, and medium roots; common fine flakes of mica; strongly acid; clear, wavy boundary.

A12—5 to 9 inches, dark-brown (10YR 4/3) fine sandy loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; a few, very fine, tubular pores; common fine flakes of mica; very strongly acid; clear, wavy boundary.

B—9 to 18 inches, yellowish-brown (10YR 5/4) fine sandy loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine and fine roots; a few, fine and medium, tubular pores; common fine flakes of mica; strongly acid; clear, wavy boundary.

C—18 to 30 inches, yellowish-brown (10YR 5/4) gravelly fine sandy loam; rock-controlled structure; friable, slightly sticky and slightly plastic; a few, very fine, fine, and medium roots; common fine flakes of mica; very strongly acid; gradual, irregular boundary.

R—30 inches, weathered granite gneiss.

Depth to bedrock ranges from 24 to 40 inches. The A horizon has hues of 10YR, values of 3 to 5, and chromas of 2 to 4. It commonly is fine sandy loam, but it ranges to sandy loam and gravelly sandy loam. The B horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 4 to 6. It commonly is fine sandy loam, but ranges to sandy loam and gravelly sandy loam. The C horizon is strongly weathered granite or gneiss that has a rock-controlled structure and is gravelly fine sandy loam or gravelly sandy loam.

Ashlar soils commonly are near Appling, Cecil, and Manor soils. Ashlar soils are coarser textured in the subsoil, and they have a thinner solum than Appling and Cecil soils. Ashlar soils contain less silt in the solum than soils in the Manor series, and they contain much less mica than those soils.

Ashlar fine sandy loam, 6 to 15 percent slopes (AsD).—The profile of this soil is similar to the one described as representative of the Ashlar series.

Included with this soil in mapping were a few small areas of Appling and Manor soils. Also included were small areas of a similar soil that has a thin layer of loam or clay loam on top of the weathered rock, and also small areas of a similar soil that has a gravelly profile.

Runoff is rapid on this soil, and erosion is a very severe hazard if this soil is clean tilled or is exposed. This soil is somewhat droughty during the growing season. It has a limited suitability for most locally grown crops because of low available moisture capacity, droughtiness, and shallowness to rock. Capability unit IVe–3; woodland suitability group 7.

Ashlar fine sandy loam, 15 to 25 percent slopes (AsE).—This soil has the profile described as representative of the Ashlar series.

Included with this soil in mapping were a few small areas of Manor and Watt soils. Also included were small areas of a similar soil that has a thin layer of loam or clay loam on top of the weathered rock, small areas of similar soils in coves that have a thicker profile than this soil, and small gullied areas.

Runoff is rapid on this soil, and erosion is a very severe hazard where the soil is exposed. This soil is droughty during the growing season because runoff is rapid, available moisture capacity is low, and depth to rock is 24 to 40 inches. This soil is suited to drought-resistant pasture and woodland. Capability unit VIe–2; woodland suitability group 7.

Ashlar fine sandy loam, 25 to 35 percent slopes (AsF).—The profile of this soil is similar to the one described as representative of the Ashlar series.

Included with this soil in mapping were small areas of gravelly soil and small areas where weathered rock is only a few inches below the soil surface. Also included on the lower slopes are small areas of rock outcrops and, in coves, small areas of similar soils that are deeper than this soil.

Erosion is a very severe hazard if this soil is exposed. This soil is droughty during the growing season because runoff is very rapid, available moisture capacity is low, and depth to rock is 24 to 40 inches. It is better suited to woodland than to pasture. Capability unit VIIe–1; woodland suitability group 7.

Atlee Series

The Atlee series consists of moderately well drained, nearly level and gently sloping soils on the Coastal Plain uplands. These soils formed in loamy and clayey Coastal Plain sediment. Atlee soils have a weak fragipan at a depth of 22 to 32 inches. The native vegetation is largely oaks and hickory, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Most of the acreage of these soils is woodland, but small areas are used for general farming and rural homesites.

In a representative profile about 2 inches of partly decayed organic material overlies a plow layer of brown silt loam about 8 inches thick. The subsoil is about 50 inches thick. The upper 5 inches is friable, yellowish-brown heavy silt loam. The next 11 inches is firm, yellowish-brown heavy silt loam. The fragipan layer is 25 inches of yellowish-brown heavy silt loam that has gray and light brownish-gray mottles. This layer is brittle and compact. The next 9 inches is yellowish-brown firm clay loam that is mottled with light brownish gray and yellowish red. The substratum begins at a depth of 58 inches and extends to a depth of 96 inches or more. It is very firm clay that is mottled with light brownish gray, strong brown, and red.

Atlee soils have a strongly acid to very strongly acid subsoil. They are low in organic-matter content and fertility. The subsoil above the fragipan is moderately permeable, but the fragipan layer is slowly permeable. Available moisture capacity is moderate to low. A perched water table occurs above the fragipan during wet periods.

Representative profile of Atlee silt loam, 2 to 6 percent slopes, 20 yards northeast of the junction of Routes 3 and 647, in King George County:

O2—2 inches to 0, very dark brown, partly decayed leaves, twigs, and fine roots.

Ap—0 to 8 inches, brown (10YR 5/3) silt loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine, medium, and coarse roots; strongly acid; clear, smooth boundary.

B1t—8 to 13 inches, yellowish-brown (10YR 5/4) heavy silt loam; weak, medium, subangular blocky structure; friable, sticky and plastic; common fine, medium, and coarse roots; common, very fine and fine, tubular pores; a few, thin, patchy clay films; very strongly acid; clear, smooth boundary.

B2t—13 to 24 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, fine, subangular blocky structure; firm, sticky and plastic; common fine, medium, and coarse roots; common, very fine and fine, tubular pores; thin patchy clay films; very strongly acid; abrupt, smooth boundary.

Bx—24 to 49 inches, yellowish-brown (10YR 5/6) heavy silt loam; many, fine, distinct, gray (10YR 6/1) and light brownish-gray (10YR 6/2) mottles; compound, very coarse, prismatic and weak, medium, platy structure; gray silt loam coatings on prism faces; firm, brittle, and compact in place; sticky and plastic; a few fine roots oriented along ped surfaces; a few, fine, tubular and vesicular pores; thin, continuous, yellowish-brown (10YR 5/6) clay films; very strongly acid; gradual, smooth boundary.

B3t—49 to 58 inches, yellowish-brown (10YR 5/6) clay loam; many, fine, distinct, light brownish-gray (10YR 6/2) and yellowish-red (5YR 5/8) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; a few, fine, tubular pores; a few, thin, patchy clay films; very strongly acid; gradual, smooth boundary.

C—58 to 96 inches, mottled light brownish-gray (2.5Y 6/2), strong-brown (7.5YR 5/8), and red (2.5YR 5/8) clay; massive; very firm, very sticky and very plastic; very strongly acid.

The solum ranges from 48 to 68 inches in thickness. In places fine rounded pebbles make up less than 1 percent to about 4 percent, by volume, of the solum. The fragipan commonly occurs at a depth of 22 to 32 inches. The A horizon has hues of 10YR, values of 4 and 5, and chromas of 2 to 4. It is commonly silt loam, but ranges to loam. The Bt horizon above the fragipan has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 4 to 8. It commonly is heavy silt loam to heavy loam. The Bx horizon has hues of 10YR and 7.5 YR, values of 5 and 6, and chromas of 4 to 6. It commonly is heavy silt loam or heavy loam. The C horizon commonly is stratified clay, clay loam, and sandy clay.

Atlee soils commonly are near Bourne, Caroline, and Sassafras soils. Atlee soils have a less strongly developed fragipan than Bourne soils, and they have less sand in the solum. They are less well drained than Caroline and Sassafras soils, and they have a fragipan, which the Caroline and Sassafras soils lack.

Atlee silt loam, 0 to 2 percent slopes (AtA).—This soil is on broad ridges. In places, its surface layer is slightly thicker than that in the profile described as representative of the Atlee series, but the two profiles otherwise are similar.

Included with this soil in mapping were a few small areas of Bourne and Craven soils.

Runoff is slow on this soil. This soil has a seasonal high water table at a depth of 1½ to 2½ feet, and artificial drainage is beneficial if the soil is cultivated. It is somewhat droughty during the growing season because of a fragipan in the subsoil and moderate to low available moisture capacity. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops, except alfalfa. Capability unit IIIw–3; woodland suitability group 8.

Atlee silt loam, 2 to 6 percent slopes (AtB).—This soil is on broad ridges. It has the profile described as representative of the Atlee series.

Included with this soil in mapping were a few small areas of Bourne, Caroline, and Craven soils. Also included were a few small areas of Atlee soil having slopes of 6 to 10 percent.

Runoff is slow to medium, and the hazard of erosion is severe if this soil is clean tilled or exposed. This soil has a seasonal high water table at a depth of 1½ to 2½ feet, and artificial drainage is beneficial if the soil is cultivated. It is somewhat droughty during the growing season because of a fragipan in the subsoil and moderate to low available moisture capacity. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops, except alfalfa. Capability unit IIIe–5; woodland suitability group 8.

Augusta Series

The Augusta series consists of deep, somewhat poorly drained, nearly level soils. These soils formed in loamy alluvium, mostly on the terraces along the Rappahannock River. The native vegetation is largely a mixture of oaks, hickory, yellow-poplar, elm, maple, and gum. Stands of Virginia pine, loblolly pine, and gum are on farmland that is reverting to woodland. Most of the areas of these soils are in woodland.

In a representative profile about 1½ inches of partly decayed organic material overlies a loam surface layer about 9 inches thick. The upper 2 inches of the surface layer is dark grayish brown and the lower 7 inches is light olive brown. The subsoil is 36 inches thick. The upper 4 inches is yellowish-brown, firm clay loam that is mottled with light brownish gray. The next 5 inches is firm yellowish-brown and gray clay loam that is mottled with brown. The next 7 inches is firm gray clay loam that is mottled with pale brown and strong brown. The lower 20 inches is gray sandy clay loam that is mottled with yellowish brown. The substratum is at a depth of 45 inches and extends to 102 inches or more. It consists of gray stratified fine sandy loam and loamy fine sand.

Augusta soils are strongly acid throughout the profile. They are low to moderate in organic-matter content and low in natural fertility. Permeability is moderate in the subsoil, and the available moisture capacity is moderate to high. The seasonal high water table is at a depth of 1 to 1½ feet in winter and in spring.

Representative profile of Augusta loam, 200 yards east of Route 631, one-half mile northwest of the junction of Route 631 and Route 601, in King George County:

O2—1½ inches to 0, very dark brown, partly decayed leaves, twigs, and fine roots.

Ap1—0 to 2 inches, dark grayish-brown (2.5Y 4/2) loam; moderate, fine, granular structure; very friable; slightly sticky and slightly plastic; many very fine and fine roots; strongly acid; clear, smooth boundary.

Ap2—2 to 9 inches, light olive-brown (2.5Y 5/4) loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; strongly acid; clear, smooth boundary.

B1t—9 to 13 inches, yellowish-brown (10YR 5/4) clay loam; common, fine, distinct, light brownish-gray (10YR 6/2) coatings on ped surfaces; weak, medium, subangular blocky structure; firm, slightly sticky and plastic; common very fine, fine, and medium roots; a few, very fine and fine, tubular pores; a few, thin, patchy clay films; strongly acid; clear, smooth boundary.

B21t—13 to 18 inches, mottled yellowish-brown (10YR 5/4), gray (10YR 6/1), and brown (7.5YR 4/4) clay

loam; firm, sticky and plastic; common very fine, fine, and medium roots; a few, very fine and fine, tubular pores; thin, patchy clay films; strongly acid; clear, smooth boundary.

B22tg—18 to 25 inches, mottled gray (10YR 5/1), pale-brown (10YR 6/3), and strong-brown (7.5YR 5/6) clay loam; weak, medium, angular blocky structure; firm, sticky and plastic; a few fine roots; a few, fine, tubular pores; thin, patchy clay films; strongly acid; clear, smooth boundary.

B3tg—25 to 45 inches, gray (10YR 6/1) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/4 and 10YR 5/6) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; a few fine roots; few, fine, tubular pores; a few, thin, patchy clay films; strongly acid; gradual, smooth boundary.

C1g—45 to 80 inches, gray (N 6/1) fine sandy loam; massive; friable, slightly sticky and slightly plastic; strongly acid; clear, smooth boundary.

C2g—80 to 102 inches, gray (10YR 6/1) loamy fine sand; single grain; very friable, nonsticky and nonplastic; strongly acid.

The solum ranges from 40 to 56 inches in thickness. In places fine rounded pebbles make up less than 1 percent to 5 percent, by volume, of the solum. The Ap horizon has hues of 2.5Y and 10YR, values of 4 and 5, and chromas of 2 to 4. It is commonly loam, but it ranges to fine sandy loam and sandy loam. The B1t horizon has hues of 10YR, values of 4 and 5, and chromas of 4 to 8. Light brownish-gray coatings occur on ped surfaces. The upper Bt horizon is mottled with yellowish brown (10YR 5/4, 5/6, 5/8), gray (10YR 5/1, 6/1), brown (7.5YR 4/4), and strong brown (7.5YR 5/6, 5/8). Lower B2t and B3t horizons are in hues of 10YR and 7.5YR with values of 4 to 6 and chromas of 1 to 6. The Bt horizon is clay loam or sandy clay loam. The C horizon is fine sandy loam, loamy sand, or sand and gravel with layers of silty and clayey material.

Augusta soils commonly are near Altavista, Roanoke, Wahee, and Wickham soils. They are less well drained than the Altavista soils and are grayer in the upper Bt horizon. They are not so poorly drained as the Roanoke soils and have a less clayey subsoil. Augusta soils have a less clayey subsoil than the Wahee soils, and they are not so well drained as the Wickham soils.

Augusta loam (Au).—This is the only Augusta soil mapped in the survey area. It is on broad terraces. Slopes are 0 to 2 percent.

Included with this soil in mapping were small areas of Altavista, Roanoke, and Wahee soils.

Runoff is slow on this soil. A seasonal high water table is at a depth of 1 to 1½ feet, and artificial drainage is needed if this soil is cultivated. In places drainage outlets are difficult to locate in this soil. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops, except alfalfa. Alfalfa is usually short lived because this soil is excessively wet in winter, in spring, and early in summer. Capability unit IIIw-2; woodland suitability group 6.

Aura Series

The Aura series consists of deep, well-drained, gently sloping to steep soils of the Coastal Plain uplands. These soils formed in stratified gravelly and loamy sediment. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine are on farmland that is reverting to woodland. Most of the acreage of these soils is in woodland, but small areas are used for general farming, as homesites, and for urban development.

In a representative profile the surface layer is gravelly fine sandy loam about 12 inches thick. The upper 4 inches is dark grayish brown and the lower 8 inches is pale brown. The subsoil is 72 inches thick. The upper 6 inches is firm, strong-brown gravelly sandy clay loam. The next 10 inches is firm, yellowish-red gravelly sandy clay loam that is mottled with strong brown and red. The next 14 inches is firm, gravelly sandy clay loam mixed with strong brown, yellowish red, and red. The lower 42 inches is gravelly sandy loam mixed with yellowish brown, strong brown, and yellowish red. The substratum begins at a depth of about 84 inches and extends to a depth of 144 inches or more. It consists of gravelly, sandy, and loamy material having thin layers of clayey material.

Aura soils have a strongly acid to very strongly acid subsoil, and they are low in organic-matter content and in natural fertility. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Aura gravelly fine sandy loam, 2 to 6 percent slopes, 200 yards north of a restaurant on U.S. Highway No. 1, about 50 yards west of the highway, in Stafford County:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) gravelly fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many very fine and fine roots; 20 to 35 percent gravel; very strongly acid; clear, smooth boundary.

A2—4 to 12 inches, pale-brown (10YR 6/3) gravelly fine sandy loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; a few, fine, tubular pores; 20 to 35 percent gravel; strongly acid; clear, smooth boundary.

B21t—12 to 18 inches, strong-brown (7.5YR 5/6) gravelly sandy clay loam; weak, medium, subangular blocky structure; firm, sticky and slightly plastic; a few very fine and fine roots; a few, fine, tubular and interstitial pores; 20 to 35 percent gravel; a few, thin, patchy clay films; strongly acid; clear, smooth boundary.

B22t—18 to 28 inches, yellowish-red (5YR 4/6) gravelly sandy clay loam; common, coarse, distinct, strong-brown (7.5YR 5/8) and red (2.5YR 4/6) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; a few very fine and fine roots; 20 to 35 percent gravel; a few, fine, tubular and interstitial pores; thin, patchy clay films; strongly acid; clear, smooth boundary.

B23t—28 to 42 inches, mottled strong-brown (7.5YR 5/8), yellowish-red (5YR 5/6), and red (2.5YR 4/6) gravelly sandy clay loam; weak, medium, subangular blocky structure to massive; firm, slightly sticky and slightly plastic; a few fine roots; a few, fine, tubular and interstitial pores; 20 to 35 percent gravel; a few, thin, patchy, yellowish-red (5YR 4/6) and brown (7.5YR 4/4) clay films; very strongly acid; gradual, smooth boundary.

B3—42 to 84 inches, mottled yellowish-brown (10YR 5/6), strong-brown (7.5YR 5/6), and yellowish-red (5YR 4/6) gravelly sandy loam; weak, coarse, subangular blocky structure to massive; friable, nonsticky and nonplastic; a few, fine, tubular pores; 20 to 35 percent gravel; a few, thin, patchy clay films; very strongly acid; gradual, wavy boundary.

C—84 to 144 inches, gravelly, sandy, and loamy material, lenses and thin layers of clay; brown, strong brown, yellowish red, red, and gray; very strongly acid.

The solum ranges from 50 to 96 inches in thickness. Rounded quartz pebbles make up 20 to 35 percent, by volume, of the solum. The A horizon has hues of 10YR, values of 4 to 6, and chromas of 2 to 4. It commonly is gravelly fine loam, but ranges to gravelly sandy loam and gravelly loam. The Bt horizon has hues of 2.5YR thru 10YR, values of 4 to 6, and chromas of 6 to 8. The B3 horizon ranges from gravelly sandy loam to gravelly sandy clay loam.

Aura soils commonly are near Caroline, Galestown, and Sassafras soils. Aura soils have a less clayey subsoil and contain more gravel throughout the profile than the Caroline soils. They have a thicker solum than the Galestown and Sassafras soils, and they have more gravel in the surface layer and in the subsoil.

Aura gravelly fine sandy loam, 2 to 6 percent slopes (AvB).—This soil is on ridges. It has the profile described as representative of the Aura series.

Included with this soil in mapping were small areas of Bourne, Caroline, Galestown, and Sassafras soils. Also included were small areas of soils that have more than 35 percent gravel in the surface layer, or in the subsoil, or in both.

Runoff is medium on this soil, and erosion is a moderate hazard if this soil is clean tilled or exposed. Because the surface layer contains gravel, damage to equipment is possible. The surface layer tends to be droughty. If this soil is limed and fertilized, it is suited to most locally grown crops. Capability unit IIs–1; woodland suitability group 10.

Aura gravelly fine sandy loam, 6 to 10 percent slopes, eroded (AvC2).—This soil is on narrow ridges and side slopes. The surface layer generally is 6 to 8 inches thick, but in a few places it ranges from 4 to 10 inches in thickness. The profile otherwise is similar to the one described as representative of the Aura series.

Included with this soil in mapping were some small areas of Caroline, Galestown, and Sassafras soils. Also included were small areas of soils that have more than 35 percent gravel in the surface layer, in the subsoil, or in both.

Runoff is rapid on this soil. Erosion is a severe hazard if this soil is clean tilled or exposed. Because the surface layer contains gravel, damage to equipment is possible. Gravel in the surface layer causes droughtiness. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–2; woodland suitability group 10.

Aura gravelly fine sandy loam, 10 to 18 percent slopes, eroded (AvD2).—The surface layer of this soil generally is 5 to 6 inches thick, but in a few places it ranges from 4 to 8 inches in thickness. The profile otherwise is similar to the one described as representative of the Aura series.

Included with this soil in mapping were some small areas of Caroline, Galestown, and Sassafras soils. Also included were some small areas of soils that have more than 35 percent gravel in the surface layer and in the subsoil, and small areas of soils that have less than 20 percent gravel in the surface layer and in the subsoil.

Runoff is rapid on this soil. Further erosion is a very severe hazard if this soil is clean tilled or exposed. Because the surface layer contains gravel, damage to equipment is possible. Gravel in the soil contributes to a droughty condition. If this soil is adequately limed and fertilized, it has a limited suitability for most locally grown crops. Because erosion is a severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to crops. Capability unit IVe–1; woodland suitability group 10.

Aura gravelly fine sandy loam, 18 to 35 percent slopes, eroded (AvE2).—The surface layer of this soil generally is 4 to 6 inches thick, but in a few places it ranges up to 8 inches in thickness. The profile otherwise is similar to the one described as representative of the Aura series.

Included with this soil in mapping were some small areas of Galestown and Sassafras soils. Also included were small areas of soils that have more than 35 percent gravel in the surface layer and in the subsoil, small areas of severely eroded soils, and small areas of gullied soils.

Runoff is rapid on this soil. Further erosion is a very severe hazard if this soil is exposed. This soil is better suited to pasture than to cultivated crops. Capability unit VIe–1; woodland suitability group 10.

Aura-Galestown-Sassafras complex, 6 to 15 percent slopes (AwD).—This soil complex consists of Aura, Galestown, and Sassafras soils that are intermingled in such an intricate pattern that it was not practical to map them separately. Aura soils make up about 35 percent of this complex, Galestown soils about 25 percent, Sassafras soils about 20 percent, and other soils make up the remaining 20 percent.

Included with these soils in mapping were some small very gravelly areas, some very sandy areas, and a few areas of Caroline soils.

Runoff is medium on the soils in this complex. Erosion is a severe hazard if the soils are exposed. These soils are better suited to pasture than to cultivated crops. Capability unit VIe-1; woodland suitability group 10.

Aura-Galestown-Sassafras complex, 15 to 30 percent slopes (AwE).—This complex consists of Aura, Galestown, and Sassafras soils. Aura soils make up 30 percent of this complex, Galestown soils about 25 percent, and Sassafras soils about 15 percent. Other soils make up the remaining 30 percent.

Included with these soils in mapping were some small very gravelly areas, some very sandy areas, and a few small gullied areas. In places, clayey sediment outcrops along the base of slopes.

Runoff is rapid on the soils in this complex. Erosion is a very severe hazard if these soils are exposed. This complex is well suited to pasture and to woodland. Capablity unit VIe-1; woodland suitability group 10.

Bertie Series

The Bertie series consists of deep, somewhat poorly drained, nearly level to very gently sloping soils in low areas. These soils formed in loamy and sandy Coastal Plain sediment. The native vegetation is largely a mixture of oaks, hickory, yellow-poplar, elm, maple, and gum, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Much of the acreage of these soils is wooded, but small areas are used for general farming.

In a representative profile about 2 inches of partly decayed organic material overlies a surface layer of very

fine sandy loam about 10 inches thick. The upper 3 inches is grayish brown, and the lower 7 inches is light olive brown. The subsoil is about 37 inches thick. The upper 15 inches is light olive-brown sandy clay loam that is mottled with light brownish gray and light gray. The next 12 inches is firm yellowish-brown clay loam that is mottled with gray. The lower 10 inches is firm gray clay loam that is mottled with yellowish brown. The substratum begins at a depth of about 47 inches. It is gray loamy fine sand, and it is mottled with yellowish brown.

Bertie soils are very strongly acid to extremely acid. They are low in organic matter content and low in natural fertility. Permeability is moderate in the subsoil, and the available moisture capacity is moderate to high. The seasonal high water table is at a depth of 1 to 1½ feet in winter and in spring.

Representative profile of Bertie very fine sandy loam, 0 to 3 percent slopes, 200 yards north of the junction of Routes 624 and 635, 10 yards west of Route 624, in King George County:

O2—2 inches to 0, very dark brown, partly decayed leaves, twigs, and fine roots.

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) very fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine and medium roots; very strongly acid; clear, smooth boundary.

A2—3 to 10 inches, light olive-brown (2.5Y 5/4) very fine sandy loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine and medium roots; a few, very fine, tubular pores; very strongly acid; clear, smooth boundary.

B1t—10 to 15 inches, light olive-brown (2.5Y 5/4) sandy clay loam; common, fine, faint, light brownish-gray (2.5Y 6/2) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common, fine and medium roots; a few, very fine and fine, tubular pores; a few, thin, patchy clay films; very strongly acid; clear, smooth boundary.

B21t—15 to 25 inches, light olive-brown (2.5Y 5/4) sandy clay loam; many, medium, distinct, light-gray (10YR 7/1) mottles; weak, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine and medium roots; common, fine, tubular pores; thin patchy clay films; very strongly acid; clear, smooth boundary.

B22t—25 to 37 inches, yellowish-brown (10YR 5/6) clay loam; many, medium, distinct, gray (10YR 6/1) mottles; moderate, fine, subangular blocky structure; firm, sticky and plastic; a few fine and medium roots; common, very fine and fine, tubular pores; thin patchy clay films; extremely acid; clear, smooth boundary.

B3g—37 to 47 inches, gray (N 6/1) clay loam; common, medium, prominent, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; a few fine and medium roots; a few, fine, tubular pores; extremely acid; clear, smooth boundary.

IICg—47 to 70 inches, gray (10YR 6/1) loamy fine sand; common, coarse, distinct, yellowish-brown (10YR 5/8) mottles; single grain; very friable, nonsticky and nonplastic; a few, fine, rounded quartz pebbles; very strongly acid.

The solum ranges from 36 to 48 inches in thickness. The A horizon has hues of 2.5Y and 10YR, values of 4 and 5, and chromas of 2 to 4. It is commonly very fine sandy loam, but ranges to loam. The upper 20 to 28 inches of the Bt horizon has hues of 10YR and 2.5Y, values of 4 to 6, and chromas of 4 to 8. It has many medium to coarse mottles that have hues of 10YR, 2.5Y, and 5Y, values of 4 to 7, and chromas of 0 to 2. The B3g horizon commonly is gray and has hues of 10YR, 5Y, and N, values of 4 to 6, and chromas of 0 to 1. It is mottled with yellowish brown or strong brown. The C horizon is loamy fine sand that has thin to thick layers of loamy material.

Bertie soils commonly are near Bladen, Pooler, and Tetotum soils. Bertie soils have a less clayey subsoil than the Bladen and Pooler soils, and they are better drained than the Bladen soils. Bertie soils are more poorly drained than the Tetotum soils, and they have gray mottles in the upper part of the Bt horizon, which the Tetotum soils lack.

Bertie very fine sandy loam, 0 to 3 percent slopes (BcA).—This is the only Bertie soil mapped in the survey area. It is on broad areas of the Coastal Plain.

Included with this soil in mapping were a few small areas of Bladen, Fallsington, and Pooler soils.

This soil has a seasonal high water table at a depth of 1 to 1½ feet, and artificial drainage is needed if it is cultivated. Suitable drainage outlets are often difficult to locate in this soil. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops, except alfalfa. Alfalfa is usually short lived because this soil is excessively wet in winter and in spring. Capability unit IIIw–2; woodland suitability group 2.

Bibb Series

The Bibb series consists of deep, poorly drained, nearly level to very gently sloping soils on flood plains. These soils formed in sandy and loamy alluvium along the larger streams of the Coastal Plain in Stafford and King George Counties. The native vegetation is largely a mixture of willow, birch, maple, elm, and gum.

In a representative profile the surface layer is fine sandy loam about 10 inches thick. The upper 4 inches is dark gray, and the lower 6 inches is gray. The substratum, to a depth of 31 inches, is very friable fine sandy loam. It is grayish brown and is mottled with yellowish red in the upper 14 inches, and it is gray and is mottled with grayish brown in the lower 7 inches. Below 31 inches the material is gray, very friable loamy fine sand.

Bibb soils are frequently flooded. The seasonal high water table commonly is at a depth of 1 foot, but it is somewhat deeper in summer and in fall.

Representative profile of Bibb fine sandy loam, on a flood plain by Route 610, one-half mile south of Route 218:

Ap1g—0 to 4 inches, dark-gray (10YR 4/1) fine sandy loam; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, fine, granular structure; very friable, slightly sticky and slightly plastic; many very fine and fine roots; a few, fine, rounded quartz pebbles; medium acid; clear, smooth boundary.

Ap2g—4 to 10 inches, gray (10YR 5/1) fine sandy loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; very friable; slightly sticky and slightly plastic; many very fine and fine roots; a few fine pores; a few, fine, rounded quartz pebbles; medium acid; clear, smooth boundary.

C1g—10 to 24 inches, grayish-brown (2.5Y 5/2) fine sandy loam; many, fine, prominent, yellowish-red (5YR 4/8) mottles; massive; very friable, slightly sticky and slightly plastic; common very fine and fine roots; a few very fine, tubular pores; a few, fine, rounded

quartz pebbles; strongly acid; clear, smooth boundary.

C2g—24 to 31 inches, gray (10YR 5/1) fine sandy loam; common, medium, faint, grayish-brown (2.5Y 5/2) mottles; massive; very friable, slightly sticky and slightly plastic; a few very fine roots; a few, very fine, tubular pores; a few, fine, rounded quartz pebbles; very strongly acid; clear, smooth boundary.

C3g—31 to 90 inches, gray (10YR 6/1) loamy fine sand; single grain; very friable, nonsticky and nonplastic; a few rounded quartz pebbles; very strongly acid.

Fine quartz pebbles commonly are in the upper 30 inches of the profile, and they make up less than 1 percent to about 10 percent of the mass, by volume. In places the substratum, below about 30 inches, is 35 percent to 60 percent fine pebbles. The Ap horizon has hues of 10YR and 2.5Y, values of 4 to 6, and chromas of 1 and 2. It is commonly fine sandy loam, but it ranges to sandy loam and loamy fine sand. The substratum above 30 inches has hues of 10YR and 2.5Y, values of 4 to 6, and chromas of 1 and 2. It has mottles of yellowish brown, strong brown, yellowish red, and red. The substratum commonly is fine sandy loam, but thin strata of sandy loam and loamy fine sand are in places. The substratum below about 30 inches has hues of 10YR, 2.5Y, or 5Y or is neutral, values of 4 to 6, and chromas of 0 to 1. It is loamy fine sand to sand and gravel.

Bibb soils commonly are near Alluvial land, wet, and Fresh water swamp. Bibb soils are better drained and have a more uniform texture than Alluvial land, wet, and Fresh water swamp, and they are not covered by water for long periods. Well drained and moderately well drained soils occupy the surrounding uplands.

Bibb fine sandy loam (Bb).—This is the only Bibb soil mapped in the survey area. It is on long, narrow flood plains. Slopes are 0 to 4 percent.

Included with this soil in mapping were small areas of Alluvial land, wet, Fresh water swamp, and Iuka soil. Also included were a few spots of a soil in which pebbles make up 30 to 80 percent, by volume, of the surface layer and the substratum. Soils that have a loamy sand and sand surface layer and substratum were also included.

This soil has a seasonal high water table at a depth of 1 foot, and artificial drainage and flood protection are needed if the soil is cultivated. Drainage outlets are very difficult to locate, and the water table commonly is high throughout the year. This soil is better suited to limited pasture than to cultivated crops. Capability unit VIw-1; woodland suitability group 5.

Bladen Series

The Bladen series consists of deep, poorly drained, nearly level soils on the Coastal Plain lowlands. These soils formed in loamy and clayey sediment along the Potomac River in eastern Stafford County and in northern and northeastern King George County. The native vegetation is largely oak, willow, elm, maple, and gum, but stands of willow, gum, Virginia pine, and loblolly pine are on farmland that is reverting to woodland. Most areas are wooded, but a few areas are cleared and are used for pasture and general farming.

In a representative profile about 2 inches of partly decayed organic material overlies a surface layer of gray loam about 10 inches thick. The subsoil is about 51 inches thick. The upper 5 inches is firm, gray heavy clay loam that is mottled with yellowish brown. The lower 46 inches is firm gray clay that is mottled with yellowish brown, olive brown, and strong brown. The substratum begins at a depth of about 61 inches and extends to a depth of 90 inches or more. It is loose, light-gray fine sand.

Bladen soils have a very strongly acid subsoil. They are low in organic-matter content and in natural fertility. Permeability is slow in the subsoil, and available moisture capacity is moderate. The seasonal high water table remains near the surface for long periods.

Representative profile of Bladen loam, in a wooded area southwest of Route 624, in the Mathias Point area of King George County:

O2—2 inches to 0, very dark brown, partly decayed leaves, twigs, and fine roots.

A1—0 to 3 inches, gray (10YR 5/1) loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine and medium roots; very strongly acid; clear, smooth boundary.

A2g—3 to 10 inches, gray (10YR 6/1) loam; a few, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; common, very fine, tubular pores; very strongly acid; clear, smooth boundary.

B1tg—10 to 15 inches, gray (10YR 6/1) heavy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, blocky structure; firm, sticky and plastic; common fine and medium roots; a few, fine, tubular pores; thin patchy clay films; very strongly acid; clear, smooth boundary.

B21tg—15 to 25 inches, gray (N 5/0) clay; common, fine, prominent, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; firm, sticky and plastic; common very fine and fine roots; a few, fine, tubular pores; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22tg—25 to 41 inches, gray (10YR 6/1) clay; common, medium, distinct, light olive-brown (2.5Y 5/4) mottles; moderate, medium, angular blocky structure; firm, sticky and plastic; a few very fine and fine roots; a few, fine, tubular pores; thin continuous clay films; very strongly acid; clear, smooth boundary.

B3tg—41 to 61 inches, gray (10YR 6/1) clay; common, medium, prominent, strong-brown (7.5YR 5/8) mottles; moderate, fine, angular blocky structure; firm, sticky and plastic; a few, fine, tubular pores; thin, patchy clay films; very strongly acid; gradual, smooth boundary.

IICg—61 to 90 inches, light-gray (10YR 7/1) fine sand; single grain; loose, nonsticky and nonplastic; strongly acid.

The solum ranges from 57 to 64 inches in thickness. The A horizon has hues of 10YR and 2.5Y, values of 4 to 6, and chromas of 1 and 2. It commonly is loam, but ranges to very fine sandy loam. The Bt horizon has hues of 10YR, 2.5Y, 5Y, and N, values of 4 to 6, and chromas of 0 to 2. It has olive-brown and yellowish-brown mottles that range from a few to common and from fine to medium. The Bt horizon commonly is clay, heavy clay loam, and sandy clay. The C horizon commonly is loamy and sandy sediment.

Bladen soils commonly are near soils of the Bertie, Pooler, and Tetotum series. Bladen soils are more poorly drained and have a finer textured Bt horizon than the Bertie and Tetotum soils. They have a grayer subsoil than the Pooler soils.

Bladen loam (Bd).—This is the only Bladen soil mapped in the survey area. It is in broad areas, and has slopes of 0 to 2 percent. Included with this soil in mapping were small areas of Bertie, Pooler, and Tetotum soils.

This soil has a seasonal high water table at a depth of 1 foot. It ponds many times during wet periods. Arti-

ficial drainage is needed if this soil is cultivated, but in many places drainage outlets are lacking. The wetness hazard is very severe. If this soil is drained, limed, and fertilized, it is suited to water-tolerant crops and to pasture. Capability unit IVw–1; woodland suitability group 5.

Bourne Series

The Bourne series consists of moderately well drained, nearly level to sloping soils on uplands. These soils formed in loamy sediments on the Coastal Plain. Bourne soils have a moderate to strong fragipan at a depth of about 18 to 24 inches. The native vegetation is oaks and hickory, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Bourne soils are used for general farming, urban development, homesites, and woodland.

In a representative profile the surface layer is dark-brown fine sandy loam about 9 inches thick. The subsoil is about 55 inches thick. The upper 13 inches is firm, yellowish-brown heavy sandy clay loam. The next 30 inches is a fragipan layer, which is pale-brown fine sandy loam that is mottled with yellowish brown and yellowish red. It is firm, brittle, and compact. The lower 12 inches is firm, yellowish-brown heavy sandy clay loam that is mottled with yellowish red and red. The substratum begins at a depth of about 64 inches and extends to a depth of 101 inches or more. The upper 26 inches of the substratum is mottled very firm clay, and the lower 12 inches is mottled, friable fine sandy loam.

Bourne soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and low in organic-matter content. Available moisture capacity is low to moderate. The subsoil above the fragipan is moderately permeable, but the fragipan is slowly to very slowly permeable. A perched water table occurs above the fragipan during wet periods.

Representative profile of Bourne fine sandy loam, 2 to 6 percent slopes, in Grafton Village by Bourne Road, 400 yards south of Route 607, in Stafford County:

Ap—0 to 9 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable; slightly sticky and slightly plastic; many roots; strongly acid; clear, smooth boundary.

B2t—9 to 22 inches, yellowish-brown (10YR 5/6) heavy sandy clay loam; moderate, medium, subangular blocky structure; firm, sticky and plastic; a few roots; thin patchy clay films; strongly acid; abrupt, smooth boundary.

Bx1—22 to 36 inches, pale-brown (10YR 6/3) fine sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; strong, very coarse, prismatic, and weak, medium, platy structure; firm, brittle and compact in place; slightly sticky and nonplastic; a few, fine, vesicular pores; thin patchy clay films on horizontal ped surfaces; strongly acid; clear, wavy boundary.

Bx2—36 to 52 inches, mottled pale-brown (10YR 6/3), yellowish-brown (10YR 5/6), and yellowish-red (5YR 4/8) fine sandy loam; strong, very coarse, prismatic, and moderate, medium, platy structure; firm, brittle, and compact in places, slightly sticky and slightly plastic; few, fine, vesicular pores; thin yellowish-brown (10YR 5/6) and yellowish-red (5YR 4/8) clay films on ped surfaces; very strongly acid; gradual, wavy boundary.

IIB3t—52 to 64 inches, yellowish-brown (10YR 5/6) heavy sandy clay loam; common, medium, prominent, yellowish-red (5YR 4/8) and red (2.5YR 4/8) mottles; moderate, coarse, angular blocky structure; firm, sticky and plastic; thin, patchy, yellowish-red and red clay films; very strongly acid; clear, smooth boundary.

IIIC1—64 to 90 inches, mottled gray (10YR 6/1), yellowish-brown (10YR 5/6), and red (2.5YR 4/8) clay; massive; very firm, very sticky and very plastic; very strongly acid; clear, smooth boundary.

IVC2—90 to 102 inches, mottled yellowish-red (5YR 5/8), light yellowish-brown (10YR 6/4), and yellowish-brown (10YR 5/6) fine sandy loam; massive; friable, slightly sticky and nonplastic; very strongly acid.

The solum ranges from about 48 to 70 inches in thickness. Depth to the fragipan ranges from 18 to 24 inches. In many places rounded quartz pebbles make up less than 1 percent to about 20 percent, by volume, of the solum. The A1 and Ap horizons commonly are fine sandy loam and loam, and have hues of 10YR, values of 4 and 5, and chromas of 2 and 3. The B2t horizon has hues of 10YR or 7.5YR, values of 5, and chromas of 4 to 8. It is commonly clay loam or heavy sandy clay loam. The Bx horizon is dominantly pale brown (10YR 6/3), but in places it is light brownish gray (10YR 6/2) and light yellowish brown (10YR 6/4). It commonly is fine sandy loam, but in places it is loam and sandy clay loam. The B3t horizon is yellowish brown (10YR 5/6 to 5/8) or strong brown (7.5YR 5/6 to 5/8), and it has mottles of yellowish red and red. It is sandy clay loam or clay loam. The C horizon ranges from clay to fine sandy loam, and in places is gravelly or very gravelly.

Bourne soils commonly are near Atlee, Caroline, Kempsville, and Sassafras soils. Bourne soils have less silt throughout the profile than the Atlee soils, and they have a more strongly developed fragipan. They are less well drained than the Caroline, Kempsville, and Sassafras soils, which do not have a fragipan.

Bourne fine sandy loam, 0 to 2 percent slopes (BmA).—This soil is on broad ridges. Its surface layer generally is somewhat thicker than that in the profile described as representative of the Bourne series, but the two profiles otherwise are similar.

Included with this soil in mapping were a few small areas of Bladen, Kempsville, Sassafras, and Tetotum soils.

Runoff is slow on this soil. The seasonal high water table is at a depth of 1½ to 2½ feet, and artificial drainage is beneficial if this soil is used for farming. This soil is somewhat droughty during the growing season because the fragipan is near the surface. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops. Excessive wetness in winter and in spring, and the fragipan are severe limitations for alfalfa and other deep-rooted crops. Capability unit IIIw–3; woodland suitability group 8.

Bourne fine sandy loam, 2 to 6 percent slopes (BmB).—This soil is on broad ridges. It has the profile described as representative of the Bourne series.

Included with this soil in mapping were a few small areas of Caroline, Craven, Kempsville, Sassafras, and Tetotum soils. Also included were small areas of Bourne soils that have a gravelly subsoil.

Runoff is slow to medium on this soil, and erosion is a severe hazard if the soil is clean tilled or exposed. The seasonal high water table is at a depth of 1½ to 2½ feet,

and artificial drainage is sometimes beneficial if the soil is used for farming. This soil is droughty during the growing season, because the fragipan is near the surface. If this soil is adequately limed and fertilized, it has a limited suitability for most locally grown crops. Excessive wetness in winter and in spring, and the fragipan are severe limitations for alfalfa and other deep-rooted crops. Capability unit IIIe–5; woodland suitability group 8.

Bourne fine sandy loam, 6 to 10 percent slopes, eroded (BmC2).—The surface layer of this soil generally is 4 to 6 inches thick, but in a few places it is as much as 8 inches thick. The profile otherwise is similar to the one described as representative of the Bourne series.

Included with this soil in mapping were a few small areas of Caroline and Sassafras soils, and small areas of Bourne soils that have a gravelly subsoil.

Runoff is medium to rapid on this soil, and erosion is a severe hazard if this soil is clean tilled or exposed. The seasonal water table is at a depth of 1½ to 2½ feet, and some seepage occurs on the lower slopes of this soil. Artificial drainage is beneficial, especially on the lower slopes, if the soil is used for farming. The soil is droughty during the growing season, because the fragipan is near the surface. It has a limited suitability for most locally grown crops. Capability unit IIIe–5; woodland suitability group 8.

Bourne loam, rock substratum, 2 to 6 percent slopes (BoB).—This soil is on broad ridges along the eastern edge of the Piedmont Plateau where fluvial materials overlie weathered Piedmont rocks. It has the profile of the soil described as representative of the Bourne series, except that it has a loam surface layer and a weathered rock substratum.

Included with this soil in mapping were small areas of Appling, Aura, Cecil, and Caroline soils, and spots of Bourne soils that have a gravelly subsoil.

Runoff is medium on this soil. Erosion is a severe hazard if this soil is clean tilled or exposed. This soil has a seasonal high water table at a depth of 1½ to 2½ feet, and artificial drainage is beneficial if the soil is used for farming. It is droughty during the growing season, because the fragipan is near the surface. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops. Excessive wetness in winter and in spring and the fragipan are severe limitations for alfalfa. Capability unit IIIe–5; woodland suitability group 8.

Bourne loam, rock substratum, 6 to 10 percent slopes, eroded (BoC2).—This soil is in small areas along the eastern edge of the Piedmont Plateau, where fluvial materials overlie weathered Piedmont rocks. It has the profile of the soil described as representative of the Bourne series, except that it has a loam surface layer and a weathered rock substratum.

Included with this soil in mapping were small areas of Appling, Aura, Caroline, Cecil, and Nason soils, and spots of Bourne soils that have a gravelly subsoil.

Runoff is medium to rapid on this soil. Erosion is a severe hazard if the soil is clean tilled or exposed. The seasonal high water table is at a depth of 1½ to 2½ feet, and much seepage occurs on the lower slopes of this soil. Artificial drainage is beneficial, especially on the lower slopes, if the soil is used for farming. This soil is droughty during the growing season because the fragipan is near the surface. It has a limited suitability for most locally grown crops. Capability unit IIIe–5; woodland suitability group 8.

Bourne Series, Gravelly Subsoil Variant

Soils of the Bourne series, gravelly subsoil variant, are well drained and gently sloping to sloping. These soils are on uplands. They formed in loamy and gravelly Coastal Plain sediment. These soils have a gravelly fragipan subsoil layer at a depth of 18 to 24 inches. They occur in Stafford County, usually in association with other Bourne soils. The native vegetation is oaks and hickory, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. The areas of these soils are used for general farming, urban development including homesites, and woodland.

In a representative profile the surface layer is dark-brown fine sandy loam about 10 inches thick. The subsoil is about 51 inches thick. The upper 12 inches is strong-brown, firm clay loam. The next 27 inches is a fragipan layer that is pale-brown gravelly fine sandy loam and gravelly sandy clay loam that is mottled with strong brown, yellowish brown, and yellowish red. It is firm, brittle, and compact. The lower 12 inches of the subsoil is yellowish-brown, firm gravelly clay loam that is mottled with strong brown and yellowish red. The substratum begins at a depth of 61 inches and extends to a depth of 90 inches or more. It is firm sandy clay loam that is mottled with strong brown, yellowish red, and gray.

These soils have a strongly to very strongly acid subsoil. They are low in natural fertility and organic-matter content. Available moisture capacity is low to moderate. The subsoil above the fragipan is moderately permeable, but the fragipan is slowly to very slowly permeable. A perched water table develops above the fragipan during wet seasons.

Representative profile of Bourne fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes, in Grafton Village, 400 yards south of Route 607, 1 mile east of Route 608, 1 mile north of Route 218, in Stafford County:

Ap—0 to 10 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common fine roots; strongly acid; clear, smooth boundary.

B2t—10 to 22 inches, strong-brown (7.5YR 5/6) clay loam; few, medium, faint, pale-brown (10YR 6/3) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; a few roots; 5 to 10 percent fine, rounded, quartz pebbles; thin, patchy clay films; strongly acid; abrupt, wavy boundary.

IIBx1—22 to 29 inches, pale-brown (10YR 6/3) gravelly fine sandy loam; common, fine, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) mottles; strong, very coarse, prismatic and weak, fine, subangular blocky structure; firm; brittle and compact in place; slightly sticky and nonplastic; a few, fine, vesicular pores; 20 to 35 percent fine, rounded, quartz pebbles; thin, patchy clay films on horizontal ped surfaces; strongly acid; clear, smooth boundary.

IIBx2—29 to 49 inches, mottled pale-brown (10YR 6/3), strong-brown (7.5YR 5/6), and yellowish-red (5YR 4/8) gravelly sandy clay loam; strong, very coarse, prismatic, and moderate, medium, platy structure; firm; brittle and compact in place; slightly sticky and slightly plastic; a few, fine, vesicular pores; 20 to 35 percent fine, rounded, quartz pebbles; thin, patchy clay films; very strongly acid; gradual, wavy boundary.

IIB3t—49 to 61 inches, yellowish-brown (10YR 5/6) gravelly clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/8) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; 20 to 35 percent fine rounded quartz pebbles; thin, patchy clay films; very strongly acid; clear, smooth boundary.

IIIC—61 to 90 inches, mottled strong-brown (7.5YR 5/8), yellowish-red (5YR 4/6), and gray (10YR 6/1) sandy clay loam; massive; firm, sticky and plastic; very strongly acid.

The solum ranges from about 45 to 70 inches in thickness. The fragipan ranges from about 18 to 24 inches in depth. Fine, rounded quartz pebbles occur throughout the solum. These pebbles make up about 1 to 10 percent, by volume, of the Ap and B2t horizons, and from 20 to 35 percent of the Bx1, Bx2, and B3t horizons. The C horizon commonly contains small amounts of gravel.

The Ap and A1 horizons have hues of 10YR, values of 4 and 5, and chromas of 2 and 3. They commonly are fine sandy loam, but range to loam. The B2t horizon has hues of 7.5YR and 10YR, a value of 5, and chromas of 4 to 8. In places this horizon has pale-brown mottles. It is clay loam or sandy clay loam. The Bx horizon commonly is pale brown (10YR 6/3), but the color ranges to yellowish brown (10YR 5/6, 5/8) and strong brown (7.5YR 5/6, 5/8). This horizon is gravelly fine sandy loam to gravelly sandy clay loam and clay loam. The B3t horizon ranges from very gravelly clay loam to clay loam, sandy clay loam, and clay. The C horizon ranges from clay to fine sandy loam. In places it is gravelly or very gravelly.

Bourne soils, gravelly subsoil variant, commonly occur near Aura, Caroline, and Sassafras soils, but they are less well drained than those soils. The Aura, Caroline, and Sassafras soils lack a fragipan that occurs in Bourne soils.

Bourne fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes (BnB).—This soil has the profile described as representative of the Bourne series, gravelly subsoil variant.

Included with this soil in mapping were small areas of Aura, Caroline, and Sassafras soils and small areas of soils that have a gravelly surface layer, a very gravelly subsoil, or both.

Runoff is slow to medium on this soil, and erosion is a severe hazard if this soil is clean tilled or exposed. This soil has a seasonal high water table at a depth of 1½ to 2½ feet, and artificial drainage is beneficial if the soil is used for farming. It is droughty during the growing season because the fragipan is near the surface. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops. Excessive wetness in winter and in spring and the fragipan are severe limitations for alfalfa and other deep-rooted crops. Capability unit IIIe–5; woodland suitability group 8.

Bourne fine sandy loam, gravelly subsoil variant, 6 to 10 percent slopes, eroded (BnC2).—The surface layer generally is 5 to 7 inches thick, but in some places ranges from 4 to 8 inches in thickness. The profile otherwise is similar to the one described as representative of the Bourne series, gravelly subsoil variant.

Included with this soil in mapping were small areas of Aura, Caroline, and Sassafras soils.

Runoff is medium to rapid on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. This soil has a seasonal high water table at a depth of 1½ to 2½ feet, and some seepage occurs on the lower slopes. Artificial drainage is beneficial, especially on the lower slopes, if the soil is used for farming. This soil is droughty during the growing season because the fragipan is near the surface. It has a limited suitability for most locally grown crops. Capability unit IIIe–5; woodland suitability group 8.

Bremo Series

The Bremo series consists of moderately deep, somewhat excessively drained, sloping to steep soils on the Piedmont uplands. These soils formed in the weathered products of hornblende schist and gneiss, and felsites. The native vegetation commonly is oaks and hickory, but some areas are in Virginia pine and yellow-poplar. Most areas of Bremo soils are wooded.

In a representative profile about 2 inches of organic material overlies the surface layer of olive-brown loam about 5 inches thick. The subsoil is about 13 inches thick. The upper 5 inches is friable, yellowish-brown gravelly loam. The lower 8 inches is friable, strong-brown very gravelly loam. The gravel consists of fine angular pieces of strongly weathered schist. The substratum begins at a depth of about 18 inches, and extends to a depth of 30 inches. It is light-gray and pale-brown schist.

Bremo soils are medium acid in the subsoil and the substratum. They are low in natural fertility and organic-matter content. Permeability is moderately rapid in the subsoil, and available moisture capacity is low.

Representative profile of Bremo loam, 15 to 35 percent slopes, on a wooded slope, 75 yards north of Austin Run, and one-fourth mile south of Route 642, in north-central Stafford County:

O1—2 inches to 0, dark grayish-brown mat of leaves, twigs, and fine roots.

A1—0 to 5 inches, olive-brown (2.5Y 4/4) loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; common fine and medium roots; strongly acid; clear, smooth boundary.

B1—5 to 10 inches, yellowish-brown (10YR 5/4) gravelly loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; common, fine, interstitial pores; medium acid; clear, wavy boundary.

B2—10 to 18 inches, strong-brown (7.5YR 5/6) very gravelly loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; a few very fine and fine roots; 40 percent of horizon consists of weathered schist fragments; a few, thin, yellowish-red (5YR 4/8) clay films on some structure surfaces; medium acid, gradual, irregular boundary.

C—18 to 30 inches, light-gray and pale-brown weathered schist; oriented vertically; thin yellowish-red (5YR 4/8) clay flows in seams in upper 12 inches of the horizon; medium acid.

R—30 inches, schist.

The solum ranges from 14 to 22 inches in thickness. Depth to bedrock ranges from 20 to about 40 inches. Weathered rock fragments make up 5 to 15 percent of the upper horizons, but increase to as much as 30 to 60 percent in lower part of the B and C horizons. The A horizon has hues of 10YR and 2.5Y, values of 4 and 5, and chromas of 2 to 4. It is commonly loam, but ranges to silt loam, gravelly loam, and gravelly silt loam. The B horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 4 to 8. It is commonly very gravelly loam but ranges to gravelly silt loam, gravelly loam, and very gravelly silt loam. In places, thin seams and pockets of clay loam occur in the subsoil.

Bremo soils commonly are near Manor, Mecklenburg, and Nason soils. They have less silt and mica in the profile than the Manor soils. They are more excessively drained, have thinner profiles, and have less clay in the subsoil than the Mecklenburg and Nason soils.

Bremo loam, 6 to 15 percent slopes (BrD).—This soil is on the sides of narrow ridges.

Included with this soil in mapping were small areas of Manor, Mecklenburg, and Zion soils.

Runoff is medium to rapid on this soil, and erosion is a severe hazard if this soil is exposed. The soil is droughty during the growing season. It is suited to drought-resistant tame pasture and woodland. Capability unit VIe–2; woodland suitability group 7.

Bremo loam, 15 to 35 percent slopes (BrE).—This soil has the profile described as representative of the Bremo series.

Included with this soil in mapping were small areas of Manor and Watt soils. Also included were gullied spots, small areas where weathered rock was only a few inches below the soil surface, and spots of rock outcrop on some lower slopes.

Runoff is rapid on this soil, and erosion is a very severe hazard if this soil is exposed. This soil is droughty during the growing season. It is better suited to native pasture than to other crops. Capability unit VIIe–1; woodland suitability group 7.

Caroline Series

The Caroline series consists of deep, well-drained, gently sloping to steep soils on uplands. These soils formed in stratified loamy and clayey Coastal Plain sediment. The native vegetation is largely oaks and hickory, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. The areas of Caroline soils are used for general farming, woodland, and urban development.

In a representative profile about 1½ inches of partly decayed organic material overlies the surface layer of fine sandy loam about 9 inches thick. The upper 4 inches is dark brown, and the lower 5 inches is brown. The subsoil is about 75 inches thick. The upper 4 inches is strong-brown, friable clay loam. The next 22 inches is yellowish-red, firm heavy clay loam that is mottled with strong brown in the lower 13 inches. The lower 49 inches of the subsoil is firm clay loam that is mottled with yellowish red, gray, yellowish brown, and strong brown. The substratum begins at a depth of about 84 inches and extends to a depth of 112 inches or more. It is firm clay loam that is mottled with strong brown, yellowish red, and gray.

Caroline soils are very strongly acid in the subsoil. They are low in natural fertility and organic-matter content. Permeability is moderately slow in the subsoil, and available moisture capacity is moderate.

Representative profile of Caroline fine sandy loam, 2 to 6 percent slopes, eroded, 20 yards west of Route 603, 300 yards south of Route 218, at White Oak, in southeastern Stafford County:

O1—1½ inches to 0, very dark grayish-brown, partly decayed pine needles and twigs, mixed with organic matter.

A1—0 to 4 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common fine and medium roots; very strongly acid; clear, smooth boundary.

A2—4 to 9 inches, brown (10YR 5/3) fine sandy loam; weak, fine and very fine, granular structure; very friable, slightly sticky and slightly plastic; common fine and medium roots; a few fine pores; very strongly acid; abrupt, smooth boundary.

B1t—9 to 13 inches, strong-brown (7.5YR 5/6) clay loam; weak, fine, subangular blocky structure; slightly hard; friable, sticky and plastic; common fine and medium roots; a few fine and very fine pores; 1 to 3 percent rounded quartz pebbles; a few thin, patchy clay films; very strongly acid; clear, smooth boundary.

B21t—13 to 22 inches, yellowish-red (5YR 4/6) heavy clay loam; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; a few fine and medium roots; a few very fine and fine pores; 1 to 3 percent rounded quartz pebbles; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22t—22 to 35 inches, mottled yellowish-red (5YR 4/6) and strong-brown (7.5YR 5/6) heavy clay loam; moderate, fine and medium, angular and subangular blocky structure; hard, firm, sticky and plastic; a few fine roots; a few fine pores; 1 to 3 percent rounded quartz pebbles; thin, continuous, yellowish-red (5YR 4/6) clay films; very strongly acid; gradual, smooth boundary.

B23t—35 to 65 inches, mottled yellowish-red (5YR 4/6), gray (10YR 6/1), and yellowish-brown (10YR 5/6) heavy clay loam; moderate, very coarse, prismatic structure that parts to weak, coarse, subangular blocky; hard, firm, sticky and plastic; slightly compact in place; a few fine roots; a few fine pores; 2 to 5 percent rounded quartz pebbles; thin and moderately thick, yellowish-brown (10YR 5/4) clay films; very strongly acid; gradual, smooth boundary.

B3t—65 to 84 inches, mottled strong brown (7.5YR 5/6), brownish-yellow (10YR 6/8), and gray (10YR 6/1) clay loam; weak, very coarse, angular blocky structure; hard, firm, sticky and plastic; thin, patchy, brown (7.5YR 5/4) clay films; 2 to 5 percent rounded quartz pebbles; very strongly acid; gradual, smooth boundary.

C—84 to 112 inches, mottled light-gray (10YR 7/1), strong-brown (7.5YR 5/8), and yellowish-red (5YR 4/8) clay loam; massive; hard, very firm, sticky and plastic; 2 to 5 percent rounded quartz pebbles; very strongly acid.

The solum is more than 60 inches thick. A few to common fine pebbles make up from 1 percent to 10 percent, by volume, of the solum. The A horizon has a hue of 10YR, values of 4 to 6, and chromas of 2 to 6. It commonly is fine sandy loam, but ranges to very fine sandy loam. Eroded areas are clay loam. The upper part of the B2t horizon has hues of 5YR and 7.5YR, values of 4 and 5, and chromas of 6 to 8. This horizon is heavy clay loam or

clay. The B23t and B3t horizons are mottled with red or yellowish red, gray, and brown or strong brown. These horizons commonly are heavy clay loam, clay loam, or clay. The C horizon is gravelly or very gravelly in places.

Caroline soils commonly are near Aura, Bourne, Craven, Sassafras, and Tetotum soils. Caroline soils are better drained than Bourne soils, and they lack the fragipan of those soils. They have a thicker solum than Craven soils and they are better drained. Caroline soils have a more clayey subsoil than the Aura, Sassafras, and Tetotum soils, and they are better drained than the Tetotum soils.

Caroline fine sandy loam, 2 to 6 percent slopes, eroded (CaB2).—This soil is on ridges. It has the profile described as representative of the Caroline series.

Included with this soil in mapping were small areas of Aura, Bourne, Craven, Sassafras, and Tetotum soils.

Runoff is medium on this soil. Further erosion is a moderate hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIe–1; woodland suitability group 10.

Caroline fine sandy loam, 6 to 10 percent slopes, eroded (CaC2).—This soil is on the sides of narrow ridges. Included with this soil in mapping were small areas of Aura, Kempsville, and Sassafras soils. Also, included were small areas of severely eroded Caroline soils that have a clay loam surface layer.

Runoff is medium on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–1; woodland suitability group 10.

Caroline fine sandy loam, 10 to 18 percent slopes, eroded (CaD2).—This soil has a profile similar to the one described as representative of the Caroline series.

Included with this soil in mapping were small areas of Aura, Kempsville, and Sassafras soils. Also included were spots of severely eroded Caroline soils that have a clay loam surface layer.

Runoff is rapid on this soil. Further erosion is a very severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most of the locally grown crops. Because erosion is a very severe hazard, this soil is better suited to close-growing crops or to pasture than to other crops. Capability unit IVe–1; woodland suitability group 10.

Caroline clay loam, 6 to 10 percent slopes, severely eroded (CcC3).—The surface layer of this soil is a mixture of material from the remaining surface layer and the subsoil, and in places the solum is thinner than that in the profile described as representative of the Caroline series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of eroded Bourne, Kempsville, and Sassafras soils.

Runoff is medium to rapid on this soil. Futher erosion is a very severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a very severe hazard, this soil is better suited to close-growing crops, to pasture, or to trees than to row crops. Capability unit IVe-2; woodland suitability group 11.

Caroline clay loam, 10 to 18 percent slopes, severely eroded (CcD3).—The surface layer of this soil is a mixture of material from the remaining surface layer and the subsoil, and in some places the profile is thinner than the one described as representative of the Caroline series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of eroded Aura, Kempsville, and Sassafras soils and small gullied areas.

Runoff is rapid on this soil. Further erosion is a very severe hazard if this soil is clean tilled or exposed. This soil is better suited to pasture and woodland than to cultivated crops. Capability unit VIe-1; woodland suitability group 11.

Caroline-Sassafras complex, 10 to 15 percent slopes (CdD).—These soils are intermingled in such an intricate pattern that it is not practical to map them separately. Caroline soils make up about 40 percent of this complex, and Sassafras soils about 35 percent. Other soils make up the remaining 25 percent.

Included with these soils in mapping were a few small areas of gravelly and very gravelly soil, very sandy soil, a few small gullied areas, and a few small areas of Galestown and Craven soils.

Runoff is medium to rapid on the soils in this complex, and erosion is a very severe hazard if the soils are clean tilled or exposed. This complex is better suited to close-growing crops, pasture, and woodland than to cultivated crops. Capability unit IVe–1; woodland suitability group 11.

Caroline-Sassafras complex, 15 to 30 percent slopes (CdE).—Caroline soils make up about 35 percent of this complex, and Sassafras soils about 35 percent. Other soils make up the remaining 30 percent.

Included with these soils in mapping were a few small areas of gravelly, very gravelly, or very sandy soil, and a few small areas of Galestown soil. Clayey material outcrops along the base of the slopes of this unit.

Runoff is rapid on the soils in this complex, and erosion is a severe hazard if the soils are exposed. This unit is suited to pasture and woodland. Capability unit VIe-1; woodland suitability group 11.

Cartecay Series

The Cartecay series consists of deep, moderately well drained to somewhat poorly drained, nearly level to very gently sloping soils. These soils formed in loamy and sandy alluvial material deposited on stream flood plains in the Piedmont and Coastal Plain. The native vegetation is largely a mixture of maple, gum, birch, and yellow-poplar, but stands of Virginia pine, loblolly pine, gum, and birch are on farmland that is reverting to woodland.

In a representative profile the surface layer is dark-brown fine sandy loam about 8 inches thick. The substratum is 96 inches thick. The upper 8 inches is very friable, pale-brown fine sandy loam. The next 17 inches is very friable fine sandy loam that is mottled with light brownish gray and brown. The next 20 inches is gray, very friable fine sandy loam that is mottled with strong brown. The lower part is gray fine sandy loam and loamy fine sand.

Cartecay soils are slightly acid to medium acid in the upper 30 to 60 inches. They are moderate in natural fer-

tility and in organic-matter content. Permeability is moderately rapid in the substratum. Available moisture capacity is moderate, and the seasonal high water table is at a depth of 1 to 1½ feet. These soils are frequently flooded.

Representative profile of Cartecay fine sandy loam, on a flood plain east of Route 301 and 50 yards south of Route 623, in southern King George County:

A1—0 to 8 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many very fine and fine roots; a few, fine, rounded quartz pebbles; a few fine flakes of mica; medium acid; clear, smooth boundary.

C1—8 to 16 inches, pale-brown (10YR 6/3) fine sandy loam; common, medium, faint, light-gray (10YR 7/2) mottles; massive; very friable, slightly sticky and slightly plastic; common very fine and fine roots; a few, fine, tubular pores; few, fine, rounded quartz pebbles; a few fine flakes of mica; medium acid; clear, smooth boundary.

C2—16 to 33 inches, mottled light brownish-gray (10YR 6/2) and brown (10YR 5/3) fine sandy loam; massive; very friable, slightly sticky and slightly plastic; a few fine flakes of mica; slightly acid; clear, smooth boundary.

C3g—33 to 53 inches, gray (10YR 6/1) fine sandy loam; many, fine, prominent, strong-brown (7.5YR 5/8) mottles; massive; very friable, slightly sticky and slightly plastic; common, very fine, tubular pores; common fine flakes of mica; strongly acid; clear, smooth boundary.

C4g—53 to 104 inches, gray (10YR 6/1) fine sandy loam and loamy fine sand; massive; very friable, nonsticky and nonplastic; common fine flakes of mica; strongly acid.

In many places a few to common fine pebbles make up 1 percent to 10 percent, by volume, of the upper 40 inches. In places pebbles make up 35 to 60 percent of the layers below 40 inches. The A horizon has a hue of 10YR, values of 4 to 6, and chromas of 2 to 4. It commonly is fine sandy loam, but ranges to loamy fine sand and sandy loam. The soil above 16 to 24 inches has hues of 10YR and 7.5YR, vaules of 5 and 6, and chromas of 3 to 4. Mottles have hues of 10YR and 2.5Y, values of 5 to 7, and chromas of 1 and 2. Layers below 16 to 24 inches has hues of 10YR and 7.5YR, values of 5 and and chromas of 1 to 3. Brown, strong-brown, yellowish-brown, and yellowish-red mottles are common. These layers are dominantly fine sandy loam and loamy sand.

The Cartecay soils in this survey area differ from the Cartecay soils in other survey areas by having a strongly acid C horizon within a depth of 40 inches below the surface. This difference, however, does not alter their usefulness or behavior.

Cartecay soils are near Altavista, Congaree, Roanoke, and Wehadkee soils. They have a less clayey subsoil than the Altavista and Roanoke soils, and are less poorly drained than the Roanoke soils. They are less well drained than the Congaree soils and have more sand throughout the profile. Cartecay soils are better drained than the Wehadkee soils and are not so gray in the upper part as those soils.

Cartecay fine sandy loam (Ce).—This is the only Cartecay soil mapped in the survey area. It is on long, narrow flood plains. Slopes are of 0 to 4 percent.

Included with this soil in mapping were small areas of Altavista and Wehadkee soils, small areas of Alluvial land, wet, and small areas of soils that have a loam and silt loam surface layer. Also included were spots of gravelly and very gravelly soils.

This soil has a seasonal high water table at a depth of 1 to 1½ feet. It is frequently flooded, and artificial drainage is needed if the soil is used for farming. If this soil is adequately drained, protected from floods, and limed and fertilized, it is suited to most locally grown crops. Alfalfa grown on this soil is short lived because wetness is excessive in winter and in spring. Capability unit IIIw-2; woodland suitability group 6.

Cecil Series

The Cecil series consists of deep, well-drained, gently sloping to strongly sloping soils of the Piedmont uplands. These soils formed in material weathered from granite and gneiss. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. The acreage of these soils is used for woodland and general farming.

In a representative profile the surface layer is fine sandy loam about 9 inches thick. The upper 4 inches is dark brown and the lower 5 inches is brown. The subsoil is 42 inches thick. The upper 4 inches is yellowish-red, firm heavy clay loam. The next 30 inches is red, firm clay. The lower 8 inches is red, firm heavy clay loam. The substratum begins at a depth of 51 inches and extends to a depth of 120 inches or more. The upper 17 inches is firm red, yellowish-red, and brown loam. The lower 52 inches is brown and pale-brown strongly weathered gneiss that has a few thin veins of white quartz.

Cecil soils are strongly acid to very strongly acid in the subsoil. They are low in natural fertility and organic-matter content. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Cecil fine sandy loam, 2 to 6 percent slopes, eroded, 10 yards south of Route 663, and one-half mile west of Holly Corner, in southwestern Stafford County:

Ap1—0 to 4 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common fine and medium roots, strongly acid, clear, smooth boundary.

Ap2—4 to 9 inches, brown (10YR 5/3) fine sandy loam; weak, fine, granular structure; very friable, slightly sticky and slightly plastic; common fine and medium roots; a few fine roots; a few, very fine, tubular pores; thin, smooth boundary.

B1t—9 to 13 inches, yellowish-red (5YR 4/6) heavy clay loam; weak, fine, subangular blocky structure; firm, sticky and plastic; common fine and medium roots; a few, fine, tubular pores; strongly acid; clear, smooth boundary.

B21t—13 to 27 inches, red (2.5YR 4/6) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; a few fine roots; a few, very fine, tubular pores; thin continuous clay films; a few fine flakes of mica; very strongly acid; clear, smooth boundary.

B22t—27 to 43 inches, red (2.5YR 4/6) clay; moderate, medium, angular blocky structure; firm, sticky and plastic; a few fine roots; a few, fine, tubular pores; thin continuous clay films; a few fine flakes of mica; very strongly acid; gradual, wavy boundary.

B3t—43 to 51 inches, red (2.5YR 4/6) heavy clay loam; weak, coarse, angular blocky structure; firm, sticky and plastic; a few, fine, tubular pores; thin patchy clay films; seams and pockets of yellowish-red (5YR 4/8) clay loam; common fine flakes of mica; very strongly acid; gradual, wavy boundary.

C1—51 to 68 inches, red (2.5YR 4/6), yellowish-red (5YR 5/8), and brown (7.5YR 5/4) loam; rock-controlled struc-

ture; firm, slightly sticky and plastic; common fine flakes of mica; thin and moderately thick red (2.5Y 4/6) clay flows in vertical seams; very strongly acid; gradual, wavy boundary.

C2—68 to 120 inches, brown and pale-brown strongly weathered granite gneiss; a few thin veins of white quartz.

The solum ranges from 42 to 60 inches in thickness. Depth to bedrock is more than 5 feet. In many places, fine to medium quartz pebbles make up less than 1 percent to about 30 percent, by volume, of the solum, The A horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 2 to 4. It is commonly fine sandy loam and gravelly fine sandy loam, but ranges to sandy loam.

Cecil soils are near the Appling, Ashlar, Nason, and Elioak soils. Cecil soils have a redder subsoil than the Appling soils. They have a thicker, more clayey solum than Ashlar soils. Cecil soils have less silt than the Nason and Elioak soils, and they have a redder subsoil than the Nason soils.

Cecil fine sandy loam, 2 to 6 percent slopes, eroded (CfB2).—This soil is on somewhat broad ridges. It has the profile described as representative of the Cecil series.

Included with this soil in mapping were small areas of Nason and Elioak soils. Also included were spots where a thin fluvial overlay has added fine, rounded, quartz pebbles to the surface layer.

Runoff is medium on this soil. Further erosion is a moderate hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe-1; woodland suitability group 4.

Cecil fine sandy loam, 6 to 15 percent slopes, eroded (CfC2).—This soil is on the sides of narrow ridges.

Included with this soil in mapping were small areas of Ashlar, Nason, and Elioak soils, and a few small areas of rock outcrops on lower slopes. Also included were small areas of Cecil soils that have a clay loam surface layer.

Runoff is medium to rapid on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe-1; woodland suitability group 4.

Cecil gravelly fine sandy loam, 2 to 6 percent slopes, eroded (CgB2).—This soil is on ridges. The surface layer consists of a thin fluvial fine sandy loam overlay that is made up of 15 to 30 percent fine, rounded, quartz pebbles. The profile otherwise is similar to the one described as representative of the Cecil series.

Included with this soil in mapping were small areas of Cullen, Nason, and Elioak soils. Also included were some areas where the overlay contained less than 15 percent pebbles, but had a thin gravel line at the base of the overlay.

Runoff is slow to medium on this soil. Further erosion is a moderate hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe-1; woodland suitability group 4.

Cecil clay loam, 6 to 15 percent slopes, severely eroded (ChC3).—This soil is on the sides of narrow ridges. The surface layer is clay loam that is a mixture of material from the remaining surface layer and the subsoil, and in places the soil profile is somewhat thinner than that of the soil described as representative of the Cecil series.

Included with this soil in mapping were small areas of eroded Nason and Elioak soils, a few small areas of rock outcrop, and a few small areas of gullied soils.

Runoff is medium to rapid on this soil. Futher erosion is a very severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe-2; woodland suitability group 11.

Colfax Series

The Colfax series consists of somewhat poorly drained to moderately well drained, gently sloping soils of the Piedmont uplands. These soils formed in material weathered from granite and gneiss. Colfax soils have a moderate to strong fragipan at a depth of 25 to 35 inches. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Most areas of Colfax soils are wooded.

In a representative profile the surface layer is fine sandy loam about 12 inches thick. The upper 4 inches is grayish brown, and the lower 8 inches is light yellowish brown. The subsoil is about 42 inches thick. The upper 3 inches is yellowish-brown sandy clay loam that is faintly mottled with light yellowish brown. The next 12 inches is yellowish-brown, firm clay loam that is mottled with gray. The next 10 inches is a fragipan that is mottled with yellowish-brown, strong-brown, and light-gray sandy clay loam that is very firm, brittle, and compact. The next 17 inches also is fragipan that is light-gray, firm, brittle, and compact sandy clay loam that is mottled with yellowish brown. The substratum begins at a depth of 54 inches and extends to a depth of 92 inches or more. The upper 30 inches is firm sandy clay loam that is mottled with gray, strong brown, and red. The lower 8 inches is gray, firm sandy clay loam.

Colfax soils are strongly acid to very strongly acid in the subsoil. They are low in natural fertility and organic-matter content. The subsoil above the fragipan is moderately permeable, but the fragipan is slowly permeable. Available moisture capacity is low to moderate. A perched water table is above the fragipan during wet periods.

Representative profile of Colfax fine sandy loam, 2 to 6 percent slopes, 200 yards south of MCS-3 on the U.S. Marine Corps Reservation, in northern Stafford County:

A1—0 to 4 inches, grayish-brown (2.5Y 5/2) fine sandy loam; moderate, fine, granular structure; very friable, nonsticky and nonplastic; many very fine and fine roots; very strongly acid; clear, smooth boundary.

A2—4 to 12 inches, light yellowish-brown (2.5Y 6/4) fine sandy loam; weak, fine, subangular blocky structure; friable, nonsticky and nonplastic; common fine and medium roots; common, fine, tubular pores; very strongly acid; clear, smooth boundary.

B1t—12 to 15 inches, yellowish-brown (10YR 5/6) sandy clay loam; common, medium, faint, light yellowish-brown (2.5Y 6/4) mottles; weak, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; a few fine and medium roots; fine, tubular pores; a few, thin, patchy clay films; very strongly acid; clear, smooth boundary.

B2t—15 to 27 inches, yellowish-brown (10YR 5/6) clay loam; common, fine, distinct, gray (10YR 6/1) mottles; moderate, fine, angular blocky structure; firm, sticky

and plastic; a few fine and medium roots; a few, fine, tubular pores; thin, continuous, dark yellowish-brown (10YR 4/4) clay films; very strongly acid; clear, smooth boundary.

Bx1—27 to 37 inches, mottled yellowish-brown (10YR 5/8), strong-brown (7.5YR 5/8), and light-gray (10YR 7/1) sandy clay loam; moderate, very coarse, prismatic structure that parts to weak, medium, subangular blocky; very firm, slightly sticky and slightly plastic; brittle and compact when in place; a few fine roots; patchy clay films; thin to thick, dark yellowish-brown (10YR 4/4) clay flows along prismatic structure faces; very strongly acid; gradual, wavy boundary.

Bx2g—37 to 54 inches, light-gray (10YR 6/1) sandy clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, very coarse, prismatic structure that parts to weak, coarse, angular blocky; firm, sticky and plastic; brittle and compact when in place; a few, fine, tubular pores; thin, patchy, dark yellowish-brown (10YR 4/4) clay films; thin to thick dark yellowish-brown (10YR 4/4) clay flows along prismatic structure faces; very strongly acid; gradual, wavy boundary.

C1g—54 to 84 inches, mottled gray (10YR 6/1), strong-brown (7.5YR 5/6), and red (2.5YR 4/8) sandy clay loam; massive; firm, slightly sticky and slightly plastic; very strongly acid; gradual, wavy boundary.

C2g—84 to 92 inches, gray (5Y 6/1) sandy clay loam; massive; firm, slightly sticky and slightly plastic; very strongly acid.

The solum ranges from 42 to 60 inches in thickness. Depth to bedrock is more than 5 feet. The A horizon has hues of 2.5Y and 10YR, values of 4 to 6, and chromas of 2 to 4. It commonly is fine sandy loam but ranges to loam. The Bt horizon has hues of 10YR and 2.5Y, values of 5 and 6, and chromas of 6 to 8. It is clay loam or sandy clay loam. Mottles in the Bt horizon have chromas of 1 and 2. The Bx horizons have hues of 10YR and 7.5YR, values of 5 to 7, and chromas of 1 to 8. The C horizon is gray sandy clay loam or sandy loam, which commonly is mottled.

Colfax soils commonly are near Appling and Cecil soils. Colfax soils are more poorly drained than Appling and Cecil soils, and they have a fragipan, which is absent in the Appling and Cecil soils.

Colfax fine sandy loam, 2 to 6 percent slopes (CIB).—This soil is in small scattered areas. It has the profile described as representative of the Colfax series.

Included with this soil in mapping were small areas of Appling and Cecil soils.

This soil has a perched seasonal high water table at a depth of 1 to 1½ feet, and artificial drainage is needed if this soil is used for farming. It is somewhat droughty during the growing season, because the fragipan is near the surface. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops, except alfalfa. Alfalfa grown on this soil is short lived because of excessive wetness in winter and in spring. Capability unit IIIw-3; woodland suitability group 8.

Colfax Series, Gravelly Subsoil Variant

Soils of the Colfax series, gravelly subsoil variant, are moderately well drained and gently sloping. They are on the Piedmont uplands. These soils formed in material weathered from granite monzonite. They have a moderate fragipan at a depth of 18 to 28 inches. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Most of the areas of these soils are wooded.

In a representative profile the surface layer is fine sandy loam about 10 inches thick. The upper 4 inches is dark grayish brown, and the lower 6 inches is a yellowish brown. The subsoil is about 32 inches thick. The upper 8 inches is yellowish-brown, firm sandy clay loam. The next 6 inches is yellowish-brown gravelly fine sandy loam fragipan that is mottled with light brownish gray. The next 6 inches is yellowish-brown gravelly clay loam that is mottled with red. The fragipan is firm, brittle, and compact. The lower 12 inches is firm gravelly clay loam that is mottled with strong brown, yellowish brown, and red. The substratum begins at a depth of 42 inches and extends to a depth of 96 inches or more. The upper 24 inches is firm gravelly clay loam that is mottled with red, brownish yellow, strong brown, and dark yellowish brown. The lower 30 inches is friable gravelly loam that is strong brown, pale brown, and yellowish red.

Colfax soils, gravelly subsoil variant, have a very strongly acid subsoil. They are low in natural fertility and organic-matter content. The subsoil above the fragipan is moderately permeable, but the fragipan is slowly permeable. Available moisture capacity is low to moderate. The water table is above the fragipan during wet periods.

Representative profile of Colfax fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes, 100 yards north of Route 654, one-fourth mile east of Route 655, in southwestern Stafford County:

A1—0 to 4 inches, dark grayish-brown (2.5Y 4/2) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many very fine and fine roots; 5 to 15 percent fine, angular, quartz fragments; strongly acid; clear, smooth boundary.

A2—4 to 10 inches, yellowish-brown (10YR 5/4) fine sandy loam; weak, fine, granular structure; very friable, slightly sticky and slightly plastic; common very fine and fine roots; 5 to 15 percent fine angular fragments; very strongly acid; clear, smooth boundary.

B2t—10 to 18 inches, yellowish-brown (10YR 5/6) sandy clay loam; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common very fine and fine roots; a few, very fine, tubular pores; thin patchy clay films; 5 to 15 percent fine, angular, quartz fragments; very strongly acid; abrupt, smooth boundary.

Bx1—18 to 24 inches, yellowish-brown (10YR 5/6) gravelly fine sandy loam; common, coarse, faint, light brownish-gray (10YR 6/2) mottles; weak, thick, platy structure; firm, slightly sticky and slightly plastic; brittle and compact when in place; a few very fine roots; a few fine pores; 15 to 35 percent fine angular quartz fragments; thin, continuous, yellowish-brown (10YR 5/8) clay films; very strongly acid; clear, smooth boundary.

Bx2—24 to 30 inches, yellowish-brown (10YR 5/6) gravelly clay loam; common, medium, prominent, red (2.5YR 4/8) mottles; weak, medium, platy structure; firm, sticky and slightly plastic; brittle and compact when in place; a few very fine roots; a few fine pores; 20 to 35 percent angular quartz fragments; thin, continuous, brown (7.5YR 4/4) clay films; very strongly acid; clear, smooth boundary.

B3t—30 to 42 inches, mottled strong-brown (7.5YR 5/6), yellowish-brown (10YR 5/4), and red (2.5YR 4/6) gravelly clay loam; weak, medium, subangular blocky structure; firm, sticky and plastic; a few fine, tubular

pores; 20 to 35 percent fine angular quartz fragments; a few, thin, patchy clay films; very strongly acid; gradual, smooth boundary.

C1—42 to 66 inches, mottled red (2.5YR 4/6), brownish-yellow (10YR 6/8), strong-brown (7.5YR 5/6), and dark yellowish-brown (10YR 4/4) gravelly clay loam; rock-controlled structure; firm, sticky and plastic; many very fine flakes of mica; 35 percent fine angular quartz fragments; very strongly acid; gradual, smooth boundary.

C2—66 to 96 inches, strong-brown (7.5YR 5/6) gravelly loam; common, fine, distinct, pale-brown (10YR 6/3) and yellowish-red (5YR 5/6) mottles; rock-controlled structure; friable, nonsticky and nonplastic; many very fine flakes of mica; 35 percent fine angular quartz fragments; very strongly acid.

The solum ranges from 40 to 52 inches in thickness. Depth to rock is more than 5 feet. Depth to the fragipan ranges from 18 to 28 inches. Coarse fragments make up from 5 to 15 percent of the A and Bt horizons and from 15 to 35 percent of the Bx horizons. The B2t horizon has hues of 10YR, a value of 5, and chromas of 4 to 8. It commonly is sandy clay loam or clay loam. The Bx horizons have hues of 10YR, values of 5 and 6, and chromas of 4 to 8, mottled with light brownish gray, red, and yellowish red.

Colfax soils, gravelly subsoil variant, commonly are near Appling and Nason soils. Colfax soils are less well drained than the Appling and Nason soils, and they have a fragipan, which is lacking in Appling and Nason soils.

Colfax fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes (CmB).—This soil is on broad ridges. It has the profile described as representative of the Colfax series, gravelly subsoil variant.

Included with this soil in mapping were small areas of Appling and Nason soils and a few small areas of moderately well drained soils that do not have a fragipan.

Runoff is slow to medium on this soil, and erosion is a severe hazard if this soil is clean tilled or exposed. This soil has a seasonal perched high water table at a depth of 1½ to 2½ feet, and artificial drainage is beneficial if it is used for farming. This soil is droughty during the growing season because the fragipan is near the surface. Where this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops, except alfalfa. Alfalfa grown on this soil is short lived because of excessive wetness in winter and in spring. Capability unit IIIe-5; woodland suitability group 8.

Congaree Series

The Congaree series consists of deep, well-drained, nearly level to very gently sloping soils on stream flood plains. These soils formed in loamy and sandy alluvial material along the larger streams in Stafford County, and along the Rappahannock River in southern Stafford and King George Counties. The native vegetation is largely oaks, maple, gum, ash, and yellow-poplar, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Most of the acreage of Congaree soils is in pasture and in trees.

In a representative profile the surface layer is dark-brown loam about 10 inches thick. The substratum consists of five layers. The upper 7 inches is brown, friable loam. The next 20 inches is brown, friable light silty clay loam. The next 12 inches is brown, friable very fine sandy loam. Below this layer is 15 inches of dark grayish-brown, friable loam. The lower 26 inches is gray sandy clay loam that is mottled with brown.

Congaree soils are slightly acid to strongly acid. They are low to moderate in organic-matter content, and are medium in natural fertility. The substratum is moderately permeable. Available moisture capacity is moderate. The seasonal high water table is at a depth of 4 feet or more, and depth varies with the level of nearby streams. These soils are frequently flooded.

Representative profile of Congaree loam, along the Rappahannock River, 500 yards south of Route 3, in southwestern King George County:

A1—0 to 10 inches, dark-brown (7.5YR 4/2) loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common very fine and fine roots; a few, fine, rounded quartz pebbles; many fine mica flakes; slightly acid; clear, smooth boundary.

C1—10 to 17 inches, brown (7.5YR 4/4) loam; massive; friable, slightly sticky and slightly plastic; common fine roots; many, fine, tubular pores; a few, fine, rounded quartz pebbles; many fine mica flakes; slightly acid; clear, smooth boundary.

C2—17 to 37 inches, brown (7.5YR 4/4) light silty clay loam; massive; friable, slightly sticky and slightly plastic; common fine roots; many, fine, tubular pores; a few, fine, rounded quartz pebbles; many fine mica flakes; medium acid; clear, smooth boundary.

C3—37 to 49 inches, brown (7.5YR 4/4) very fine sandy loam; massive; friable, slightly sticky and slightly plastic; common fine roots; many, fine, tubular pores; a few, fine, rounded quartz pebbles; many fine mica flakes; medium acid; clear, smooth boundary.

C4—49 to 64 inches, dark grayish-brown (10YR 4/2) loam; massive; friable, slightly sticky and slightly plastic; a few fine roots; common, very fine, tubular pores; a few, fine, rounded quartz pebbles; many fine flakes of mica; strongly acid; clear, smooth boundary.

C5—64 to 90 inches, gray (10YR 6/1) sandy clay loam; common, fine, distinct, brown (7.5YR 4/4) mottles; massive; friable, slightly sticky and slightly plastic; a few fine roots; a few, fine, rounded quartz pebbles; many fine mica flakes; strongly acid.

Rounded quartz pebbles commonly make up less than 1 percent to about 15 percent, by volume, of the solum. The A horizon has hues of 7.5YR and 10YR, values of 3 to 5, and chromas of 2 to 4. It is commonly loam, but ranges to silt loam and fine sandy loam. The upper part of the substratum is 30 inches thick and has hues of 7.5YR and 10YR, values of 4 to 6, and chromas of 3 to 6. It is light silty clay loam to fine sandy loam. The lower part is 40 inches thick and commonly mottled. It ranges from sand and gravel to silty clay loam.

Congaree soils commonly are near Cartecay, Roanoke, and Wehadkee soils. They lack the gray mottles in the upper 40 inches typical of the Cartecay soils. Congaree soils also lack the gray subsoil of the Roanoke and Wehadkee soils.

Congaree loam (Cn).—This is the only Congaree soil mapped in the survey area. It is on long, narrow flood plains. Slopes are 0 to 4 percent.

Included with this soil in mapping were small areas of Altavista, Cartecay, and Wickham soils. Also included were small spots of soils that have a gravelly and very gravelly subsoil.

Runoff is slow on this soil. Congaree loam is frequently flooded in many areas. If this soil is adequately limed and fertilized, it is well suited to most of the locally grown summer crops. Capability unit IIw–2; woodland suitability group 1.

Craven Series

The Craven series consists of deep, moderately well drained, nearly level to gently sloping soils of the Coastal Plain lowlands. These soils formed in clayey sediments. The native vegetation is largely oaks and hickory, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Most of the acreage of Craven soils is wooded.

In a representative profile the surface layer is loam about 9 inches thick. The upper 3 inches is dark grayish brown, and the lower 6 inches is pale brown. The subsoil is about 47 inches thick. The upper 6 inches is yellowish-brown, firm heavy clay loam. The next 11 inches is yellowish-brown, firm clay. Below this layer is 18 inches of very firm clay that is mottled with strong brown, red, and gray. The lower 12 inches is very firm yellowish-brown clay that is mottled with red and gray. The substratum begins at a depth of 56 inches and extends to a depth of 92 inches or more. It is very firm clay that is mottled with yellowish brown, light gray, and red.

Craven soils have a strongly acid or very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is slow in the subsoil, and available moisture capacity is moderate. The seasonal high water table is at a depth of 2½ to 5 feet in winter and in spring.

Representative profile of Craven loam, 0 to 2 percent slopes, 50 yards east of Route 625, one-half mile south of Route 629, in eastern King George County:

A1—0 to 3 inches, dark grayish-brown (2.5Y 4/2) loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine and medium roots; very strongly acid; clear, smooth boundary.

A2—3 to 9 inches, pale-brown (10YR 6/3) loam; a few, fine, faint, strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; a few, fine and medium, tubular pores; strongly acid; clear, smooth boundary.

B1—9 to 15 inches, yellowish-brown (10YR 5/6) heavy clay loam; weak, fine, subangular blocky structure; firm, sticky and plastic; common fine and medium roots; a few, fine, tubular pores; very strongly acid; clear, smooth boundary.

B21t—15 to 26 inches, yellowish-brown (10YR 5/6) clay; moderate, very fine and fine, angular blocky structure; firm, sticky and plastic; common fine and medium roots; a few, fine, tubular pores; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22t—26 to 44 inches, mottled strong-brown (7.5YR 5/8), red (2.5YR 5/8), and gray (10YR 6/1) clay; strong, very fine and fine, angular blocky structure; very firm, sticky and plastic; a few fine and medium roots; thin continuous clay films; strongly acid; gradual, smooth boundary.

B23t—44 to 56 inches, yellowish-brown (10YR 5/6) clay; many, medium, prominent, gray (10YR 6/1) and red (2.5YR 4/6) mottles; strong, thin, platy structure; very firm, sticky and plastic; a few fine and medium roots; thin continuous clay films; very strongly acid; gradual, smooth boundary.

C—56 to 92 inches, mottled yellowish-brown (10YR 5/6), light-gray (10YR 7/1), and red (10YR 4/8) clay; massive; very firm, sticky and plastic; very strongly acid.

The solum ranges from 44 to 62 inches in thickness. The A horizon has hues of 10YR and 2.5Y, values of 4 to 6, and chromas of 2 to 4. It is commonly loam, but ranges to fine sandy loam and silt loam. The upper 10 to 15 inches of the Bt horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 6 to 8. It is commonly clay loam or clay. The C horizon is mottled with gray, yellowish brown, strong brown, red, and yellowish red.

Craven soils are near Bourne, Caroline, Sassafras, and Tetotum soils. They lack the fragipan of the Bourne soils. They are more poorly drained than the Caroline soils, and have a thinner and more clayey solum. Craven soils have a more clayey solum than the Sassafras and Tetotum soils, and are more poorly drained than the Sassafras soils.

Craven loam, 0 to 2 percent slopes (CrA).—This soil has the profile described as representative of the Craven series.

Included with this soil in mapping were a few small areas of Bladen, Bourne, Caroline, and Tetotum soils.

Runoff is slow on this soil. It has a seasonal high water table at a depth of 2½ to 5 feet, and some areas pond during wet periods. Artificial drainage is beneficial if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. If alfalfa is grown, it is short lived because wetness is excessive in winter and in spring. Capability unit IIIw-1; woodland suitability group 2.

Craven loam, 2 to 6 percent slopes (CrB).—This soil is in broad areas.

Included with this soil in mapping were small areas of Bourne, Caroline, Pooler, and Tetotum soils.

Runoff on this soil is slow to medium, and erosion is a severe hazard if the soil is clean tilled or exposed. Artificial drainage is beneficial if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. If alfalfa is grown on this soil, it is short lived because wetness is excessive in winter and in spring. Capability unit IIIe-4; woodland suitability group 2.

Cullen Series

The Cullen series consists of deep, well-drained, gently sloping to strongly sloping soils of the Piedmont uplands. These soils formed in material weathered from gneiss and schist, and felsites. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Large areas of these soils are used for general farming, and small areas are wooded.

In a representative profile the plow layer is dark-brown loam about 8 inches thick. The subsoil is about 49 inches thick. The upper 9 inches is red, friable clay loam. The next 25 inches is dark-red, firm clay. The lower 15 inches is friable silty clay loam mottled with red and reddish yellow. The substratum begins at a depth of 57 inches and extends to 110 inches or more. It is friable silt loam that is red, dark red, reddish yellow, and brownish yellow.

Cullen soils have a medium acid to very strongly acid subsoil. They are low in organic-matter content and moderate in natural fertility. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Cullen loam, 2 to 6 percent slopes, eroded, 500 yards north of Route 610 and 1 mile west of Garrisonville, in northern Stafford County:

Ap—0 to 8 inches, dark-brown (7.5YR 4/4) loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; a few, fine, hard, black concretions; medium acid; clear, smooth boundary.

B21t—8 to 17 inches, red (2.5YR 4/6) clay loam; moderate, fine, subangular blocky structure; friable; slightly sticky and slightly plastic; a few very fine roots; common, fine, tubular pores; a few, thin, patchy films; a few, fine, hard, black concretions; medium acid; clear, smooth boundary.

B22t—17 to 30 inches, dark-red (10R 3/6) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; a few very fine roots; common, fine, tubular pores; thin continuous clay films; a few, fine, hard, black concretions; medium acid; gradual, smooth boundary.

B23t—30 to 42 inches, dark-red (10R 3/6) clay; moderate, medium, angular blocky structure; firm, sticky and plastic; a few very fine roots; a few, fine, tubular pores; thin continuous clay films; small pockets of reddish-yellow (7.5YR 7/8) clay; a few, fine, hard, black concretions; strongly acid; gradual, smooth boundary.

B24t—42 to 57 inches, mottled red (2.5YR 4/8), red (10R 4/8), and reddish-yellow (7.5YR 7/8) silty clay loam; weak, coarse, angular blocky structure; friable, slightly sticky and slightly plastic; common, fine, tubular pores; common, thin, dark-red (2.5YR 3/6) clay films; a few, fine, hard, black concretions; very strongly acid; gradual, smooth boundary.

C1—57 to 82 inches, mottled red (2.5YR 4/8), red (10R 4/8), and reddish-yellow (7.5YR 6/8) silt loam; massive; friable, slightly sticky and slightly plastic; thin and moderately thick red (2.5YR 4/8) clay in seams in upper part of horizon; very strongly acid; gradual, smooth boundary.

C2—82 to 110 inches, dark-red, red, and brownish-yellow silt loam that has rock-controlled structure; friable, slightly sticky and slightly plastic; very strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 5 feet. The A horizon has hues of 7.5YR and 5YR, values of 4 and 5, and chromas of 2 to 4. It is commonly loam, but ranges to silt loam. Severely eroded areas have a clay loam surface layer. The B2t horizon has hues of 10R and 2.5YR, values of 3 and 4, chromas of 4 to 8. The C horizon is very strongly weathered gneiss, schist, or felsite that has a rock-controlled structure and loam or silt loam texture.

Cullen soils commonly are in association with Nason, Orange, and Zion soils. Cullen soils have a thicker solum and are less acid than Nason soils. They are better drained than Orange soils and have a redder subsoil and are more acid than Zion soils.

Cullen loam, 2 to 6 percent slopes, eroded (CuB2).—This soil is on ridges. It has the profile described as representative of the Cullen series.

Included with this soil in mapping were small areas of Cecil, Nason, and Elioak soils. Also included were small areas of severely eroded Cullen soil that have a clay loam surface layer.

Runoff is medium on this soil. Further erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe-1; woodland suitability group 1.

Cullen loam, 6 to 15 percent slopes, eroded (CuC2).—This soil is on the sides of narrow ridges.

Included with this soil in mapping were small areas of Cecil, Nason, and Elioak soils. Also included were small areas of a severely eroded Cullen soil that has a clay loam surface layer.

Runoff on this soil is medium to rapid, and erosion is a severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–1; woodland suitability group 1.

Cullen clay loam, 6 to 15 percent slopes, severely eroded (CvC3).—The surface layer of this soil is clay that is a mixture of material from the remaining surface layer and the subsoil, and in places the solum is thinner than that in the profile described as representative of the Cullen series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of eroded Cecil, Nason, and Elioak soils, and some small gullied areas.

Runoff is medium to rapid on this soil. Further erosion is a very severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a very severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe–2; woodland suitability group 11.

Cut and Fill Land

Cut and fill land (Cw) consists of areas where soil material has been removed or reworked by machinery. Some of these areas are along recent highway-construction sites and include both borrow areas outside the right-of-way and the right-of-way itself. A few areas are leveled and are used for commercial construction and as trailer parks. Other areas have been excavated and filled or shaped for various purposes. A few areas are severely eroded.

In many places cuts and excavations in the areas are deep and extend into the underlying geologic materials. These materials are either unconsolidated sandy, loamy, and clayey sediment or bedrock formations.

Texture in areas of Cut and fill land generally ranges from loamy sand to clay loam and clay, but some areas are very gravelly. Color generally is yellowish brown, strong brown, pale brown, yellowish red, red, or gray.

Many areas of Cut and fill land have little or no vegetative cover. Other areas have a thin cover of grasses, weeds, Virginia pine, and loblolly pine. Sediment production is medium to high. Runoff is rapid, and permeability is moderate to slow. Slopes are variable, but they commonly range from 6 to 45 percent. Small areas of unworked soils within areas of Cut and fill land commonly are compacted and are shaped to some extent, but otherwise they generally resemble the other soils of the immediate surrounding areas. Capability unit unassigned; woodland suitability group 13.

Dogue Series

The Dogue series consists of deep, moderately well drained, nearly level to gently sloping soils. These soils formed in loamy and clayey alluvium on the terraces along the Rappahannock River in Stafford and King George Counties. The native vegetation is largely a mixture of oaks, hickory, and yellow-poplar, but stands of

Virginia pine and loblolly pine are on farmland that is reverting to woodland. Most of the acreage of Dogue soils is wooded, but some areas are used for farming.

In a representative profile the surface layer is loam about 10 inches thick. The upper 4 inches is dark grayish brown and the lower 6 inches is light olive brown. The subsoil is about 37 inches thick. The upper 4 inches is yellowish-brown heavy clay loam. The next 10 inches is yellowish-brown firm clay. The next 10 inches is firm, yellowish-brown heavy clay loam that is mottled with light brownish gray and strong brown. The lower 13 inches is a firm heavy clay loam that is mottled with strong brown, gray, and red. The substratum begins at a depth of about 47 inches and continues to 98 inches or more. It is loamy fine sand that is strong brown mottled with light brownish gray.

Dogue soils have a strongly to very strongly acid subsoil. They are low in organic-matter content and low in natural fertility. Permeability is moderately slow in the subsoil, and available moisture capacity is moderate. The seasonal high water table is at a depth of 2½ to 3½ feet in winter and in spring months.

Representative profile of Dogue loam, 0 to 2 percent slopes, 30 yards west of Route 631, 75 yards north of Route 607, in southern King George County:

A1—0 to 4 inches, dark grayish-brown (2.5Y 4/2) loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine roots; strongly acid; clear, smooth boundary.

A2—4 to 10 inches, light olive-brown (2.5Y 5/4) loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; a few, fine, tubular pores; strongly acid; clear, smooth boundary.

B1t—10 to 14 inches, yellowish-brown (10YR 5/6) heavy clay loam; weak, medium, subangular blocky structure; firm, sticky and plastic; common fine and medium roots; a few fine pores; a few fine flakes of mica; a few, thin, patchy clay films; very strongly acid; clear, smooth boundary.

B21t—14 to 24 inches, yellowish-brown (10YR 5/6) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; common fine roots; a few fine pores; a few fine flakes of mica; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22t—24 to 34 inches, yellowish-brown (10YR 5/6) heavy clay loam; common, fine, distinct, light brownish-gray (10YR 6/2), gray (10YR 5/1), and strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; firm, sticky and plastic; a few fine roots; a few fine pores; common fine flakes of mica; thin continuous clay films; very strongly acid; clear, smooth boundary.

B3t—34 to 47 inches, mottled strong-brown (7.5YR 5/8), gray (10YR 5/1), and red (2.5YR 4/6) heavy clay loam; firm, sticky and plastic; moderate, fine, angular blocky structure; a few fine roots; a few fine pores; common fine flakes of mica; thin, patchy, gray (10YR 5/1) clay films; very strongly acid; gradual, smooth boundary.

IIC—47 to 98 inches, strong-brown (7.5YR 5/6) loamy fine sand; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; structureless; friable, nonsticky and nonplastic; common fine flakes of mica; very strongly acid.

The solum ranges from 40 to 54 inches in thickness. The A horizon has hues of 2.5Y and 10YR, values of 4 and 5, and chromas of 2 to 4. It commonly is loam, but ranges to silt loam and very fine sandy loam. The upper 24 inches of the Bt horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 4 to 8. Mottles that have a chroma of 2 occur at a depth of 14 to 18 inches below the top of the Bt horizon. The B3t horizon commonly is heavy clay loam or clay, but ranges to silty clay loam and clay loam. The C horizon in many places contains layers of silty and clayey material.

Dogue soils are near Altavista, Augusta, Wahee, and Wickham soils. They are similar to Altavista soils, but have more clay in the subsoil. They are better drained than the Augusta soils, and they have a finer textured subsoil. Dogue soils are better drained than the Wahee soils. They are more poorly drained and have a finer textured subsoil than the Wickham soils.

Dogue loam, 0 to 2 percent slopes (DoA).—This nearly level soil is on broad terraces. It has the profile described as representative of the Dogue series.

Included with this soil in mapping were small areas of Altavista, Augusta, Wahee, and Wickham soils.

Artificial drainage is needed if this soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is well suited to most locally grown crops. Alfalfa grown in this soil is short lived because wetness is excessive in winter and in spring. Capability unit IIw-1; woodland suitability group 4.

Dogue loam, 2 to 6 percent slopes (DoB).—This soil is on terraces.

Included with this soil in mapping were small areas of Altavista, Turbeville, and Wickham soils.

Runoff is slow to medium on this soil, and erosion is a moderate hazard if this soil is clean tilled or exposed. Artificial drainage is beneficial if this soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is well suited to most of the locally grown crops. Alfalfa grown on this soil is short lived because wetness is excessive in winter and in spring. Capability unit IIe-4; woodland suitability group 4.

Elbert Series, Thin Solum Variant

Soils of the Elbert series, thin solum variant, are deep, poorly drained, and nearly level. They formed in material weathered from hornblende gneiss, basic schist, and felsites in upland depressions and along drainageways. The native vegetation is a mixture of oaks, maple, sycamore, willow, elm, and birch, but stands of birch, gum, and willow are on farmlands that are reverting to woodland.

In a representative profile the surface layer is silt loam about 10 inches thick. The upper 4 inches is dark brown, and the lower 6 inches is brown. The subsoil is about 25 inches thick. The upper 7 inches is gray, friable silty clay loam that is mottled with yellowish brown. The lower 18 inches is gray, very firm clay that is mottled with yellowish brown. The substratum begins at a depth of about 35 inches and extends to 110 inches or more. The upper 29 inches is greenish-gray friable loam that is mottled with olive brown. The next 26 inches is gray sand and gravel. The lower 20 inches is very strongly weathered hornblende gneiss.

Elbert soils, thin solum variant, have a medium acid to slightly acid subsoil. They are moderate in natural fertility and organic-matter content. Permeability is slow to very slow in the subsoil, and available moisture

capacity is moderate. Depth to the seasonal high water table ranges from 0 to 1 foot from the surface in winter and in spring.

Representative profile of Elbert silt loam, thin solum variant, three-fourths of a mile west of Route 616 by Potomac Run, in west-central Stafford County:

Ap1—0 to 4 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; slightly acid; clear, smooth boundary.

Ap2—4 to 10 inches, brown (10YR 4/3) silt loam; many, fine, faint, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; common, fine, tubular pores; medium acid; clear, smooth boundary.

B1tg—10 to 17 inches, gray (10YR 6/1), silty clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and plastic; few fine roots; common, fine, tubular pores; common fine pockets of black concretionary material; slightly acid; abrupt, irregular boundary.

B2tg—17 to 35 inches, gray (N 5/0) clay; common, fine, prominent, yellowish-brown (10YR 5/6) mottles; strong, coarse, prismatic structure that breaks readily into moderate, medium, angular blocky structure; very firm, sticky and plastic; a few fine roots; common, fine, tubular pores; thin, continuous gray (N 5/0) clay films; common fine pockets of black concretions; common slickensides; medium acid; gradual, smooth boundary.

IIC1g—35 to 64 inches, greenish-gray (5G 5/1) loam; common, fine, prominent, olive-brown (2.5Y 4/4) mottles; massive; friable, slightly sticky and slightly plastic; a few fine roots; a few, fine, tubular pores; common very fine flakes of mica; medium acid; clear, smooth boundary.

IIIC2g—64 to 90 inches, gray loamy sand and gravel; very friable, nonsticky and nonplastic; common very fine flakes of mica; medium acid; clear, smooth boundary.

IVC3—90 to 110 inches, soft, very strongly weathered hornblende gneiss.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is more than 5 feet. The A horizon has hues of 10YR, values of 4 and 5, and chromas of 2 to 4. In the lower part many mottles have a chroma of 2. It is commonly silt loam but ranges to loam and light silty clay loam. The Bt horizon has hues of 10YR, 2.5Y, or is neutral, values of 4 to 6, and chromas of 0 and 1. It has common to many mottles of yellowish brown and, in places, strong brown. The B1t horizon generally is silty clay loam or clay loam.

Elbert soils, thin solum variant, commonly are near Meadowville and Worsham soils. They are more poorly drained than the Meadowville soils, and they have a more clayey subsoil. They are similar in drainage to the Worsham soils, but are less strongly acid and have less sand.

Elbert silt loam, thin solum variant (Eb).—This is the only Elbert soil, thin solum variant, mapped in the survey area. Slopes are dominantly 0 to 2 percent.

Included with this soil in mapping were a few small areas of Meadowville, Orange, and Worsham soils.

This soil has a seasonal high water table at or near the surface, and it ponds during wet periods. Artificial drainage is needed if this soil is used for farming. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for some locally grown crops. It is poorly suited to alfalfa or other deep-rooted crops. Capability unit IVw–1; woodland suitability group 12.

460-460—74——3

Elioak Series

The Elioak series consists of deep, well-drained, gently sloping to strongly sloping soils on uplands. These soils formed in material weathered from micaceous schist. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Large areas of these soils are wooded.

In a representative profile the surface layer is silt loam about 8 inches thick. The upper 3 inches is dark brown, and the lower 5 inches is strong brown. The subsoil is about 41 inches thick. The upper 5 inches is yellowish-red, friable silty clay loam. The next 26 inches is red, firm clay. The lower 10 inches is red, firm silty clay loam. The substratum begins at a depth of 49 inches and extends to a depth of 98 inches or more. It is very strongly weathered, vertically oriented micaceous schist that is dark red, dusky red, and reddish brown.

Elioak soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is moderate in the subsoil, and available moisture capacity is high.

Representative profile of Elioak silt loam, 2 to 6 percent slopes, eroded, 200 yards east of Route 612, 1½ miles south of Route 616, in west-central Stafford County:

Ap1—0 to 3 inches, dark-brown (7.5YR 4/4) silt loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; strongly acid; clear, smooth boundary.

Ap2—3 to 8 inches, strong-brown (7.5YR 5/6) silt loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; a few, fine, tubular pores; strongly acid; clear, smooth boundary.

B1t—8 to 13 inches, yellowish-red (5YR 4/6) silty clay loam; weak, medium, subangular blocky structure; friable, sticky and plastic; common fine and medium roots; a few, fine, tubular pores; a few, thin, patchy clay films; very strongly acid; clear, smooth boundary.

B21t—13 to 27 inches, red (2.5YR 4/6) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; a few fine and medium roots; a few, fine, tubular pores; thin continuous clay films; a few fine seams of brownish-yellow (10YR 6/8) clay; common fine flakes of mica; very strongly acid; clear, smooth boundary.

B22t—27 to 39 inches, red (2.5YR 4/6) clay; moderate, medium, angular blocky structure; firm, sticky and plastic; a few fine roots; a few, fine, tubular pores; thin continuous clay films; a few fine seams of brownish-yellow (10YR 6/8) clay; common fine flakes of mica; very strongly acid; gradual, smooth boundary.

B3—39 to 49 inches, red (2.5YR 4/6) silty clay loam; moderate, medium, angular blocky structure; firm, sticky and plastic; a few fine roots; a few, fine, tubular pores; a few, thin, patchy clay films; common fine flakes of mica; very strongly acid; gradual, smooth boundary.

C—49 to 98 inches, very strongly weathered, vertically oriented, very strongly acid, dark-red, reddish-brown, and dusky-red mica schist.

The solum ranges from 30 to 50 inches in thickness. Depth to rock is more than 5 feet. The A horizon has hues of 7.5YR,

values of 4 and 5, and chromas of 2 to 6. It is commonly silt loam or loam, but severely eroded areas are silty clay loam. The B2t horizon has hues of 2.5YR, values of 4 and 5, and chromas of 4 to 6. It is clay, but it has a "slick" feeling that resembles a lighter textured material. The C horizon is very strongly weathered schist, and it commonly is silt loam or loam. In places thin veins of quartz extend into the solum.

In this survey area the Elioak soils contain less kaolinite in the profile than the Elioak soils in other survey areas, but this difference does not alter their usefulness and behavior.

Elioak soils commonly are near Cullen, Nason, and Manor soils. They are similar to the Cullen soils, but are more acid. They have a thicker solum than the Nason soils, and are less yellow. They have a thicker solum than the Manor soils and are finer textured.

Elioak silt loam, 2 to 6 percent slopes, eroded (E1B2).—This soil is on ridges. It has the profile described as representative of the Elioak series.

Included with this soil in mapping were small areas of Cullen, Mecklenburg, and Nason soils. Also included were spots of a similar soil in which angular quartz fragments made up 15 to 35 percent of the surface layer and the subsoil.

Runoff is medium on this soil. Erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe–1; woodland suitability group 4.

Elioak silt loam, 6 to 15 percent slopes, eroded (E1C2).—Most of this soil is wooded.

Included with this soil in mapping were small areas of Cullen, Manor, Mecklenburg, and Nason soils. Also included were spots of a similar soil in which angular quartz pebbles make up 15 to 50 percent of the surface layer and the subsoil, and spots of a severely eroded soil that has a silty clay loam surface layer.

Runoff on this soil is medium to rapid. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–1; woodland suitability group 4.

Elioak silty clay loam, 6 to 15 percent slopes, severely eroded (EmC3).—The surface layer of this soil is silty clay loam that is a mixture of material from the remaining surface layer and the subsoil, and in places the solum is thinner than that in the profile described as representative of the Elioak series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of eroded Cullen, Manor, Mecklenburg, and Nason soils. Also included were spots of a similar soil in which angular quartz pebbles make up 15 to 50 percent of the surface layer and the subsoil.

Runoff on this soil is rapid. Further erosion is a very severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it has a limited suitability for most locally grown crops. Because of the very severe erosion hazard, this soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe–2; woodland suitability group 11.

Fairfax Series

The Fairfax series consists of deep, well-drained, gently sloping soils on uplands. These soils formed in a thin layer of fluvial material and in material weathered from schist and gneiss. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Most of the acreage of these soils is wooded.

In a representative profile the surface layer is loam about 11 inches thick. The upper 3 inches is dark yellowish brown, and the lower 8 inches is yellowish brown. The subsoil is about 35 inches thick. The upper 6 inches is yellowish-brown, firm silty clay loam. The next 7 inches is firm gravelly silty clay loam that is yellowish brown mottled with light yellowish brown. The lower 22 inches is firm silty clay loam that is mottled with strong brown and red. The substratum begins at a depth of 46 inches and extends to a depth of 76 inches or more. It is red, dark-red, and strong-brown strongly weathered schist.

Fairfax soils have a very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is moderate in the subsoil, and available moisture capacity is high.

Representative profile of Fairfax loam, 2 to 6 percent slopes, on the U.S. Marine Corps Reservation near Route 617A, one-fourth mile southeast of MCS 6, in northern Stafford County:

Ap1—0 to 3 inches, dark yellowish-brown (10YR 4/4) loam; moderate, fine, granular structure; very friable, slightly sticky and plastic; common fine roots; a few angular and rounded pebbles; very strongly acid; clear, smooth boundary.

Ap2—3 to 11 inches, yellowish-brown (10YR 5/4) loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; a few, fine, tubular pores; a few angular and rounded pebbles; very strongly acid; clear, smooth boundary.

B21t—11 to 17 inches, yellowish-brown (10YR 5/6) silty clay loam; weak, medium, subangular blocky structure; firm, sticky and plastic; a few fine and medium roots; a few, fine, tubular pores; a few angular and rounded pebbles; a few, thin, patchy clay films; very strongly acid; clear, wavy boundary.

IIB22t—17 to 24 inches, yellowish-brown (10YR 5/6) gravelly silty clay loam; a few, fine, faint, light yellowish-brown (10YR 6/4) mottles; weak, fine, subangular blocky structure; firm, sticky and plastic; a few fine and medium roots; a few, fine, tubular pores; thin, continuous, strong-brown (7.5YR 5/6) clay films; angular and rounded pebbles; very strongly acid; clear, wavy boundary.

IIIB3t—24 to 46 inches, mottled strong-brown (7.5YR 5/8) and red (2.5YR 4/8) silty clay loam; moderate, fine, subangular blocky structure; firm, sticky and plastic; thin patchy clay films; many fine mica flakes; very strongly acid; gradual, smooth boundary.

C—46 to 76 inches, mottled dark-red (10YR 3/6), strong-brown (7.5YR 5/8), and red (2.5YR 4/8) strongly weathered schist; rock-controlled structure; crushes into silt loam; many fine mica flakes; very strongly acid.

The solum ranges from 38 to 46 inches in thickness. Depth to bedrock is more than 5 feet. Pebbles make up about 1 to 6 percent of the A and B21t horizons and 15 to 30 percent of the IIB22t horizon. The B3t horizon commonly

has no pebbles. The A horizon has hues of 10YR, values of 4 to 6, and chromas of 2 to 8. It commonly is loam, but ranges to silt loam. The B21t and B22t horizons have hues of 10YR and 7.5YR, values of 5 and 6, and chromas of 4 to 8. The B21t horizon is commonly silty clay loam, but ranges to clay loam. The B22t horizon is commonly gravelly silty clay loam, but ranges to gravelly clay loam, silty clay loam, and clay loam. The C horizon is strongly weathered schist or gneiss that has a rock-controlled structure and is silt loam or loam.

Fairfax soils commonly occur near Nason and Elioak soils. They have a less clayey subsoil than either of these soils.

Fairfax loam, 2 to 6 percent slopes (FaB).—This is the only Fairfax soil mapped in the survey area. It is on broad ridges.

Included with this soil in mapping were small areas of Nason and Elioak soils. Also included were spots of a similar soil that has a gravelly loam surface layer.

Runoff on this soil is slow to medium, and erosion is a moderate hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIe–2; woodland suitability group 4.

Fallsington Series

The Fallsington series consists of deep, poorly drained, nearly level soils on lowlands. These soils formed in loamy and sandy Coastal Plain sediment that contains lenses and thin strata of clayey materials. The native vegetation is largely a mixture of oaks, elm, willow, maple, and gum, but Virginia pine and loblolly pine are on farmland that is reverting to woodland. Most areas of Fallsington soils are wooded.

In a representative profile the surface layer is dark-brown and grayish-brown very fine sandy loam about 6 inches thick. The subsoil is about 24 inches thick. The upper 5 inches is light brownish-gray, friable sandy clay loam that is mottled with yellowish brown. The next 7 inches is gray, firm clay loam that is mottled with yellowish brown. The lower 12 inches is gray, firm sandy clay loam that is mottled with yellowish brown. The substratum begins at a depth of 30 inches and extends to a depth of 110 inches or more. It is gray and greenish-gray, friable very fine sandy loam and loamy very fine sand.

Fallsington soils have a very strongly acid to extremely acid subsoil. They are low in organic-matter content and natural fertility. The subsoil has moderate permeability. Available moisture capacity is moderate. The seasonal high water table is at the surface or within a depth of 1½ feet during wet periods.

Representative profile of Fallsington very fine sandy loam, 20 yards north of Route 301, ½ mile west of Potomac River Bridge, in northeastern King George County:

A1—0 to 2 inches, dark-brown (10YR 3/3) very fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common fine and medium roots; very strongly acid; abrupt, smooth boundary.

A2—2 to 6 inches, grayish-brown (2.5Y 5/2) very fine sandy loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles primarily on ped surfaces and in pores; weak, medium, subangular blocky structure; friable; slightly sticky and slightly plastic; common fine, medium, and coarse roots; a few, fine, tubular pores; extremely acid; clear, smooth boundary.

B1tg—6 to 11 inches, light brownish-gray (2.5Y 6/2) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable, sticky and slightly plastic; common fine and medium roots; a few, fine, tubular pores; a few, thin, patchy clay films; extremely acid; clear, smooth boundary.

B21tg—11 to 18 inches, gray (10YR 6/1) clay loam; many, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, fine, subangular blocky structure; firm, sticky and plastic; common fine and medium roots; a few, fine and medium, tubular pores; thin patchy clay films; very strongly acid; gradual, smooth boundary.

B22tg—18 to 30 inches, gray (N 5/0) sandy clay loam; common, coarse, prominent, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; firm, sticky and plastic; a few fine and medium roots; a few, fine, tubular pores; thin continuous clay films; very strongly acid; gradual, smooth boundary.

C1g—30 to 50 inches, gray (10YR 6/1) very fine sandy loam; a few, medium, distinct, yellowish-brown (10YR 5/6) mottles; friable, slightly sticky and slightly plastic; a few fine and medium roots; a few, fine, tubular pores; extremely acid; gradual, smooth boundary.

C2g—50 to 110 inches, greenish-gray (5GY 5/1) loamy very fine sand; single grain; very friable, nonsticky and nonplastic; very strongly acid.

The solum ranges from 24 to 36 inches in thickness. In many places fine, rounded, quartz pebbles make up less than 1 percent to about 5 percent, by volume, of the solum. The A horizon has hues of 10YR and 2.5Y, values of 3 to 6, and chromas of 2 to 4. It commonly is very fine sandy loam, but ranges to loam. The Bt horizon has hues of 10YR, 2.5Y, 5Y, and N, values of 4 to 6, and chromas of 0 to 2. In many places, it has a few to many yellowish-brown or light olive-brown mottles, and it ranges from sandy clay loam to clay loam. The C horizon commonly is gray and greenish gray, and it has thin layers of sandy to clayey material.

The Fallsington soils in this survey area differ from the Fallsington soils in other survey areas in that they have higher content of very fine sand within a depth of 40 inches below the surface. This difference, however, does not alter their usefulness or behavior.

Fallsington soils commonly are near Bertie, Bladen, and Tetotum soils. They are more poorly drained than the Bertie and Tetotum soils and have a coarser textured subsoil than Bladen soils.

Fallsington very fine sandy loam (Fd).—This soil is in broad areas. Slopes are 0 to 2 percent.

Included with this soil in mapping were small areas of Bertie and Bladen soils.

This soil has a seasonal high water table at the surface or within a depth of 1½ feet. Artificial drainage is needed if this soil is used for farming. Drainage outlets are difficult to locate in most areas of this soil. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most of the locally grown crops. It is not suited to alfalfa and other deep-rooted crops. Capability unit IIIw–2; woodland suitability group 5.

Fresh Water Swamp

Fresh water swamp (Fs) consists of low-lying areas of mixed alluvium that are waterlogged or covered by fresh water, except during extended dry periods. It is along the larger streams commonly toward the lower reaches.

These areas consist of layers of sandy loam, fine sandy loam, loamy fine sand, loam, and silt loam. A mat of partly decayed organic material is on the surface in many places. The surface layer commonly is gray or dark gray. The lower layers are strongly gleyed and are gray, greenish gray, or bluish gray.

Many of the areas of Fresh water swamp are wooded, but small areas contain open water, and other areas are covered by reeds, cattails, arrowleaf, and other aquatic plants. Capability unit VIIw–1; woodland suitability group 13.

Galestown Series

The Galestown series consists of deep, somewhat excessively drained, sloping to steep soils on uplands. These soils formed in sandy Coastal Plain sediment. The native vegetation is largely a mixture of oaks, hickory, yellow-poplar, and beech, but stands of Virginia pine, loblolly pine, yellow-poplar, and oaks are on farmland that is reverting to woodland. The Galestown soils in Stafford and King George Counties are mapped only in complex with Aura and Sassafras soils. Most areas of these soils are wooded.

In a representative profile about 2 inches of partly decayed organic material overlies a surface layer of loamy fine sand about 10 inches thick. The upper 4 inches is very dark grayish brown, and the lower 6 inches is dark brown. The subsoil is about 28 inches thick and is strong-brown and yellowish-brown, very friable loamy fine sand. The substratum begins at a depth of about 38 inches and extends to a depth of 110 inches or more. The upper 42 inches of the substratum is light yellowish-brown fine sand. The lower 30 inches is strong-brown loamy fine sand.

Galestown soils are very strongly acid. They are low in natural fertility and organic-matter content. Permeability is rapid in the subsoil, and available moisture capacity is low.

Representative profile of a Galestown loamy fine sand, in an area of Galestown-Sassafras complex, 15 to 30 percent slopes, 20 yards north of Route 218, 400 yards east of Route 610, in northern King George County:

O1—2 inches to 0, very dark brown, partly decayed leaves, twigs, and fine roots.

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; moderate, fine, granular structure; very friable, nonsticky and nonplastic; many fine and medium roots; very strongly acid; clear, smooth boundary.

A2—4 to 10 inches, dark-brown (10YR 4/3) loamy fine sand; weak, fine, granular structure; very friable, nonsticky and nonplastic; common fine, medium, and coarse roots; very strongly acid; clear, smooth boundary.

B21t—10 to 26 inches, strong-brown (7.5YR 5/6) loamy fine sand; very weak, coarse, subangular blocky structure that breaks easily into single grain; very friable, nonsticky and nonplastic; a few fine, medium, and coarse roots; a few, fine, tubular pores; sand grains coated with clay; common, weak, fine clay bridging; very strongly acid; gradual, wavy boundary.

B22t—26 to 38 inches, yellowish-brown (10YR 5/6) loamy fine sand; very weak, coarse, subangular blocky and single grain structure; very friable, nonsticky and nonplastic; a few fine, medium, and coarse roots; a few, fine, tubular pores; sand grains partly coated with clay; some weak, fine clay bridging; very strongly acid; gradual, wavy boundary.

C1—38 to 80 inches, light yellowish-brown (10YR 6/4) fine sand; single grain; loose, nonsticky and nonplastic; a few fine and medium roots; a few thin (½ inch to 1 inch) layers of brown loamy fine sand; very strongly acid; clear, wavy boundary.

C2—80 to 110 inches, strong-brown (7.5Y 5/8) loamy fine sand; single grain; loose, nonsticky and nonplastic; a few fine and medium roots; very strongly acid.

The solum ranges from 27 to 40 inches in thickness. In many places fine rounded quartz pebbles make up less than 1 percent to about 5 percent, by volume, of the solum and of the underlying material. The A horizon has hues of 10YR, values of 3 to 4, and chromas of 2 to 4. It commonly is loamy fine sand, but ranges to sand. The Bt horizon has hues of 7.5YR, 10YR, and in places, 5YR, values of 4 to 6, and chromas of 4 to 8. It commonly is loamy fine sand, but ranges to sand. The C horizon commonly is fine sand or sand, but ranges to loamy fine sand. Thin strata of loamy material or of loamy and gravelly material occur in places.

Galestown soils occur in association with Aura, Caroline, and Sassafras soils. Galestown soils have sandier profiles than those soils.

Galestown-Sassafras complex, 6 to 15 percent slopes (GsD).—Galestown soils make up about 45 percent of this complex and Sassafras soils about 30 percent. Other soils make up the remaining 25 percent. Galestown and Sassafras soils have the profiles described as representative of their respective series.

Included with these soils in mapping were a few small areas of gravelly soil and a few spots of Caroline soil.

Runoff is medium on the soils of this complex, and erosion is a moderate hazard if the soils are exposed. These soils are better suited to pasture and woodland than to row crops. Capability unit VIe–1; woodland suitability group 10.

Galestown-Sassafras complex, 15 to 30 percent slopes (GsE).—The soils of this complex are along drainageways, and they are extensive in King George County. Galestown soils make up about 40 percent of this complex and Sassafras soils about 30 percent. Other soils make up the remaining 30 percent. The Galestown and Sassafras soils have the profiles of their respective series.

Included with these soils in mapping were small areas of gravelly soil, very sandy soil, and some small gullied areas. In many places clayey sediment outcrops along the base of some slopes.

Runoff is rapid on the soils in this complex, and erosion is a very severe hazard if the soils are exposed. It is droughty during the growing season. These soils are better suited to permanent grasses and trees than to other crops. Capability unit VIIe–1; woodland suitability group 10.

Galestown-Sassafras complex, 30 to 45 percent slopes (GsF).—The soils of this complex occur along drainageways. Galestown soils make up about 40 percent of this complex and Sassafras soils about 25 percent. Other soils make up the remaining 35 percent. The Galestown and Sassafras soils have the profiles of their respective series.

Included with these soils in mapping were small areas of gravelly soil, small areas of clayey soil, and small gullied areas. In many places clayey sediment outcrops along the base of many of the slopes.

Runoff is rapid on the soils of this complex, and erosion is a very severe hazard if the areas are exposed. These soils are droughty during the growing season. The soils in this unit are better suited to native grasses and trees than to other crops. Capability unit VIIe–1; woodland suitability group 10.

Iuka Series

The Iuka series consists of deep, moderately well drained, nearly level to very gently sloping soils on the Coastal Plain. These soils formed in loamy and sandy local alluvium around the heads of drainageways, on foot slopes, and in depressions. The native vegetation is a mixture of oaks, hickory, elm, yellow-poplar, beech, and gum, but stands of Virginia pine, loblolly pine, and yellow-poplar are on farmland that is reverting to woodland.

In a representative profile the plow layer is dark-brown fine sandy loam about 8 inches thick. The substratum is about 100 inches or more thick. The first 10 inches is yellowish-brown, friable fine sandy loam. The next 14 inches is dark yellowish-brown, friable fine sandy loam that is mottled with light brownish gray. The next 24 inches is light brownish-gray, friable fine sandy loam that is mottled with yellowish brown. The lower 52 inches is friable loam that is mottled with olive, pale olive, and strong brown.

Iuka soils are strongly acid to very strongly acid. They are low in natural fertility and organic-matter content. The substratum has moderate permeability. Available moisture capacity is moderate. The seasonal high water table is at a depth of 2½ to 3½ feet in winter and in spring.

Representative profile of Iuka fine sandy loam, local alluvium, 100 yards east of Route 687, one-fifth mile south of Route 629, in eastern Stafford County:

Ap—0 to 8 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many very fine and fine roots; very strongly acid; clear, smooth boundary.

C1—8 to 18 inches, yellowish-brown (10YR 5/4) fine sandy loam; massive; friable, slightly sticky and slightly plastic; common very fine and fine roots; a few fine pores; very strongly acid; clear, smooth boundary.

C2—18 to 32 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; massive; friable, nonsticky and nonplastic; common fine roots; a few fine pores; a few, fine, brown concretions; very strongly acid; gradual, smooth boundary.

C3—32 to 56 inches, light brownish-gray (10YR 6/2) fine sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable, slightly sticky and slightly plastic; a few fine roots; a few fine pores; very strongly acid; gradual, smooth boundary.

IIC4g—56 to 108 inches, mottled olive (5Y 5/4), pale-olive (5Y 6/3), and strong-brown (7.5YR 5/8) loam; massive; friable, slightly sticky and slightly plastic; a few fine roots; a few fine pores; very strongly acid.

The A horizon has hues of 10YR, values of 4 to 6, and chromas of 2 to 4. It commonly is fine sandy loam, but ranges to sandy loam. The substratum above about 30 inches has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 3 to 6. It commonly is fine sandy loam, but ranges to sandy loam and loam. Low-chroma mottles commonly occur within 20 inches of the surface. The substratum below 30 inches has hues of 10YR, 2.5Y, 7.5YR, and 5Y; values of 4 to 6; and chromas of 1 to 8. It commonly is fine sandy loam or loam, but ranges to loamy fine sand, loamy sand, and sandy clay loam.

Iuka soils are near Bibb soils and Alluvial land, wet. They are better drained than those soils. Many of the surrounding upland soils are of the Caroline and Sassafras series, and both are well drained.

Iuka fine sandy loam, local alluvium (Iu).—This is the only Iuka soil mapped in the survey area. Slopes range from 0 to 4 percent.

Included with this soil in mapping were small areas of Bibb soil and Alluvial land, wet. Also included were spots of gravelly soils and very sandy soils.

In many places seepage occurs where this soil adjoins soils on the uplands. Artificial drainage generally is beneficial if this soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. Alfalfa grown on this soil is short lived because wetness is excessive in winter and in spring. Capability unit IIw–2; woodland suitability group 1.

Kempsville Series

The Kempsville series consists of deep, well-drained, nearly level to strongly sloping soils on the uplands. These soils formed in sandy and loamy Coastal Plain sediment. The native vegetation is largely oaks and hickory, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland.

In a representative profile the plow layer is dark-brown fine sandy loam about 10 inches thick. The subsoil is about 44 inches thick. The upper 5 inches is yellowish-brown, friable light sandy clay loam. The next 10 inches is brown, friable sandy clay loam. The next 15 inches is brown, friable fine sandy loam that is mottled with pale brown. The lower 14 inches is yellowish-red, friable fine sandy loam that is mottled with light brown. The substratum begins at a depth of about 54 inches and extends to a depth of 112 inches or more. It is strong-brown and light-brown, very friable loamy fine sand and sand.

Kempsville soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Kempsville fine sandy loam, 0 to 2 percent slopes, 10 yards east of Route 206, one-half mile south of Lord Culpepers Mill stream, in northern King George County:

Ap—0 to 10 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common fine roots; strongly acid; clear, smooth boundary.

B1t—10 to 15 inches, yellowish-brown (10YR 5/4), light sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; a few fine roots; a few fine pores; a few, thin, patchy clay films; very strongly acid; clear, smooth boundary.

B21t—15 to 25 inches, brown (7.5YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; a few fine roots; common fine pores; thin, patchy clay films; very strongly acid; clear, smooth boundary.

B22t—25 to 40 inches, brown (7.5YR 4/4) fine sandy loam; many, coarse, distinct, pale-brown (10YR 6/3) mottles; weak, coarse, subangular blocky structure; friable but somewhat compact when in place, slightly sticky and slightly plastic; a few fine roots oriented along ped surfaces; few fine pores; common clay coatings on sand grains, common bridging; a few, very thin, patchy clay films; very strongly acid; clear, wavy boundary.

B3t—40 to 54 inches, yellowish-red (5YR 4/8) fine sandy loam; common, medium, distinct, light-brown (7.5YR 6/4) mottles; weak, coarse, subangular blocky structure; friable but somewhat compact when in place, slightly sticky and slightly plastic; a few fine pores; some clay coatings on sand grains; common bridging; a few, very thin, patchy clay films; very strongly acid; gradual, wavy boundary.

C—54 to 112 inches, strong-brown (7.5YR 5/6) and light-brown (7.5YR 6/4) loamy fine sand and sand; single grain; very friable, nonsticky and nonplastic; very strongly acid.

The solum ranges from 42 to 60 inches in thickness. Fine rounded quartz pebbles make up less than 1 percent to about 6 percent, by volume, of the solum. The A horizon has hues of 10YR, values of 4 and 5, and chromas of 3 and 4. It is commonly fine sandy loam, but ranges to sandy loam. The Bt horizon above about 24 inches has hues of 7.5YR and 10YR, values of 4 to 6, and chromas of 4 to 8. It commonly is sandy clay loam, but ranges from loam to sandy clay loam. The Bt horizon below about 24 inches has hues of 7.5YR and 5YR, values of 4 to 6, and chromas of 4 to 8. It contains medium to coarse mottles of pale brown, light brown, or light yellowish brown. It commonly is fine sandy loam, but ranges to loam and sandy clay loam. The C horizon is gravelly in a few places.

Kempsville soils are near Bourne and Sassafras soils. Kempsville soils lack the fragipan that is characteristic of Bourne soils. They have a thicker solum and are more compact in the lower subsoil than the Sassafras soils.

Kempsville fine sandy loam, 0 to 2 percent slopes (KeA).—This soil is on broad ridges. It has the profile described as representative of the Kempsville series.

Included with this soil in mapping were small areas of Bourne and Sassafras soils.

If this soil is limed and fertilized, it is well suited to locally grown crops. Capability unit I–1; woodland suitability group 4.

Kempsville fine sandy loam, 2 to 6 percent slopes (KeB).—This soil is on broad ridges.

Included with this soil in mapping were small areas of Bourne, Caroline, and Sassafras soils.

Runoff is slow to medium on this soil, and erosion is a moderate hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe–2; woodland suitability group 4.

Kempsville fine sandy loam, gravelly substratum, 2 to 6 percent slopes (KfB).—This soil is on ridges. In many places the subsoil of this soil is 5 to 15 percent fine pebbles, and the substratum is 15 to 35 percent or more. The profile otherwise is similar to the one described as representative of the Kempsville series.

Included with this soil in mapping were small areas of Bourne, Caroline, Sassafras, and Turbeville soils.

Runoff on this soil is medium, and erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe–2; woodland capability group 4.

Kempsville fine sandy loam, gravelly substratum, 6 to 10 percent slopes, eroded (KfC2).—In many places the subsoil of this soil is 5 to 15 percent fine pebbles, and the substratum is 15 to 35 percent or more. Also, the surface layer is thinner than that in the profile described as representative of the series. It commonly ranges from 5 to 8 inches in thickness. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of Caroline, Sassafras, and Turbeville soils. Also included were small spots of a similar soil that contains 15 to 35 percent pebbles in the surface layer.

Runoff is medium on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–2; woodland suitability group 4.

Kempsville fine sandy loam, gravelly substratum, 10 to 18 percent slopes, eroded (KfD2).—The subsoil of this soil is 5 to 15 percent fine pebbles, and the substratum is 15 to 35 percent or more. Also, the surface layer is thinner than that in the profile described as representative of the Kempsville series. It commonly ranges from 4 to 7 inches in thickness. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of Caroline, Sassafras, and Turbeville soils, and small spots of similar soil that has 15 to 35 percent gravel content in the surface layer.

Runnoff is medium to rapid on this soil. Further erosion is a very severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a very severe hazard, the soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe–1; woodland suitability group 4.

Lignum Series

The Lignum series consists of deep, somewhat poorly drained, nearly level to gently sloping soils. These soils formed in material weathered from schist. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland.

In a representative profile the plow layer is dark-brown silt loam about 10 inches thick. The subsoil is about 29 inches thick. The upper 6 inches is strong-brown, firm silty clay loam. The next 17 inches is strong-brown, firm heavy silty clay loam that is mottled with light brownish gray. The lower 6 inches is light-gray and brownish-yellow, firm silty clay loam. The substratum begins at a depth of 39 inches and extends to a depth of 104 inches or more. It is friable silt loam that is mottled strong brown, white, and yellowish brown.

Lignum soils have a strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is moderately slow in the subsoil, and available moisture capacity is high. The seasonal high water table is at a depth of 1 to 2 feet in winter and in spring.

Representative profile of Lignum silt loam, 0 to 2 percent slopes, 200 yards west and 500 yards southwest

of junction of Routes 616 and 627, in northwestern Stafford County:

Ap—0 to 10 inches, dark-brown (7.5YR 4/4) silt loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; a few, fine, black concretions; a few very fine flakes of mica; strongly acid; clear, smooth boundary.

B21t—10 to 16 inches, strong-brown (7.5YR 5/8) silty clay loam; moderate, fine, subangular blocky structure; firm, sticky and plastic; many fine roots; a few fine pores; very thin, continuous, yellowish-brown (10YR 5/6) clay films; a few, fine, black concretions; common very fine flakes of mica; strongly acid; clear, smooth boundary.

B22t—16 to 33 inches, strong-brown (7.5YR 5/8) heavy silty clay loam; many, fine, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, prismatic structure that breaks easily into moderate, medium, angular blocky; firm, sticky and plastic; a few fine roots; a few fine pores; thin and moderately thick, continuous, grayish-brown (10YR 5/2) clay films; common very fine flakes of mica; strongly acid; gradual, smooth boundary.

B3g—33 to 39 inches, mottled light-gray (10YR 7/1) and brownish-yellow (10YR 6/6) silty clay loam; weak, coarse, subangular blocky structure; firm, sticky and plastic; a few fine roots; a few fine pores; a few, thin, patchy clay films; black organic matter staining on pore surfaces; common very fine flakes of mica; strongly acid; clear, smooth boundary.

C—39 to 104 inches, mottled strong-brown (7.5YR 5/8), white (10YR 8/1), and yellowish-brown (10YR 5/8) silt loam; rock-controlled structure; friable, slightly sticky and slightly plastic; common very fine flakes of mica; common fine pebbles composed of blue quartz; seams of black concretionary material in upper part; horizon is very strongly weathered schist; very strongly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to rock is more than 5 feet. The A horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 2 to 4. It is commonly silt loam but ranges to loam. The Bt horizon has hues of 10YR and 7.5YR, values of 5 and 6, and chromas of 6 to 8. Mottles generally have hues of 10YR, values of 5 and 6, and chromas of 1 and 2. It is silty clay loam, but ranges to silty clay and clay.

Lignum soils occur near Elioak, Meadowville, and Nason soils. Lignum soils are more poorly drained and have a finer textured subsoil than Meadowville soils. They are more poorly drained than Elioak and Nason soils.

Lignum silt loam, 0 to 2 percent slopes (LgA).—This soil has the profile described as representative of the Lignum series.

Included with this soil in mapping were small areas of Elbert and Worsham soils. Also included were small areas of Alluvial land, wet.

This soil has a seasonal high water table at a depth of 1 to 2 feet. Artificial drainage is needed if this soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops except alfalfa. Alfalfa grown on this soil commonly is short lived because wetness is excessive in winter and in spring. Capability unit IIIw–1; woodland suitability group 2.

Lignum silt loam, 2 to 6 percent slopes (LgB).—In places the surface layer of this soil is slightly thinner than that in the profile described as representative of the Lignum series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of Colfax, Meadowville, Orange, and Worsham soils.

Runoff is slow to medium on this soil, and erosion is a severe hazard if the soil is clean tilled or exposed. This soil has a seasonal high water table at a depth of 1 to 2 feet, and artificial drainage is beneficial if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. Alfalfa grown on this soil commonly is short lived because wetness is excessive in winter and in spring. Capability unit IIIe–4; woodland suitability group 2.

Manor Series

The Manor series consists of deep, well-drained to somewhat excessively drained, sloping to steep soils on uplands. These soils formed in material weathered from micaceous schist. The native vegetation is largely oaks and hickory. Yellow-poplar is on the lower slopes. Most areas of these soils are wooded.

In a representative profile the surface layer is brown silt loam about 4 inches thick. The subsoil is yellowish-red silt loam about 19 inches thick. The substratum begins at a depth of 23 inches and extends to a depth of 60 inches or more. It is yellowish-red and strong-brown, very strongly weathered micaceous schist that is vertically oriented.

Manor soils are very strongly acid and are low in organic-matter content and natural fertility. Permeability is moderately rapid in the subsoil, and available moisture capacity is moderate.

Representative profile of Manor silt loam, 15 to 35 percent slopes, 200 yards south of Route 615, one-fourth mile southwest of Route 614, in eastern Stafford County:

O1—2 inches to 0, dark grayish-brown, partly decayed oak leaves, twigs, and fine roots.

A1—0 to 4 inches, brown (7.5YR 4/4) silt loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine and medium roots; very strongly acid; clear, smooth boundary.

B1—4 to 8 inches, yellowish-red (5YR 5/6) silt loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine and medium roots; common fine pores; a few, fine, very strongly weathered pieces of mica schist that crush easily into silt loam; very strongly acid; clear, smooth boundary.

B2—8 to 23 inches, yellowish-red (5YR 5/6) silt loam; weak, medium, subangular blocky structure; very friable, slightly sticky and slightly plastic; common fine and medium roots; a few fine pores; common to many fine and medium pieces of strongly weathered mica schist that crush easily into silt loam; very strongly acid; gradual, irregular boundary.

C—23 to 60 inches, very strongly weathered, yellowish-red (5YR 5/6) and strong-brown (7.5YR 5/8) mica schist; vertically oriented; very strongly acid.

The solum ranges from 20 to 24 inches in thickness. Depth to hard rock is more than 5 feet. Small fragments of strongly weathered schist occur throughout the solum, and range from about 5 percent in the B1 horizon to 30 percent in the Bt horizon. These fragments are very soft and crush easily into silt loam. The A horizon has hues of 7.5YR and 10YR, values of 4 and 5, and chromas of 2 to 4. It is commonly silt loam, but ranges to loam. The B horizon has hues of 5YR and 7.5YR, values of 4 and 5, and chromas of 6 to 8. It commonly is silt loam, but ranges to loam.

Manor soils commonly occur near Elioak, Nason, and Watt soils. Manor soils have a coarser textured profile than Elioak and Nason soils. They contain fewer coarse fragments than Watt soils.

Manor silt loam, 6 to 15 percent slopes (MaD)—.This soil is somewhat droughty during the growing season.

Included with this soil in mapping were small areas of Elioak and Nason soils. Also included were a few small areas of similar soils that have angular quartz fragments on the surface and throughout the profile, and small areas of soils that have bedrock at a depth of 2 to 4 feet.

Runoff on this soil is medium to rapid. Erosion is a severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it has a limited suitability for most locally grown crops. Capability unit IVe-3; woodland suitability group 7.

Manor silt loam, 15 to 35 percent slopes (MaE).—This soil has the profile described as representative of the Manor series.

Included with this soil in mapping were small areas of Ashlar and Watt soils. Also included were a few small areas of similar soils that have angular quartz fragments on the surface and throughout the profile, and small areas of a soil that has bedrock at a depth of 1 to 4 feet. In a few places rock outcrops occur on the lower slopes.

Runoff is rapid on this soil, and erosion is a severe hazard if the soil is exposed. This soil is droughty during the growing season. It is suited to pasture and woodland. Capability unit VIe-2; woodland suitability group 7.

Marr Series

The Marr series consists of deep, well-drained, gently sloping to steep soils on uplands. These soils formed in Coastal Plain sediment. The native vegetation is largely a mixture of oaks, hickory, yellow-poplar, and beech, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. The areas of Marr soils are used for general farming and for woodland.

In a representative profile the surface layer is very fine sandy loam about 12 inches thick. The upper 4 inches is dark brown, and the lower 8 inches is light yellowish brown. The subsoil is about 24 inches thick. The upper 15 inches is strong-brown, firm sandy clay loam. The lower 9 inches is strong-brown, friable light sandy clay loam. The substratum begins at a depth of 36 inches and continues to a depth of 72 inches or more. It is brownish-yellow loamy very fine sand.

Marr soils have a strongly acid to very strongly acid subsoil. They are low in organic-matter content and natural fertility. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Marr very fine sandy loam, 2 to 6 percent slopes, located 20 yards west of Route 600, one-half mile north of Route 218, in western King George County:

A1—0 to 4 inches, dark-brown (10YR 3/3) very fine sandy loam; moderate, fine, granular structure; very friable, nonsticky and nonplastic; many fine, medium, and coarse roots; strongly acid; clear, smooth boundary.

A2—4 to 12 inches, light yellowish-brown (10YR 6/4) very fine sandy loam; weak, fine, granular structure; very friable, nonsticky and nonplastic; many fine, medium, and coarse roots; common fine pores; strongly acid; clear, smooth boundary.

B21t—12 to 27 inches, strong-brown (7.5YR 5/6) sandy clay loam; moderate, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine, medium, and coarse roots; common fine pores; thin, patchy clay films; strongly acid; clear, smooth boundary.

B22t—27 to 36 inches, strong-brown (7.5YR 5/8) light sandy clay loam; weak, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; a few fine, medium, and coarse roots; a few fine pores; a few, thin, patchy clay films; very strongly acid; gradual, smooth boundary.

C—36 to 72 inches, brownish-yellow (10YR 6/8) loamy very fine sand; single grain; very friable, nonsticky and nonplastic; very strongly acid.

The solum ranges from 30 to 40 inches in thickness. The Bt horizon has hues of 7.5YR, values of 5, and chromas of 6 to 8. It commonly is sandy clay loam. The C horizon is brownish yellow, light yellowish brown, and strong brown. Thin strata of silt occur in a few areas.

Marr soils commonly are near the Caroline, Kempsville, and Westphalia soils. Marr soils are coarser textured in the solum and have a thinner solum than the Caroline soils. They have a thinner solum and a much higher content of very fine sand than Kempsville soils. They have a finer textured subsoil than Westphalia soils.

Marr very fine sandy loam, 2 to 6 percent slopes (MdB).—This soil is on ridges. It has the profile described as representative of the Marr series.

Included with this soil in mapping were small areas of Caroline and Westphalia soils.

Runoff on this soil is medium, and erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIe-2; woodland suitability group 10.

Marr very fine sandy loam, 6 to 10 percent slopes, eroded (MdC2).—The surface layer of this soil commonly is 6 to 8 inches thick, but it ranges from 4 to 10 inches in a few places. The profile otherwise is similar to the one described as representative of the Marr series.

Included with this soil in mapping were small areas of Caroline and Westphalia soils. Also included were small areas of similar soils that have 15 to 30 percent fine pebbles in the surface layer and the subsoil.

Runoff on this soil is medium. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe-2; woodland suitability group 10.

Marr very fine sandy loam, 10 to 15 percent slopes, eroded (MdD2).—The surface layer of this soil commonly is 5 to 7 inches thick, but it ranges from 4 to 8 inches in a few places. The profile is otherwise similar to the one described as representative of the Marr series.

Included with this soil in mapping were small areas of Caroline and Westphalia soils and some small gullied areas. Also included were small areas of similar soils that have 15 to 30 percent fine pebbles in the surface layer and the subsoil.

Runoff on this soil is medium to rapid. Further erosion is a very severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a

very severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe-1; woodland suitability group 10.

Marr very fine sandy loam, 15 to 30 percent slopes, eroded (MdE2).—The surface layer of this soil commonly is 4 to 6 inches thick, but it is as much as 8 inches in a few places. The profile otherwise is similar to the one described as representative of the Marr series.

Included with this soil in mapping were small areas of Galestown, Sassafras, and Westphalia soils, and some small gullied areas. Also included were small areas of similar soils that have 20 to 35 percent fine pebbles in the surface layer and the subsoil.

Runoff on this soil is rapid. Further erosion is a severe hazard if the soil is exposed. Some areas of this soil are unstable. The soil is better suited to pasture and woodland than to row crops. Capability unit VIe-1; woodland suitability group 10.

Meadowville Series

The Meadowville series consists of deep, well drained to moderately well drained, nearly level to very gently sloping soils. These soils formed in local alluvium washed from upland soils underlain by gneiss, schist, and fine-grained basic rock. The native vegetation is mainly oak, hickory, and gum, but stands of Virginia pine grow on farmlands that are reverting to woodland. The areas of Meadowville soils are used for general farming and for woodland.

In a representative profile the surface layer is silt loam about 13 inches thick. The upper 5 inches is dark-brown and the lower 8 inches is brown. The subsoil is 37 inches thick. The upper part is brown, friable light silty clay loam about 7 inches thick, and the middle part is yellowish-red, friable silty clay loam about 12 inches thick. The lower part is yellowish-red, very friable gravelly sandy clay loam, about 18 inches thick, that is mottled with strong brown. The substratum begins at a depth of 50 inches and extends to a depth of 86 inches or more. It is very friable fine sandy loam that is mottled with strong brown, yellowish red, and dark red.

Meadowville soils are medium acid to strongly acid throughout the profile. They are low in natural fertility and moderate in organic-matter content. Permeability is moderate in the subsoil, and available moisture capacity is high. The seasonal high water table is at a depth of 3 to 5 feet.

Representative profile of Meadowville silt loam, 50 yards north of Route 610, 1 mile northwest of Ruby Post Office, in northwestern Stafford County:

A11—0 to 5 inches, dark-brown (7.5YR 4/4) silt loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine roots; many fine flakes of mica; medium acid; clear, smooth boundary.

A12—5 to 13 inches, brown (7.5YR 4/4) silt loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; a few fine pores; many fine flakes of mica; strongly acid; clear, smooth boundary.

B21t—13 to 20 inches, brown (7.5YR 4/4) light silty clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; a few fine pores; a few, thin, patchy clay films; many fine flakes of mica; strongly acid; clear, smooth boundary.

B22t—20 to 32 inches, yellowish-red (5YR 5/6) silty clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and plastic; a few fine roots; a few fine pores; a few, thin, patchy clay films on ped surfaces; many fine flakes of mica; medium acid; clear, smooth boundary.

IIB23t—32 to 50 inches, yellowish-red (5YR 4/8) gravelly sandy clay loam; a few, fine, faint, strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure; very friable, slightly sticky and slightly plastic; a few fine roots; a few, fine, tubular pores; many fine flakes of mica; a few, thin, patchy clay films; medium acid; clear, smooth boundary.

IIIC—50 to 86 inches, mottled strong-brown (7.5YR 5/8), yellowish-red (5YR 4/8), and dark-red (10R 3/6) fine sandy loam; rock-controlled structure; very friable, nonsticky and nonplastic; many fine flakes of mica; medium acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 5 feet. The A horizon has hues of 7.5YR, values of 4 and 5, and chromas of 4 to 8. The Bt horizon commonly is silty clay loam, but it ranges to clay loam and gravelly sandy clay loam. The C horizon ranges from fine sandy loam to silt loam.

Meadowville soils commonly are near Cullen, Elioak, and Nason soils. They are coarser textured throughout the profile than any of these soils.

Meadowville silt loam (Me).—This is the only Meadowville soil mapped in the survey area. Slopes are dominantly 0 to 4 percent.

Included with this soil in mapping were small areas of soils that are similar to this soil, but they are redder throughout the profile. Also included were small areas where the subsoil is mottled with gray.

Small seeps occur where areas of this soil adjoin areas of soils that occupy higher positions. Artificial drainage is beneficial if this soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most of the locally grown crops. Capability unit IIw-2; woodland suitability group 1.

Mecklenburg Series

In the Mecklenburg series are deep, well-drained, gently sloping to sloping soils on uplands. These soils formed in material weathered from basic rocks. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Most areas of Mecklenburg soils are used for general farming and for woodland.

In a representative profile the plow layer is dark yellowish-brown loam about 8 inches thick. The subsoil is about 25 inches thick. The upper 7 inches is yellowish-red, firm heavy clay loam. The lower 18 inches is yellowish-red, firm clay. The substratum begins at a depth of 33 inches and extends to a depth of 86 inches or more. It is strong-brown and yellowish-brown, very strongly weathered, soft basic rock.

Mecklenburg soils have a medium acid to slightly acid subsoil. They are moderate in natural fertility and organic-matter content. Permeability is slow in the subsoil, and available moisture capacity is moderate.

460-460—74——4

Representative profile of Mecklenburg loam, 2 to 6 percent slopes, eroded, 10 yards north of Route 610, opposite Route 643, in northwestern Stafford County:

Ap—0 to 8 inches, dark yellowish-brown (10YR 4/4) loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; common fine roots; a few, fine, angular pieces of white and brown quartz; slightly acid; clear, smooth boundary.

B1t—8 to 15 inches, yellowish-red (5YR 4/8) heavy clay loam; moderate, fine, subangular blocky structure; firm, sticky and plastic; common fine roots; a few fine pores; thin patchy clay films; many, fine, black and brown concretions; a few, fine, angular pieces of white and brown quartz; slightly acid; clear, smooth boundary.

B21t—15 to 22 inches, yellowish-red (5YR 4/8) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; common fine roots; common fine pores; thin continuous clay films; a few, fine, angular pieces of white and brown quartz; medium acid; clear, smooth boundary.

B22t—22 to 33 inches, yellowish-red (5YR 4/8) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; a few fine roots; common fine pores; thin, continuous, strong-brown (7.5YR 5/6) clay films; a few, fine, angular pieces of white and brown quartz; medium acid; gradual, smooth boundary.

C—33 to 86 inches, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/8) very strongly weathered, highly fractured, soft basic rock; slightly acid to neutral; silt loam texture; thin and moderately thick strong-brown clay flows in seams and cracks in the upper 24 inches of horizon; thin seams of weathered quartz.

The solum ranges from 26 to 38 inches in thickness. In many places angular quartz fragments make up less than 1 percent to 5 percent, by volume, of the solum. Depth to hard rock is more than 5 feet. The A horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 3 and 4. It commonly is loam, but it is clay loam in severely eroded areas. The Bt horizon has hues of 5YR, values of 4 and 5, and chromas of 6 to 8.

Mecklenburg soils occur near Cullen, Elioak, and Nason soils. Mecklenburg soils are less acid than Cullen soils. They are less acid than and they lack the mica content of the Elioak and Nason soils.

The Mecklenburg soils in this survey area are less acid in the subsoil and have yellower hues in the A horizon than the Mecklenburg soils in other survey areas. This, however, does not alter their usefulness or management.

Mecklenburg loam, 2 to 6 percent slopes, eroded (MkB2).—This soil is on ridges. It has the profile described as representative of the Mecklenburg series.

Included with this soil in mapping were small areas of Elioak, Nason, and Zion soils.

Runoff is medium on this soil. Further erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIe-3; woodland suitability group 3.

Mecklenburg loam, 6 to 10 percent slopes, eroded (MkC2).—This soil is on the sides of narrow ridges.

Included with this soil in mapping were small areas of Appling, Nason, and Zion soils. Also included were small areas of severely eroded soils that have a clay loam surface layer.

Runoff is medium on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe-3; woodland suitability group 3.

Mecklenburg clay loam, 6 to 10 percent slopes, severely eroded (MlC3).—The surface layer of this soil is a mixture of material from the remaining surface layer and the subsoil. Also, in places the profile is thinner than that described as representatives of the series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of eroded Appling, Nason, and Zion soils, and a few small gullied areas.

Runoff is rapid on this soil. Further erosion is a very severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a very severe hazard, this soil is best suited to close growing crops, pasture, and woodland than to row crops. Capability unit IVe-2; woodland suitability group 11.

Nason Series

The Nason series consists of deep, well-drained, gently sloping to strongly sloping soils on the Piedmont uplands. These soils formed in material weathered from micaceous schist (fig. 3). The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Large areas of these soils are wooded.

In a representative profile the surface layer is brown silt loam about 5 inches thick. The subsoil is about 35 inches thick. The upper 4 inches is strong-brown, friable silty clay loam. The lower 31 inches is yellowish-red, firm clay. The substratum begins at a depth of 40 inches and extends to a depth of 60 inches or more. It is made up of very strongly weathered schist that crushes to silt loam, and it is mottled with reddish yellow, yellowish red, and red.

Nason soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Nason silt loam, 2 to 6 percent slopes, 20 yards north of Route 610, 500 yards east of county line, in northwestern Stafford County:

O1—2 inches to 0, very dark brown, decomposed leaves, twigs, and fine roots.

Ap—0 to 5 inches, brown (10YR 5/3) silt loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; common fine coarse fragments; many fine flakes of mica; strongly acid; clear, smooth boundary.

B1t—5 to 9 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, fine, subangular blocky structure; friable, slightly sticky and plastic; common fine roots; a few fine pores; a few, thin, patchy clay films; common fine and coarse fragments; many fine flakes of mica; very strongly acid; clear, smooth boundary.

B21t—9 to 20 inches, yellowish-red (5YR 4/6) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; common fine roots; common fine pores; thin continuous clay films; common fine and coarse fragments; many fine flakes of mica; very strongly acid; clear, smooth boundary.

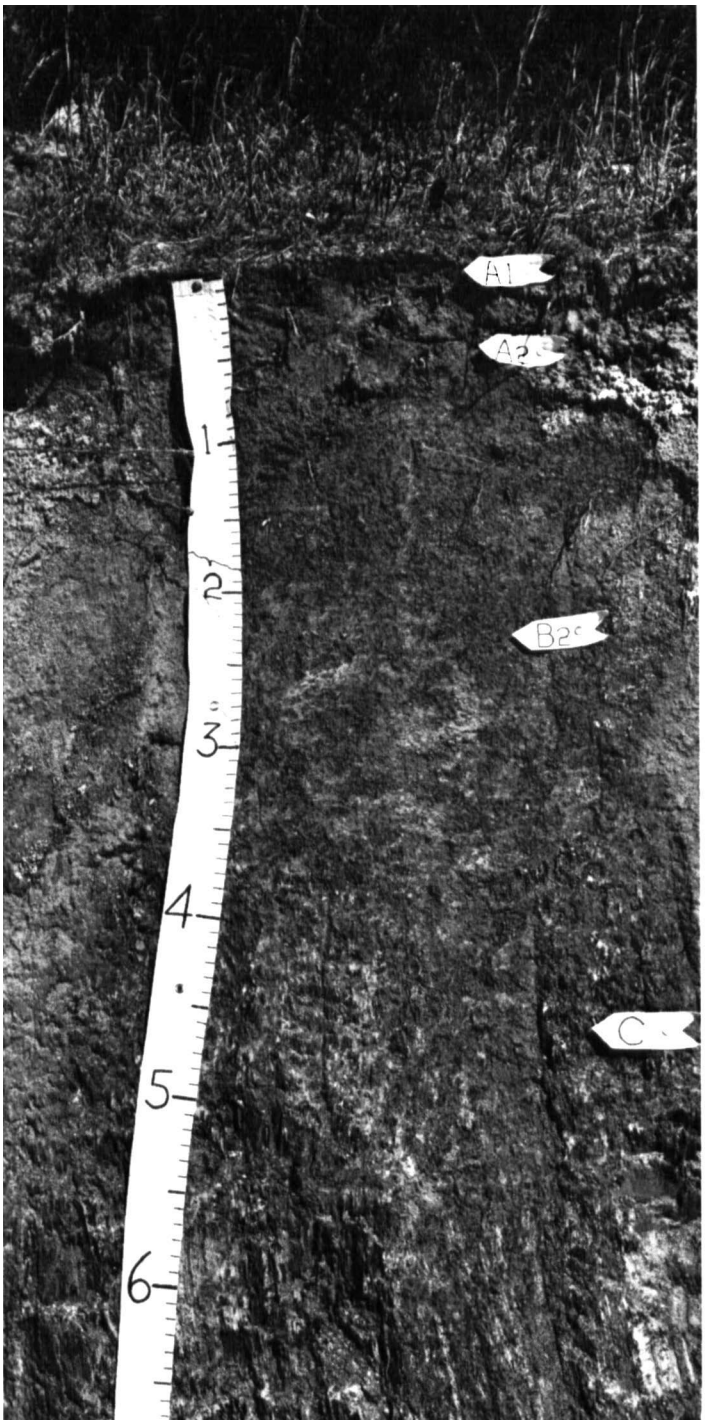

Figure 3.—**Profile of a Nason silt loam. Strongly weathered, vertically oriented schist is at a depth of about 4 feet.**

B22t—20 to 40 inches, yellowish-red (5YR 4/6) clay; strong, fine, angular blocky structure; firm, sticky and plastic; a few fine roots; a few fine pores; moderately thick continuous clay films; common fine and coarse fragments; many fine flakes of mica; strongly acid; gradual, wavy boundary.

C—40 to 60 inches, mottled reddish-yellow (7.5YR 6/6), yellowish-red (5YR 4/6), and red (10R 4/8) silt loam; rock-controlled structure; friable, slightly sticky and slightly plastic; common fine pebbles; many fine flakes of mica; horizon composed of strongly weathered schist; very strongly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is more than 5 feet. In many places angular quartz fragments make up about 1 to 10 percent, by volume, of the solum. The A horizon has hues of 10YR and 7.5YR, values of 4 and 5, and chromas of 2 to 4. It is commonly silt loam and ranges to loam, but it is silty clay loam in severely eroded areas. The Bt horizon has hues of 7.5YR and 5YR, values of 4 and 5, and chromas of 6 to 8.

Nason soils commonly are near Elioak, Lignum, Manor, and Mecklenburg soils. Nason soils are better drained than Lignum soils. They have a finer textured subsoil than Manor soils and are more acid than Mecklenburg soils. Nason soils have a thinner solum than Elioak soils.

Nason silt loam, 2 to 6 percent slopes (NaB).—This soil is on ridges. Its surface layer generally is about 5 inches thick, but in places it is as much as 9 inches thick. The profile otherwise is similar to that of the soil described as representative of the Nason series.

Included with this soil in mapping were small areas of Appling and Mecklenburg soils. Also included were small areas of a soil that is made up of 20 to 50 percent angular quartz pebbles.

Runoff is medium on this soil, and erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIe-1; woodland suitability group 4.

Nason silt loam, 6 to 15 percent slopes, eroded (NaC2).—This soil has a profile similar to the one described as representative of the Nason series, except that its surface layer is stickier.

Included with this soil in mapping were small areas of Appling, Manor, and Mecklenburg soils, and small areas where bedrock is at a depth of about 4 feet. Also included are small areas of a soil made up of 20 to 50 percent angular quartz pebbles.

Runoff is medium to rapid on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe-1; woodland suitability group 4.

Nason silty clay loam, 6 to 10 percent slopes, severely eroded (NcC3).—This soil is on the sides of narrow ridges. The surface layer is a mixture of material from the remaining surface layer and the subsoil. Also, in places the profile is thinner than that of the soil described as representative of the Nason series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of eroded Appling and Mecklenburg soils, some small gullied areas, and small areas of a soil made up of 20 to 50 percent angular quartz fragments.

Runoff is rapid on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe-2; woodland suitability group 11.

Orange Series

The Orange series consists of deep, somewhat poorly drained to moderately well drained, nearly level to sloping soils on the Piedmont plateau. These soils formed in material weathered from basic gneiss, schist, and felsites. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. The acreage of these soils is used for general farming and as woodland.

In a representative profile the surface layer is loam about 14 inches thick. The upper 8 inches is dark grayish brown and the lower 6 inches is light olive brown. The subsoil is 25 inches thick. The upper 7 inches is brown clay loam that is mottled with light gray and strong brown. The next 18 inches is yellowish-brown, very firm clay that is mottled with light brownish gray, gray, and strong brown. The substratum begins at a depth of about 39 inches and extends to a depth of 72 inches. It is firm silty clay loam that is mottled with light olive gray and strong brown. Weathered basic rock is at a depth of about 72 inches.

Orange soils are medium acid to strongly acid in the surface layer and in the subsoil, but in places they are neutral in the substratum. They are low in organic-matter content and moderate in natural fertility. Permeability is slow in the subsoil, and available moisture capacity is moderate. The seasonal high water table is at a depth of 2 to 3 feet, and it persists for significant lengths of time.

Representative profile of Orange loam, 0 to 2 percent slopes, 50 yards northwest of the junction of Routes 650 and 651, in west-central Stafford County:

Ap—0 to 8 inches, dark grayish-brown (2.5Y 4/2) loam; moderate, fine granular structure; friable, slightly sticky and slightly plastic; many fine roots; a few, fine, angular quartz fragments; medium acid; clear, smooth boundary.

A2—8 to 14 inches, light olive-brown (2.5Y 5/4) loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; common fine and medium pores, a few, fine, angular quartz fragments; strongly acid; clear, smooth boundary.

B21t—14 to 21 inches, brown (10YR 5/3) clay loam; common, fine, distinct, light-gray (10YR 7/1) and strong-brown (7.5YR 5/6) mottles; weak to moderate, medium, subangular blocky structure; friable, sticky and plastic; a few fine roots; common fine pores; thin, patchy, light olive-brown (2.5Y 5/4) clay films; a few, fine, angular quartz fragments; strongly acid; clear, wavy boundary.

B22t—21 to 30 inches, yellowish-brown (10YR 5/8) clay; a few, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; strong, fine, angular blocky structure; very firm, very sticky and very plastic; a few fine roots; a few fine pores; thin, continuous clay films; common, fine and medium slickensides; a few, fine, angular quartz fragments; strongly acid; clear, wavy boundary.

B23t—30 to 39 inches, yellowish-brown (10YR 5/4) clay; common, coarse, distinct, gray (10YR 6/1) mottles and a few, medium, distinct, strong-brown (7.5YR 5/8 mottles; strong, fine, angular blocky structure; very firm, very sticky and very plastic; a few fine roots; a few fine pores; thin, continuous clay films; common slickensides; a few, fine, angular quartz fragments; strongly acid; clear, wavy boundary.

C—39 to 72 inches, mottled light olive-gray (5Y 6/2) and strong-brown (7.5YR 5/8) silty clay loam; rock; controlled structure; firm, sticky and plastic; a few, fine, angular quartz fragments; thin and moderately thick clay in seams and cracks in upper part of horizon; common fine fragments of strongly weathered basic rock; neutral; gradual, irregular boundary.

R—72 inches, weathered basic rock.

The solum ranges from 28 to 40 inches in thickness. Depth to bedrock ranges from 4 to 6 feet. The A horizon has hues of 2.5Y and 10YR, values of 4 to 6, and chromas of 2 to 4. The C horizon commonly is silty clay loam or silt loam that has a rock-controlled structure.

Orange soils commonly are near Cullen, Elioak, and Zion soils. They have a yellower subsoil than Cullen and Elioak soils. They are less well drained than Zion soils.

Orange loam, 0 to 2 percent slopes (OrA).—This soil is on broad ridges, in upland depressions, and around the heads of drainageways. It has the profile described as representative of the Orange series.

Included with this soil in mapping were small areas of Elbert, Meadowville, and Worsham soils.

This soil is seasonally wet and ponds during wet periods. Artificial drainage is needed if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most of the locally grown crops. Alfalfa grown on this soil is short lived because wetness is excessive in winter and in spring. Capability unit IIIw-1; woodland suitability group 9.

Orange loam, 2 to 6 percent slopes (OrB).—This soil is in broad, low-lying areas. The surface layer commonly is 6 to 8 inches thick, but ranges from 4 to 10 inches thick in a few places. The profile otherwise is similar to the one described as representative of the Orange series.

Included with this soil in mapping were small areas of Cullen, Mecklenburg, and Zion soils, and small areas of similar soils that have a gravelly fine sandy loam surface layer. Also included were spots where weathered rock is only 10 to 20 inches below the soil surface.

Runoff is slow to medium on this soil, and erosion is a severe hazard if this soil is clean tilled or exposed. This soil is seasonally wet, and artificial drainage is beneficial if it is farmed. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. Alfalfa grown on this soil is short lived because wetness is excessive in winter and in spring. Capability unit IIIe-4; woodland suitability group 9.

Orange loam, 6 to 10 percent slopes, eroded (OrC2).—The loam surface layer of this soil commonly is 5 to 8 inches thick, but it ranges from 4 to 10 inches in a few places. The profile otherwise is similar to the one described as representative of the Orange series.

Included with this soil in mapping were small areas of Mecklenburg and Zion soils, small gullied areas, and small areas of similar soils that have a clay loam surface layer. Also included were spots where weathered rock is only 6 to 12 inches below the soil surface.

Runoff is medium to rapid on this soil. Further erosion is a very severe hazard if the soil is clean tilled or exposed. This soil is seasonally wet and some seepage occurs on the lower slopes. Artificial drainage is sometimes beneficial if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for most locally grown crops. Because erosion is a severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe-2; woodland suitability group 9.

Pooler Series, Thin Solum Variant

The Pooler series, thin solum variant, consists of deep, somewhat poorly drained, nearly level soils. These soils formed in loamy and clayey Coastal Plain sediment. The native vegetation is largely a mixture of oaks, hickory, elm, maple, and gum, but a few stands of Virginia pine, loblolly pine, and gum are on farmland that is reverting to woodland. The areas of these soils are used for general farming and as woodland.

In a representative profile the plow layer is dark grayish-brown loam about 10 inches thick. The subsoil is about 34 inches thick. The upper 9 inches is light olive-brown, firm heavy clay loam. The next 9 inches is grayish-brown, firm heavy clay loam that is mottled with gray and yellowish brown. The lower 16 inches is dark-gray, firm clay that is mottled with strong brown. The substratum begins at a depth of 44 inches and extends to a depth of 108 inches or more. The upper 28 inches is olive loam that is mottled with strong brown. The lower 36 inches is gray very fine sandy loam that is mottled with strong brown and light yellowish brown.

These soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is slow in the subsoil, and available moisture capacity is moderate. The seasonal high water table is at a depth of 1 to 1½ feet in winter and in spring.

Representative profile of Pooler loam, thin solum variant, 20 yards south of Route 615, one-half mile east of Route 218, in northeastern King George County:

Ap—0 to 10 inches, dark grayish-brown (2.5Y 4/2) loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine roots; a few rounded pebbles; medium acid; clear, smooth boundary.

B1t—10 to 19 inches, light olive-brown (2.5Y 5/4) heavy clay loam; weak, medium, subangular blocky structure; firm, sticky and plastic; common fine roots; a few fine and medium pores; a few, thin, patchy clay films; some ped surfaces grayish brown (2.5Y 5/2); a few rounded pebbles; strongly acid; clear, smooth boundary.

B21t—19 to 28 inches, grayish-brown (2.5Y 5/2) heavy clay loam; common, medium, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic; common fine roots; a few fine pores; thin continuous clay films; a few rounded pebbles; very strongly acid; clear, smooth boundary.

B22t—28 to 44 inches, dark-gray (10YR 4/1) clay; common, fine, prominent, strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; firm, sticky and plastic; common fine roots oriented along ped surfaces; a few fine pores; thin continuous clay films; a few rounded pebbles; very strongly acid; clear, smooth boundary.

C1—44 to 72 inches, olive (5Y 4/3) loam; common, coarse, prominent, strong-brown (7.5YR 5/6) mottles; massive; friable, slightly sticky and slightly plastic; extremely acid; gradual, smooth boundary.

C2—72 to 108 inches, gray (10YR 5/1) very fine sandy loam; common, medium, prominent, strong-brown (7.5YR 5/6) and light yellowish-brown (2.5Y 6/4) mottles; massive; friable, slightly sticky and slightly plastic; extremely acid.

The solum ranges from 40 to 52 inches in thickness. In many places fine or medium, rounded quartz pebbles make up less than 1 percent to about 10 percent, by volume, of the solum. The A horizon has hues of 2.5Y and 10YR, values of 4 and 5, and chromas of 2 to 4. It commonly is loam, but ranges to very fine sandy loam and silt loam. The Bt horizon above 24 to 30 inches has hues of 2.5Y and 10YR, values of 4 and 5, chromas of 2 to 4. It has common to many mottles that have a chroma of 1. It is commonly clay loam or clay. The Bt horizon below 24 to 30 inches has hues of 10YR, values of 4 to 6, and chromas of 0 and 1. It has strong-brown, yellowish-brown, and grayish-brown mottles. The C horizon ranges from very fine sandy loam to clay loam and clay.

Soils of the Pooler series, thin solum variant, occur near Bertie, Bladen, Fallsington, and Tetotum soils. These variants have a more clayey subsoil than the Bertie soils. They are better drained than the Bladen soils. They have a finer textured subsoil than the Fallsington soils and are better drained. These soils are not so well drained as Tetotum soils, and they are finer textured.

Pooler loam, thin solum variant (Po).—This is the only Pooler soil mapped in the survey area. Slopes are dominantly 0 to 2 percent.

Included with this soil in mapping were small areas of Bladen and Tetotum soils.

Artificial drainage is beneficial if this soil is used for farming. In places drainage outlets are difficult to locate in areas of this soil. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops, except alfalfa. Alfalfa grown on this soil is short lived because of excessive wetness. Capability unit IIIw–1; woodland suitability group 2.

Roanoke Series

The Roanoke series consists of deep, poorly drained, nearly level soils. These soils formed in loamy and clayey alluvium, mostly on the terraces along the Rappahannock River. The native vegetation is largely a mixture of oaks, willow, elm, ash, maple, gum, and birch, but willow, gum, birch, Virginia pine, and loblolly pine are on farmland that is reverting to woodland. The acreage of Roanoke soils is used for general farming and as woodland.

In a representative profile the plow layer is dark-gray silt loam about 9 inches thick. The subsoil is about 44 inches thick. The upper 7 inches is gray firm silty clay that is mottled with yellowish brown. The next 12 inches is gray, very firm clay that is mottled with yellowish brown. The lower 25 inches is gray, very firm clay that is mottled with light olive brown. The substratum begins at a depth of 53 inches and extends to a depth of 116 inches or more. The upper 37 inches is grayish-brown, friable fine sandy loam that is mottled with yellowish brown. The lower 26 inches is gray sand and fine sand.

Roanoke soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and moderate in organic-matter content. Permeability is slow in the subsoil, and available moisture capacity is moderate. The seasonal high water table is at the surface or at a depth of 1 foot in winter and in spring.

Representative profile of Roanoke silt loam, 200 yards southeast of Route 692, 1 mile southwest of Route 607, in southern King George County:

Ap—0 to 9 inches, dark-gray (10YR 4/1) silt loam; strong, fine, granular structure; friable, slightly sticky and slightly plastic; common fine roots; a few fine flakes of mica; medium acid; clear, smooth boundary.

B1tg—9 to 16 inches, gray (10YR 5/1) silty clay; few, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic; a few fine roots; a few fine pores; common fine flakes of mica; a few, thin, patchy clay films; strongly acid; clear, smooth boundary.

B21tg—16 to 28 inches, gray (10YR 5/1) clay; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; strong, medium, angular blocky structure; very firm, sticky and plastic; a few fine roots; common fine pores; common fine flakes of mica; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22tg—28 to 53 inches, gray (5Y 6/1) clay; common, medium, distinct, light olive-brown (2.5Y 5/4) mottles; moderate, coarse, prismatic structure that breaks readily into moderate, coarse, angular blocky structure; very firm, sticky and plastic; a few fine roots; a few fine pores; common fine flakes of mica; thin continuous clay films; very strongly acid; clear, smooth boundary.

IIC1g—53 to 90 inches, grayish-brown (2.5Y 5/2) fine sandy loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; massive; friable, slightly sticky and slightly plastic; common fine flakes of mica; lenses of gray clay throughout horizon; very strongly acid; gradual, smooth boundary.

IIC2g—90 to 116 inches, gray sand and fine sand; very strongly acid.

The solum ranges from 44 to 58 inches in thickness. The A horizon has hues of 10YR and 2.5Y, values of 4 and 5, and chromas of 1 and 2. It commonly is silt loam, but ranges to loam. The Bt horizon has hues of 10YR, 2.5Y, and 5Y, values of 4 to 6, and chromas of 1. It commonly is clay, but ranges to silty clay, sandy clay, and heavy clay loam. The C horizon is gravelly in places, and thin strata of loamy and clayey material are common.

Roanoke soils commonly are near Altavista, Augusta, Wahee, and Wickham soils. Roanoke soils have a finer textured subsoil and are more poorly drained than the Wickham, Altavista, and Augusta soils. They are more poorly drained than the Wahee soils.

Roanoke silt loam (Ro).—This is the only Roanoke soil mapped in the survey area. It is on terraces, and slopes are 0 to 2 percent.

Included with this soil in mapping were small areas of Altavista, Wahee, and Wehadkee soils. Also included were small areas of similar soils that have a loam and fine sandy loam surface layer.

This soil is seasonally wet, and it ponds when wet. Artificial drainage is needed if this soil is used for farming, but drainage outlets are difficult to locate. If this soil is adequately drained, limed, and fertilized, it has a limited suitability for some locally grown crops. Roanoke silt loam is not well suited to alfalfa, because it is excessively wet. Capability unit IVw–1; woodland suitability group 5.

Sand and Gravel Pits

Sand and gravel pits (Sa) consist of open excavations from which sand and gravel are mined, and of dumps containing waste materials. These pits generally are in the Coastal Plain and range from less than 1 acre to over 50 acres in size. Many large pits are along the Rappahannock River and along the lower reaches of the larger streams of the area. These pits are, or have been, used as a source of sand and gravel for commercial purposes and as a source of road fill and subgrade for road construction. A few small pits south of lower Potomac Creek are sources of moulding sand.

Included with sand and gravel pits in mapping were several small abandoned sandstone mines that were formerly used to mine Aquia sandstone for building purposes. These mines are along Austin Run and Aquia Creek to the northwest, northeast, and east of Stafford Courthouse, in Stafford County. Also included were several small sanitary land fills in the Coastal Plain and several small stone quarries in the Piedmont. These sanitary land fills and stone quarries are in use.

The soil material of the miscellaneous land type generally is coarse, and that of the included stone quarries generally is fine. Runoff is slow, and permeability is moderately rapid to rapid. Abandoned areas generally are stable, and they commonly have a thin cover of weeds, brush, and small trees. Thin grass grows where the material is fine textured. These areas have an irregular surface, and in places they contain pools of water. In other places small pits are filled with water. Capability unit VIIs–1; woodland suitability group 13.

Sandy and Clayey Land, Steep, Sassafras and Caroline Materials

Sandy and clayey land, steep, Sassafras and Caroline materials (ScF) is along the larger, more deeply incised drainageways in northeastern Stafford County and northern King George County. It consists of interbedded sandy, clayey, and, in places, gravelly materials. The surface layer ranges from loamy sand to clay loam, and generally is grayish brown, yellowish brown, or yellowish red. In places this layer contains gravel. The underlying material ranges from yellowish-brown, grayish-brown, and yellowish-red sand and gravelly sand to red, yellowish-red, yellowish-brown, and gray clay. Shell beds occur in places. Included with this unit in mapping were small areas of soils that are similar to Aura, Caroline, and Sassafras soils.

This miscellaneous land type is better suited to permanent grasses and trees than to other crops. Capability unit VIIe–1; woodland suitability group 10.

Sassafras Series

The Sassafras series consists of deep, well-drained, nearly level to steep soils. These soils formed in sandy and loamy Coastal Plain sediment. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Sassafras soils are mapped alone and also in a complex with Aura, Caroline, and Galestown soils. The areas of Sassafras soils are used for farming, as homesites, and for subdivision developments.

In a representative profile the plow layer is dark brown fine sandy loam about 9 inches thick. The subsoil is about 29 inches thick. The upper 5 inches is brown, friable fine sandy loam. The next 18 inches is brown, friable sandy clay loam. The lower 6 inches is strong-brown, very friable loamy fine sand. The substratum begins at a depth of 38 inches and extends to a depth of 112 inches or more. It is light yellowish-brown and strong-brown fine sand and loamy fine sand.

Sassafras soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is moderate in the subsoil, and available moisture capacity is moderate.

Representative profile of Sassafras fine sandy loam, 0 to 2 percent slopes, in the northwest corner of the junction of Route 206 and Route 610, in central King George County:

Ap—0 to 9 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine and medium roots; a few, fine, rounded pebbles; strongly acid; clear, smooth boundary.

B1—9 to 14 inches, brown (7.5YR 4/4) fine sandy loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; common fine pores; a few, fine, rounded pebbles; strongly acid; clear, smooth boundary.

B21t—14 to 24 inches, brown (7.5YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; a few fine pores; a few, thin, patchy clay films; a few, fine, rounded pebbles; very strongly acid; clear, smooth boundary.

B22t—24 to 32 inches, brown (7.5YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; a few fine pores; a few, thin, patchy clay films; a few, fine, rounded pebbles; very strongly acid; gradual, smooth boundary.

B3—32 to 38 inches, strong-brown (7.5YR 5/6) loamy fine sand; very weak, coarse, subangular blocky structure; very friable, nonsticky and nonplastic; a few fine roots; a few, fine, rounded pebbles; very strongly acid; gradual, smooth boundary.

C—38 to 112 inches, light yellowish-brown (10YR 6/4) and strong-brown (7.5YR 5/6) fine sand and loamy fine sand; single grain; very friable, nonsticky and nonplastic; very strongly acid.

The solum ranges from 30 to 40 inches in thickness. In many places fine, rounded quartz pebbles make up less than 1 percent to about 5 percent, by volume, of the solum. The A horizon has hues of 10YR, values of 4 to 6, and chromas of 3 and 4. It commonly is fine sandy loam, but ranges to sandy loam. The Bt horizon has hues of 7.5YR and 5YR, values of 4 and 5, and chromas of 4 to 8. It commonly is sandy clay loam, but ranges to heavy loam. The C horizon ranges from fine sand to fine sandy loam and fine gravel.

Sassafras soils are near Bourne, Galestown, Kempsville, and Woodstown soils. They lack the fragipan of the Bourne soils and are finer textured and not so excessively drained as the Galestown soils. Sassafras soils have a thinner solum than Kempsville soils, and they lack the somewhat compact lower subsoil of those soils. Sassafras soils are better drained than Woodstown soils.

Sassafras fine sandy loam, 0 to 2 percent slopes (SfA).—This soil is on broad ridges. It has the profile described as representative of the Sassafras series.

Included with this soil in mapping were small areas of Bourne and Kempsville soils. Also included were small areas of soils that are similar to this soil but that have oyster shells mixed in the surface layer.

If this soil is adequately limed and fertilized, it is well suited to locally grown crops. Capability unit I–1; woodland suitability group 4.

Sassafras fine sandy loam, 2 to 6 percent slopes (SfB).—This soil is on broad ridges.

Included with this soil in mapping were small areas of Bourne, Caroline, and Kempsville soils. Also included were small areas of soils that are similar to this soil but that have oyster shells mixed in the surface layer.

Runoff is medium on this soil, and erosion is a moderate hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe–2; woodland suitability group 4.

Sassafras fine sandy loam, 6 to 10 percent slopes, eroded (SfC2).—This soil is on the sides of narrow ridges. Its surface layer commonly is 5 to 7 inches thick, but it ranges from 4 to 8 inches in some places. The profile otherwise is similar to the one described as representative of the Sassafras series.

Included with this soil in mapping were small areas of Bourne, Caroline, Galestown, and Kempsville soils. Also included were a few small areas of severely eroded soils that have a sandy clay loam surface layer, and a few small areas of gravelly soil.

Runoff is medium on this soil. Further erosion is a severe hazard if this soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–2; woodland suitability group 4.

Sassafras fine sandy loam, 10 to 15 percent slopes, eroded (SfD2).—The surface layer of this soil commonly is 4 to 6 inches thick, but it is as much as 8 inches thick in a few places. The profile otherwise is similar to the one described as representative of the Sassafras series.

Included with this soil in mapping were small areas of Aura, Caroline, and Kempsville soils. Also included were spots of severely eroded soils that have a sandy clay loam surface layer and small areas of gravelly soils.

Runoff is medium to rapid on this soil. Further erosion is a very severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because erosion is a very severe hazard, this soil is better suited to close-growing crops, pasture, and woodland than to row crops. Capability unit IVe–1; woodland suitability group 4.

Sassafras fine sandy loam, 15 to 35 percent slopes, eroded (SfE2).—The surface layer of this soil commonly is 4 to 6 inches thick, and in places the solum is thinner than that in the profile described as representative of the Sassafras series. The two profiles otherwise are similar.

Included with this soil in mapping were small areas of Aura and Galestown soils, small areas of gravelly soils, and a few small gullied areas. Also included were small spots of severely eroded soils that have a sandy clay loam surface layer.

Runoff is rapid on this soil. Further erosion is a severe hazard if the soil is exposed. It is better suited to pasture and to woodland than to other crops. Capability unit VIe–1; woodland suitability group 4.

State Series

The State series consists of deep, well-drained, nearly level to very gently sloping soils. These soils formed in local alluvium washed from surrounding upland soils

that are underlain by granite and gneiss. These soils occur in upland depressions and along the heads of drainageways in Stafford County. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. The areas of State soils are used for general farming and as woodland.

In a representative profile the surface layer is dark-brown fine sandy loam about 8 inches thick. The subsoil is about 42 inches thick. The upper 5 inches is brown, very friable fine sandy loam. The next 17 inches is brown, friable clay loam. The lower 20 inches is strong-brown, friable loam. The substratum begins at a depth of 50 inches and extends to a depth of 110 inches or more. It is friable fine sandy loam that is yellowish red and strong brown.

State soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. Permeability is moderately rapid, and available moisture capacity is moderate.

Representative profile of State fine sandy loam, local alluvium, 100 yards west of the Basic School on the U.S. Marine Corps Reservation, in northern Stafford County:

Ap—0 to 8 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable, nonsticky and nonplastic; many fine roots; strongly acid; clear, smooth boundary.

B1—8 to 13 inches, brown (10YR 4/3) fine sandy loam; weak, medium, subangular blocky structure; very friable, slightly sticky and slightly plastic; common fine and medium roots; a few fine pores; a few fine flakes of mica; strongly acid; clear, smooth boundary.

B2t—13 to 30 inches, brown (7.5YR 4/4) clay loam; weak, medium, subangular blocky structure; friable, sticky and plastic; a few fine and medium roots; common fine pores; a few fine flakes of mica; a few, thin, patchy clay films; very strongly acid; gradual, smooth boundary.

B3—30 to 50 inches, strong-brown (7.5YR 5/8) loam; weak, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; a few fine roots; a few fine pores; a few fine flakes of mica; common fine pockets of black concretionary material; very strongly acid; clear, smooth boundary.

IIC—50 to 110 inches, yellowish-red (5YR 5/8) and strong-brown (7.5YR 5/6) fine sandy loam; rock-controlled structure; friable, nonsticky and nonplastic; common fine and medium pockets and seams of black concretionary material; a few fine flakes of mica; very strongly acid.

The solum ranges from 42 to 60 inches in thickness. Depth to rock is more than 5 feet. The A horizon has hues of 10YR, values of 4 and 5, and chromas of 2 to 4. The Bt horizon has hues of 7.5YR and 10YR, values of 4 and 5, and chromas of 4 to 8. It commonly is clay loam or heavy loam.

State soils are near Appling, Cecil, and Worsham soils, and Alluvial land, wet. State soils have a coarser textured solum than Appling and Cecil soils. They are better drained and have a coarser textured subsoil than Worsham soils. They are better drained and finer textured than Alluvial land, wet.

State fine sandy loam, local alluvium (Sn).—This is the only State soil mapped in the survey area. Slopes are dominantly 0 to 4 percent.

Included with this soil in mapping were a few small areas of Alluvial land, wet. Also included were small areas of similar soils that have gray mottles in the subsoil.

This soil tends to be wetter than other well-drained soils because it occupies areas that collect runoff from other soils. Small seeps occur where areas of this soil adjoin other soils on uplands. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Seasonal wetness is a limitation to use in places. Capability unit IIw–2; woodland suitability group 1.

Stony Land

Stony land consists of areas that have outcrops and boulders of Aquia sandstone. Areas of this land occur throughout the Coastal Plain in Stafford County, but they are mainly along the upper parts of Accokeek Creek and Austin Run and along the lower courses of Aquia Creek and Potomac Creek. Some of the sandstone has been quarried for cut building stone.

The sandstone in Stony land is fairly soft and weathers readily. The sand is medium grained to coarse grained, and the sandstone is fossiliferous and conglomeritic in some areas. It is underlain mainly by schist and clay to the west of Interstate 95, and mainly by clay and coarse sand to the east of Interstate 95.

Stony rolling land (StD) is sloping to strongly sloping and is on narrow ridges. Stones and boulders of Aquia sandstone cover from 20 to 70 percent of the surface. Soils in these areas are variable. They range from thin sandy loam over sandstone or clay to deep, well-drained, brown loam. The subsoil is strong-brown to yellowish-red loam and clay. The sand in most of these soils is medium grained to coarse grained. Included in mapping were small areas of Caroline and Sassafras soils.

Runoff is rapid on this mapping unit, and erosion is a very severe hazard if the vegetation is removed. Stony rolling land is better suited to trees than to other crops. Capability unit VIIs–1; woodland suitability group 13.

Stony steep land (StE) is moderately steep to steep and is on slopes along streams and drainageways. Stones, boulders, and outcrops of Aquia sandstone cover 30 to 70 percent of the surface. Sandy and loamy Coastal Plain sediment are around and between the boulders and outcrops. Included in mapping were small areas of Caroline and Sassafras soils.

Runoff is rapid on stony steep land, and erosion is a severe to very severe hazard if the vegetation is removed. Stony steep land is better suited to trees than to cultivated crops. Capability unit VIIs–1; woodland suitability group 13.

Susquehanna Series

The Susquehanna series are deep, moderately well drained to somewhat poorly drained, gently sloping to sloping soils. These soils formed in clayey Coastal Plain sediments. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine are on farmland that is reverting to woodland. Susquehanna soils are mostly wooded.

In a representative profile the surface layer is dark-brown loam about 8 inches thick. The subsoil is about 73 inches thick. The upper 14 inches is very firm clay that is mottled with dark red, reddish yellow, and brown. The next 26 inches is grayish-brown very firm clay that is mottled with red and reddish yellow. The lower 33 inches is gray, very firm clay that is mottled with strong brown. The substratum begins at a depth of 81 inches and continues to a depth of 150 inches or more. It is greenish-gray, very firm clay that is mottled with strong brown.

Susquehanna soils have a very strongly acid to extremely acid subsoil. They are low in natural fertility and organic-matter content. The subsoil is slowly permeable to very slowly permeable, and the available moisture capacity is moderate. The seasonal high water table is at a depth of 3 to 5 feet.

Representative profile of Susquehanna loam, in an area of Susquehanna soils, 2 to 10 percent slopes, south of MCS–1 on the U.S. Marine Corps Reservation, in northeastern Stafford County:

Ap—0 to 8 inches, dark-brown (7.5YR 4/4) loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; common, fine, medium, and coarse roots; strongly acid; clear, smooth boundary.

B21t—8 to 22 inches, mottled dark-red (2.5Y 3/6), reddish-yellow (5YR 6/8), and brown (7.5YR 4/4) clay; strong, very fine, angular blocky structure; very firm, very sticky and very plastic; common, fine, medium, and coarse roots; thin continuous clay films; many slickensides; very strongly acid; gradual, smooth boundary.

B22t—22 to 48 inches, grayish-brown (2.5Y 5/2) clay; many, fine, prominent, red (2.5YR 4/8) and reddish-yellow (5YR 6/8) mottles; moderate, fine, angular blocky structure; very firm, very sticky and very plastic; common fine roots; few, fine, tubular pores; thin continuous clay films; common slickensides; extremely acid; gradual, smooth boundary.

B3tg—48 to 81 inches, gray (5Y 6/1) clay; many, fine, prominent, strong-brown (7.5YR 5/8) mottles; strong, medium, angular blocky structure; very firm, sticky and plastic; common fine roots oriented along ped surfaces; common slickensides; extremely acid; gradual, smooth boundary.

Cg—81 to 150 inches, greenish-gray (5GY 5/1) clay; common, coarse, prominent, strong-brown (7.5YR 5/6) mottles; massive; very firm, sticky and plastic; common fine roots; extremely acid.

The solum is more than 60 inches thick. The A horizon has hues of 7.5YR, and 5YR, values of 4 and 5, and chromas of 2 to 4. It is loam, clay loam, and clay. The B22t horizon has hues of 2.5Y and 10YR, values of 5 and 6, and chromas of 1 and 2. The B3t and C horizons have hues of 5Y and 5GY, or are neutral, values of 4 to 6, and chromas of 0 to 2.

The Susquehanna soils in this survey area differ from the Susquehanna soils in other survey areas by being extremely acid in the lower part of the solum. This difference, however, does not alter their usefulness or management.

Susquehanna soils commonly occur near Aura and Caroline soils. They have a finer textured subsoil and are less well drained than Aura soils. They are less well drained than the Caroline soils.

Susquehanna soils, 2 to 10 percent slopes (SuC).—These soils are on the top and sides of ridges. They have the profile described as representative of the Susquehanna series. The surface layer is loam, clay loam, or clay.

Included with these soils in mapping were small areas of Aura and Caroline soils, and small areas of gravelly soils. Also included were small wet areas on lower slopes where seeps occur.

Runoff is medium to rapid on these soils. Erosion is a very severe hazard if the soils are clean tilled or exposed. The seasonal high water table is at a depth of 3 to 5 feet, and seeps occur on the lower slopes. If these soils are adequately limed and fertilized, they have a limited suitability to most locally grown crops. Because erosion is a very severe hazard in areas of row crops, these soils are better suited to close-growing crops, pasture, and woodland. Capability unit IVe–2; woodland suitability group 11.

Tetotum Series

The Tetotum series consists of deep, moderately well drained, nearly level to sloping soils. These soils formed in loamy Coastal Plain sediments. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Tetotum soils are important for farming.

In a representative profile the plow layer is dark grayish-brown fine sandy loam about 9 inches thick. The subsoil is about 39 inches thick. The upper 5 inches is dark yellowish-brown, friable sandy clay loam. The next 9 inches is yellowish-brown firm clay loam. The next 7 inches is yellowish-brown firm clay loam that is mottled with gray and strong brown. The next 8 inches is firm clay loam that is mottled with yellowish brown, gray, and red. The lower 10 inches is gray, firm sandy clay loam mottled with yellowish brown and strong brown. The substratum begins at a depth of 48 inches and continues to a depth of 105 inches or more. It is gray, friable fine sandy loam and loamy fine sand that is mottled with yellowish brown and strong brown.

Tetotum soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. The subsoil is moderately permeable, and the available moisture capacity is moderate. The seasonal high water table is at a depth of 1½ to 2½ feet during winter and spring.

Representative profile of Tetotum fine sandy loam, 0 to 2 percent slopes, 50 yards north of Route 619, 500 yards west of road end, in eastern King George County:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many very fine and fine roots; few, fine and medium, rounded pebbles; medium acid; clear, smooth boundary.

B1t—9 to 14 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine pores; few, thin, patchy clay films; few, fine and medium, rounded pebbles; strongly acid; clear, smooth boundary.

B21t—14 to 23 inches, yellowish-brown (10YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm, sticky and slightly plastic; common very fine and fine roots; common very fine, fine, and medium pores; thin patchy clay films; few, fine and medium, rounded pebbles; strongly acid; clear, smooth boundary.

B22t—23 to 30 inches, yellowish-brown (10YR 5/8) clay loam; few, fine, distinct, gray (10YR 6/1) and strong-brown (7.5YR 5/8) mottles; moderate, fine, subangular blocky structure; firm, sticky and slightly plastic; few very fine and fine roots; few, very fine, fine, and medium pores; thin patchy clay films; few, fine and medium, rounded pebbles; strongly acid; clear, smooth boundary.

B23t—30 to 38 inches, mottled yellowish-brown (10YR 5/8), gray (10YR 6/1), and red (2.5YR 4/8) clay loam; moderate, fine, angular blocky structure; firm, sticky and plastic; few very fine and fine roots; few very fine and fine pores; thin continuous clay films; very strongly acid; clear, smooth boundary.

B3tg—38 to 48 inches, gray (10YR 6/1) sandy clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine pores; thin patchy clay films; few, fine and medium, rounded pebbles; very strongly acid; gradual, smooth boundary.

IIcg—48 to 105 inches, gray (10YR 5/1) fine sandy loam and loamy fine sand; common, medium, distinct, yellowish-brown (10YR 5/4) and strong-brown (7.5YR 5/6) mottles; massive; friable; few, fine and medium, rounded pebbles; very srongly acid.

The solum ranges from 40 to 60 inches in thickness. In places fine to medium quartz pebbles make up less than 1 percent to about 10 percent, by volume, of the solum. The A horizon has hues of 10YR and 2.5Y, values of 4 and 5, and chromas of 2 and 3. It is commonly fine sandy loam but ranges to loam. The Bt horizon above 18 to 24 inches has hues of 10YR, values of 4 and 5, and chromas of 4 to 8. Mottles have chromas of 1 and 2 within the upper 24 inches of the Bt horizon, which is commonly light clay loam and clay loam but ranges to sandy clay loam. The B22t horizon has a hue of 10YR, value of 5, and chromas of 4 to 8. It ranges from sandy clay loam to heavy clay loam, gravelly sandy clay loam, and gravelly clay loam. In many places thin layers of clayey material and gravelly material occur in the C horizon.

Tetotum soils commonly are near Bourne, Bertie, Bladen, and Caroline soils. They lack the fragipan of the Bourne soils. They are better drained than Bertie soils. They are less well drained and have a coarser textured subsoil than Caroline soils. They are better drained than Bladen soils.

Tetotum fine sandy loam, 0 to 2 percent slopes (TeA).—This soil has the profile described as representative of the Tetotum series.

Included with this soil in mapping were small areas of Bertie, Bladen, Fallsington, and Pooler soils.

This soil is seasonally wet, and artificial drainage is desirable if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is well suited to most locally grown crops. If alfalfa is grown, it is usually not long lived, because wetness is excessive in the winter and spring. Capability unit IIw–1; woodland suitability group 4.

Tetotum fine sandy loam, 2 to 6 percent slopes (TeB).—This soil has a profile similar to the one described as representative of the Tetotum series.

Included with this soil in mapping were small areas of Bertie and Caroline soils.

Runoff is slow to medium on this soil, and erosion is a moderate hazard if the soil is clean tilled or exposed. This soil is seasonally wet, and artificial drainage is beneficial if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is well suited to most locally grown crops. Where alfalfa is grown, it is usually short lived because wetness is excessive in the winter and spring. Capability unit IIe–4; woodland suitability group 4.

Tetotum fine sandy loam, 6 to 10 percent slopes, eroded (TeC2).—The surface layer of this soil is commonly 5 to 7 inches thick and ranges from 4 to 8 inches in some places.

Included with this soil in mapping were small areas of Caroline and Sassafras soils, and small areas of similar soil that has a clayey subsoil.

Runoff is medium on this soil. Further erosion is a severe hazard if the soil is clean tilled or exposed. The soil is seasonally wet, and some small seepages occur on the lower slopes. Artificial drainage is beneficial, especially on the lower slopes, if the soil is used for farming. Where this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. Capability unit IIIe–2; woodland suitability group 4.

Tidal Marsh

Tidal marsh (Tm) consists of broad, low areas of mixed alluvium that are covered periodically by tidal waters. These areas occur along the lower reaches of the larger streams and along the Potomac and Rappahannock Rivers. Tidal marsh is commonly moderately coarse textured to medium textured, and it is composed of various combinations and layers of sandy, loamy, clayey, and mucky materials. The surface layer is commonly gray or dark-gray muck. The subsurface layers are strongly gleyed and are gray, greenish gray, or bluish gray. Layers of black or dark-gray mucky materials occur at various depths.

Tidal marsh is constantly waterlogged. Low areas are covered by tidal waters daily. Higher areas are only covered by unusually high tides or storm tides. Tidal marsh commonly has a vegetative cover of reeds, cattails, arrowleaf, rushes, and other aquatic plants. In places, higher areas support a few stunted trees. Areas of Tidal marsh should not be disturbed, because they have been found to be extremely important in the ecology of certain species of fish and wildlife. Capability unit VIIIw–1; woodland suitability group 13.

Turbeville Series

The Turbeville series consists of deep, well-drained, nearly level to strongly sloping soils. These soils formed in loamy and clayey alluvial materials that are above and some distance from present stream channels. Areas of these soils generally parallel the Rappahannock and Potomac Rivers. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. Large areas of these soils are farmed.

In a representative profile the surface layer is dark-brown loam 15 inches thick. The subsoil begins at a depth of about 15 inches and continues to a depth of 116 inches or more. The upper 14 inches is red, firm clay loam. The next 55 inches is dark-red, firm clay. The lower 32 inches is red, friable clay loam.

Turbeville soils have a strongly acid to very strongly acid subsoil except in areas that are limed. They are low in natural fertility and organic-matter content. The subsoil is moderately permeable, and the available moisture capacity is moderate.

Representative profile of Turbeville loam, 2 to 6 percent slopes, 300 yards north of Route 218, one-half mile west of Route 605, in southeastern Stafford County:

Ap—0 to 10 inches, dark-brown (7.5YR 4/4) loam; reddish yellow (7.5YR 6/6) when dry; weak, fine, granular structure; friable, slightly sticky and slightly plastic; common fine roots; medium acid; clear, smooth boundary.

A3—10 to 15 inches, dark-brown (7.5YR 4/4) loam; reddish yellow (7.5YR 6/6) when dry; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; common fine pores; strongly acid; clear, smooth boundary.

B21t—15 to 29 inches, red (2.5YR 4/6) clay loam; light red (2.5YR 6/6) when dry; moderate, medium, subangular blocky structure; firm, sticky and plastic; common fine roots; common fine pores; few, thin, patchy clay films; medium acid; clear, smooth boundary.

B22t—29 to 47 inches, dark-red (2.5YR 3/6) clay; red (2.5YR 4/6) when dry; moderate, fine, angular blocky structure; firm, sticky and plastic; common fine roots; common fine pores; thin continuous clay films; medium acid; gradual, smooth boundary.

B23t—47 to 84 inches, dark-red (10R 3/6) clay; red (10R 4/6) when dry; moderate, medium, angular blocky structure; firm, sticky and plastic; few fine roots; common fine pores; thin continuous clay films; very strongly acid; gradual, smooth boundary.

B3—84 to 116 inches, red (10R 4/8) clay loam; light red (10R 6/6–6/8) when dry; weak, medium, angular blocky structure; friable, slightly sticky and plastic; common fine pores; very strongly acid.

The solum is more than 60 inches in thickness. In places fine, rounded, quartz pebbles make up less than 1 percent to about 8 percent, by volume, of the solum. The A horizon has hues of 7.5YR and, in places, 5YR values of 4 and 5, and chromas of 2 to 4. It is commonly loam but ranges to fine sandy loam. The Bt horizon has hues of 2.5YR and 10R, values of 3 and 4, and chromas of 6 to 8. It is heavy clay loam or clay. The Bt horizon has many thin vertical seams and small pockets of yellowish-red, strong-brown, or pale-brown fine sandy loam, loam, or clay loam. These are generally limited to the upper 30 inches of the Bt horizon.

Turbeville soils occur near Caroline, Kempsville, and Sassafras soils. They are redder than the Caroline soils. They have a thicker profile and a finer textured subsoil than the Kempsville and Sassafras soils.

Turbeville loam, 0 to 2 percent slopes (TuA).—This soil is on broad ridges.

Included with this soil in mapping were small areas of Altavista, Bourne, Dogue, and Kempsville soils.

If this soil is adequately limed and fertilized, it is well suited to locally grown crops. Erosion is not commonly a hazard. Capability unit I–1; woodland suitability group 1.

Turbeville loam, 2 to 6 percent slopes (TuB).—This soil is on ridges. It has the profile described as representative of the Turbeville series.

Included with this soil in mapping were small areas of Bourne, Caroline, and Kempsville soils and small areas of soils that have a gravelly surface layer and subsoil.

Runoff is medium on this soil, and erosion is a moderate hazard if the soil is clean tilled or exposed. Where this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe–1; woodland suitability group 1.

Turbeville loam, 6 to 15 percent slopes, eroded (TuC2).—The surface layer of this soil is commonly 6 to 8 inches thick and in some places ranges from 5 to 10 inches.

Included with this soil in mapping were small areas of Caroline, Kempsville, and Sassafras soils. Also included were small areas of soils that have a gravelly surface layer and subsoil, and small areas of soils that have a clay loam surface layer.

Runoff is rapid on this soil. Further erosion is a severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–1; woodland suitability group 1.

Wahee Series

The Wahee series consists of deep, somewhat poorly drained, nearly level soils. These soils formed in loamy and clayey alluvium on the terraces along the Rappahannock River. The native vegetation is largely a mixture of oaks, willow, gum, maple, elm, ash, and sycamore, but stands of Virginia pine, loblolly pine, and gum are on farmland that is reverting to woodland. Large areas of these soils are wooded.

In a representative profile the surface layer is silt loam about 11 inches thick. The upper 4 inches is grayish brown, and the lower 7 inches is light olive brown. The subsoil is about 46 inches thick. The upper 6 inches is light olive-brown, firm clay that is mottled with gray. The next 16 inches is firm clay that is mottled with grayish brown and gray. The lower 24 inches is gray, very firm clay that is mottled with strong brown. The substratum begins at a depth of 57 inches and continues to a depth of 102 inches or more. The upper 23 inches is gray, very firm sandy clay. The lower 22 inches is gray, friable loam that is mottled with strong brown.

Wahee soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. The subsoil is slowly permeable, and the available moisture capacity is moderate. The seasonal high water table is at a depth of 1 to 1½ feet during the winter and spring.

Representative profile of Wahee silt loam, 200 yards east of Route 607, one-half mile south of Route 3, in southern King George County:

A1—0 to 4 inches, grayish-brown (2.5Y 5/2) silt loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; common fine and medium roots; very strongly acid; clear, smooth boundary.

A2—4 to 11 inches, light olive-brown (2.5Y 5/4) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; common, fine, soft-brown concretions; very strongly acid; clear, smooth boundary.

B21t—11 to 17 inches, light olive-brown (2.5Y 5/6) clay; common, fine, distinct, gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic; common fine and medium roots; few fine pores; few, thin, patchy clay films; very strongly acid; clear, smooth boundary.

B22t—17 to 33 inches, mottled grayish-brown (10YR 5/2) and gray (10YR 5/1) clay, strong, fine, angular blocky structure; firm, sticky and plastic; few fine and medium roots; few fine pores; thin, continuous, grayish-brown (2.5Y 5/2) clay films; very strongly acid; clear, smooth boundary.

B23tg—33 to 57 inches, gray (10YR 5/1) clay; common, medium, prominent, strong-brown (7.5YR 5/8) mottles; strong, medium, angular blocky structure; very firm, sticky and plastic; few fine and medium roots; few

fine pores; thin, continuous, gray (10YR 5/1) clay films; very strongly acid; gradual, smooth boundary.

C1g—57 to 80 inches, gray (5Y 6/1) sandy clay; massive; very firm, sticky and plastic; very strongly acid; gradual, smooth boundary.

IIC2g—80 to 102 inches, gray (5Y 6/1) loam; many, fine, prominent, strong-brown (7.5YR 5/8) mottles; massive; friable, slightly sticky and slightly plastic; very strongly acid.

The solum ranges from 50 to 70 inches in thickness. The A horizon has hues of 2.5Y and 10YR, values of 4 and 5, and chromas of 2 to 4. It is commonly silt loam or loam. The Bt horizon above 30 to 36 inches has hues of 10YR and 2.5Y, values of 4 and 5, and chromas of 4 to 8. It is commonly clay but ranges to silty clay, heavy silty clay loam, and heavy clay loam. The Bt horizon below, to a depth of 30 to 36 inches, has hues of 10YR, 2.5Y, and 5Y, or is neutral, values of 5 and 6, and chromas of 0 and 1. In many places mottles have hues of 7.5Y and 10YR, values of 4 and 5, and chromas of 6 to 8. At this depth the Bt horizon is commonly clay but ranges to silty clay, sandy clay, heavy silty clay loam, and heavy sandy clay loam.

In many places Wahee soils are near Augusta, Roanoke, and Dogue soils. They have a more clayey subsoil than Augusta soils. They are better drained than Roanoke soils and are more poorly drained and have a grayer lower subsoil than Dogue soils.

Wahee silt loam (Wa).—This is the only Wahee soil mapped in Stafford and King George Counties. It is on broad terraces. Slopes are 0 to 2 percent.

Included with this soil in mapping were small areas of Altavista, Augusta, Dogue, and Roanoke soils.

This soil is seasonally wet, and it ponds during very wet periods. Artificial drainage is necessary if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops, except alfalfa and other deep-rooted crops. Capability unit IIIw–1; woodland suitability group 2.

Watt Series, Gray Surface Variant

Soils of the Watt series, gray surface variant, are moderately deep, somewhat excessively drained, and strongly sloping to steep. These soils are on the Piedmont uplands. They formed in materials weathered from graphitic schist. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on cleared areas that are reverting to woodland. Watt soils are mostly wooded.

In a representative profile about 3 inches of partly decayed organic material overlies a surface layer of silt loam about 9 inches thick. The upper 4 inches of the surface layer is dark gray and the lower 5 inches is dark grayish brown. The subsoil is about 9 inches thick and is olive-brown channery silt loam. The substratum begins at a depth of 18 inches and continues to a depth of about 36 inches. It is very dark grayish-brown, very channery silt loam. Dark-gray or dark olive-gray, weathered graphitic schist begins at a depth of about 36 inches.

Watt soils, gray surface variant, have a very strongly acid to extremely acid solum. They are low in natural fertility and organic-matter content. The subsoil has moderately rapid permeability, and the available moisture capacity is low.

Representative profile of Watt silt loam, gray surface variant, 15 to 35 percent slopes, one-third mile north of Route 630, three-quarters of a mile southeast of Route 628, in central Stafford County:

O1—3 inches to 0, dark grayish-brown, partly decayed oak, maple, and laurel leaves, twigs, stems, and fine roots.

A11—0 to 4 inches, dark-gray (5Y 4/1) silt loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine and medium roots; fine pieces of strongly weathered graphitic schist compose 10 to 20 percent of horizon; very strongly acid; clear, smooth boundary.

A12—4 to 9 inches, dark grayish-brown (2.5Y 4/2) silt loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; common, fine and medium roots; few fine pores; pieces of strongly weathered graphitic schist compose 10 to 20 percent of horizon; very strongly acid; clear, smooth boundary.

B—9 to 18 inches, olive-brown (2.5Y 4/4) channery silt loam; moderate, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine and medium roots; few fine pores; fine pieces of strongly weathered graphitic schist compose 35 to 50 percent of horizon; very strongly acid; gradual, smooth boundary.

C—18 to 36 inches, very dark grayish-brown (2.5Y 3/2) very channery silt loam; rock-controlled structure; firm, slightly sticky and slightly plastic; few fine and medium roots; 50 percent or more of horizon is strongly weathered graphitic schist fragments; extremely acid; diffuse, wavy boundary.

R—36 to 50 inches, dark-gray and dark olive-gray, weathered, extremely acid, graphitic schist, oriented vertically.

The solum ranges from 16 to 20 inches in thickness. Depth to bedrock ranges from 20 to 36 inches. Small fragments of strongly weathered schist occur throughout the solum. These make up 35 to 50 percent of the B horizon. The A horizon has hues of 2.5Y and 5Y, values of 3 and 4, and chromas of 1 and 2. It is silt loam. The B horizon has hues of 2.5Y, values of 3 and 4, and chromas of 2 to 4. It is channery silt loam or light channery silty clay loam. Fine veins of quartz occur in the underlying schist and, in many places, extend up into the solum.

Watt soils, gray surface variant, commonly occur near Aura, Manor, and Nason soils. They have a thinner solum, more silt, and are grayer than Aura soils. They are shallower to hard bedrock and are grayer than Manor soils. They lack the mica content of Manor soils. They have a coarser textured, thinner subsoil than Nason soils.

Watt silt loam, gray surface variant, 10 to 15 percent slopes (WgD).—This soil has a profile similar to the one described as representative of the Watt series.

Included with this soil in mapping were small areas of Aura, Manor, and Nason soils. Also included were small areas of soils that have a gravelly fine sandy loam surface layer and small areas of Watt soil that has 6 to 10 percent slopes.

Runoff is medium to rapid on this soil, and erosion is a severe hazard in cuts or where the vegetative cover is removed. The soil material slides down slopes readily when wet because the water acts as a lubricant between the soil material and the underlying schist (fig. 4). This soil is droughty during the growing season. It is better suited to drought-resistant pasture and woodland than other uses. Capability unit VIe–2; woodland suitability group 7.

Watt silt loam, gray surface variant, 15 to 35 percent slopes (WgE).—This soil has the profile described as representative of the Watt series.

Included with this soil in mapping were small areas of Manor soil, and small gullied areas. Also included were small areas of rock outcrop on some lower slopes, and a few small areas of Watt soil that has slopes of 35 to 50 percent.

Figure 4.—**Concrete drain in Watt silt loam, gray surface variant, 10 to 15 percent slopes, destroyed by a landslip.**

Runoff is rapid on this soil, and erosion is a very severe hazard if the soil is exposed. This soil is unstable and is droughty during the growing season. It is better suited to woodland. Capability unit VIIe–1; woodland suitability group 7.

Wehadkee Series

The Wehadkee series consists of deep, poorly drained, nearly level soils on stream flood plains. These soils formed in loamy alluvium on the Piedmont Province and the Coastal Plain. The native vegetation is a mixture of willow, maple, gum, birch, ash, elm, and sycamore, but willow, gum, birch, and Virginia pine are on farmland that is reverting to woodland.

In a representative profile about an inch of partly decayed organic material overlies a surface layer of very fine sandy loam about 11 inches thick. The upper 4 inches of the surface layer is brown, and the lower 7 inches is grayish brown. The subsoil is about 35 inches thick. The upper 9 inches is light brownish-gray, friable very fine sandy loam that is mottled with olive brown and yellowish brown. The lower 26 inches is dark-gray, friable loam that is mottled with brown and yellowish brown. The substratum begins at a depth of 46 inches and continues to a depth of 84 inches or more. It is dark-gray gravelly fine sandy loam that is mottled with strong brown.

Wehadkee soils are strongly acid. They are low in natural fertility and organic-matter content. The subsoil has moderate permeability, and the available moisture capacity is moderate. The seasonal high water table is at the surface or at a depth of 1 foot, and the soils are subject to flooding.

Representative profile of Wehadkee very fine sandy loam, located near Aquia Creek, 50 yards east of Route 637, one-fifth mile north of Highway 1, in northeastern Stafford County:

O1—1 inch to 0, grayish-brown, partly decayed leaves, pine needles, twigs, and fine roots.

A11—0 to 4 inches, brown (10YR 4/3) very fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine roots; common fine mica flakes; strongly acid; clear, smooth boundary.

A12—4 to 11 inches, grayish-brown (2.5Y 5/2) very fine sandy loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; many fine pores; common fine mica flakes; strongly acid; gradual, smooth boundary.

B1g—11 to 20 inches, light brownish-gray (2.5Y 6/2) very fine sandy loam; many, medium, faint, olive-brown (2.5Y 4/4) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; many fine pores; common fine mica flakes; strongly acid; gradual, smooth boundary.

B2g—20 to 46 inches, dark-gray (5Y 4/1) loam; many, fine, prominent, brown (7.5YR 4/4) mottles and common, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots in upper 12 inches; common fine mica flakes; few fine and medium pockets of soft, black, concretionary material; strongly acid; clear, smooth boundary.

IICg—46 to 84 inches, dark-gray (5Y 4/1) gravelly fine sandy loam; many, medium, prominent, strong-brown (7.5YR 5/6) mottles; massive; friable, slightly sticky and slightly plastic; common fine mica flakes; strongly acid.

The solum ranges from 36 to 48 inches in thickness. The B horizon has few to many mottles that have hues of 2.5Y, 10YR, and 7.5YR, values of 4 to 6, and chromas of 4 to 8. The C horizon is commonly loamy and gravelly alluvium.

The Wehadkee soils in this survey area differ from the Wehadkee soils in the other survey areas by having a strongly acid solum. This difference, however, does not alter their usefulness or management.

Wehadkee soils are near Cartecay soils and Alluvial land, wet. They are more poorly drained and finer textured than the Cartecay soils. They are similar in drainage to Alluvial land, wet, but are slightly finer textured and are less variable.

Wehadkee very fine sandy loam (Wh).—This is the only Wehadkee soil mapped in Stafford and King George Counties. Slopes are dominantly 0 to 2 percent.

Included with this soil in mapping were small areas of Cartecay soil and Alluvial land, wet. Also included were small areas of similar soil that has a gravelly surface layer and subsoil and small areas of very poorly drained soil.

This soil is seasonally wet and it is frequently flooded. Artificial drainage is necessary if the soil is used for farming, but drainage outlets are difficult to locate. If this soil is adequately drained, limed, and fertilized, it has a limited suitability to most locally grown crops, except alfalfa. It is too wet for alfalfa. Capability unit IVw–2; woodland suitability group 5.

Westphalia Series

The Westphalia series consists of deep, well-drained, gently sloping to steep soils on uplands. These soils formed in stratified Coastal Plain sediments that are dominantly very fine sands. The native vegetation is largely oaks, hickory, yellow-poplar, and beech, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. The Westphalia soils are used for general farming and woodland.

In a representative profile (fig. 5) the surface layer is loamy very fine sand about 13 inches thick. The upper 6 inches is dark brown, and the lower 7 inches is brown. The subsoil is about 23 inches thick. The upper 5 inches is brown, friable loamy very fine sand. The next 10 inches is brown, friable very fine sandy loam. The lower 8 inches is strong-brown, very friable loamy very fine sand. The substratum begins at a depth of 36 inches and continues to a depth of 110 inches or more. The upper 30 inches is brownish-yellow, very friable loamy very fine sand. The lower 42 inches is strong-brown gravelly very fine sand.

Westphalia soils have a strongly acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. The subsoil has moderately rapid permeability, and the available moisture capacity is moderate to low.

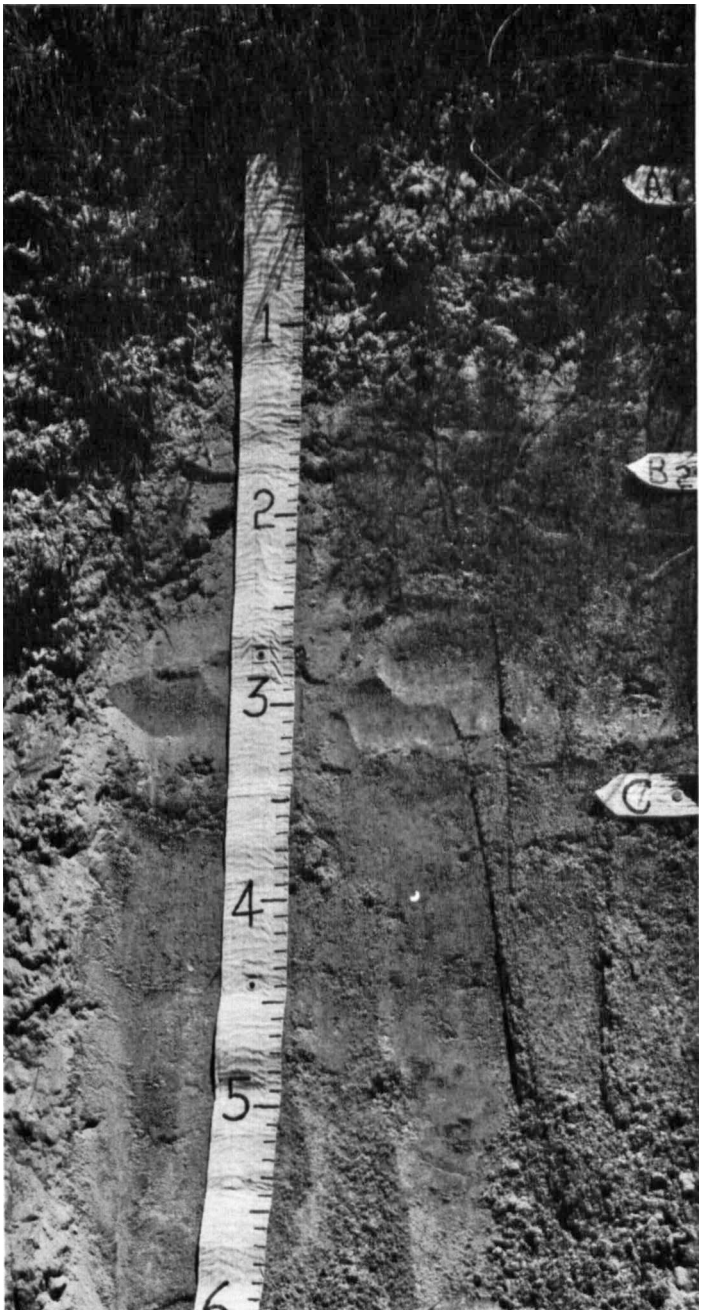

Figure 5.—**Profile of a Westphalia loamy very fine sand.**

Representative profile of Westphalia loamy very fine sand, 2 to 6 percent slopes, 50 yards east of Route 600, 1¼ miles north of Route 218, in eastern Stafford County:

Ap—0 to 6 inches, dark-brown (10YR 4/3) loamy very fine sand; weak, fine, granular structure; very friable, nonsticky and nonplastic; many fine roots; medium acid; clear, smooth boundary.

A2—6 to 13 inches, brown (10YR 5/3) loamy very fine sand; weak, fine, granular structure; very friable, nonsticky and nonplastic; few fine roots; few fine pores; strongly acid; clear, smooth boundary.

B1—13 to 18 inches, brown (7.5YR 4/4) loamy very fine sand; weak, medium, subangular blocky structure; friable, nonsticky and slightly plastic; few fine roots; few fine pores; very strongly acid; clear, smooth boundary.

B2t—18 to 28 inches, brown (7.5YR 4/4) very fine sandy loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; few fine pores; few, very thin, patchy clay films; very strongly acid; gradual, smooth boundary.

B3—28 to 36 inches, strong-brown (7.5YR 5/6) loamy very fine sand; weak, coarse, subangular blocky structure; very friable, nonsticky and nonplastic; few fine pores; very strongly acid; gradual, wavy boundary.

C1—36 to 68 inches, brownish-yellow (10YR 6/8) loamy very fine sand; single grain, very friable, nonsticky and nonplastic; very strongly acid; clear, smooth boundary.

C2—68 to 110 inches, strong-brown (7.5YR 5/8) fine gravelly very fine sand; single grain; very friable, nonsticky and nonplastic; very strongly acid.

The solum ranges from 24 to 36 inches in thickness. The A horizon has hues of 10YR, values of 4 and 5, and chromas of 3 and 4. The Bt horizon has hues of 7.5YR and 10YR, values of 4 and 5, and chromas of 4 to 8. The Bt horizon is generally 10 inches or less in thickness. The B3 horizon has hues of 7.5YR and 10YR, a value of 5, and chromas of 6 to 8.

Westphalia soils occur near Carolina, Marr, and Sassafras soils. They have a coarser-textured subsoil than any of those soils.

Westphalia loamy very fine sand, 2 to 6 percent slopes (WlB).—This soil has the profile described as representative of the Westphalia series.

Included with this soil in mapping were small areas of Caroline, Marr, and Sassafras soils.

This soil is droughty during the growing season. Runoff is slow to medium on this soil, and erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Because of droughtiness it is better suited to spring crops than to summer crops. Capability unit IIs–1; woodland suitability group 10.

Westphalia loamy very fine sand, 6 to 15 percent slopes, eroded (WlD2).—The surface layer is commonly 5 to 8 inches thick, but it ranges from 4 to 10 inches in a few places. The profile otherwise is similar to the one described as representative of the Westphalia series.

Included with this soil in mapping were small areas of Caroline, Galestown, Marr, and Sassafras soils.

Runoff is medium on this soil. Further erosion is a very severe hazard if the soil is clean tilled or exposed. This soil is droughty during the growing season. If this soil is adequately limed and fertilized, it has a limited suitability to most locally grown crops. Capability unit IVe–1; woodland suitability group 10.

Westphalia loamy very fine sand, 15 to 30 percent slopes, eroded (WlE2).—The surface layer is commonly 4 to 6 inches thick, but ranges from 4 to 10 inches thick in a few places. The profile otherwise is similar to the one described as representative of the Westphalia series.

Included with this soil in mapping were small areas of Galestown, Marr, and Sassafras soils and some small gullied areas.

Runoff is medium to rapid on this soil. Further erosion is a severe hazard if the soil is exposed. This soil is droughty during the growing season, and it tends to be unstable on slopes. It is better suited to drought-resistant pasture and woodland than to other uses. Capability unit VIe–1; woodland suitability group 10.

Wickham Series

The Wickham series consists of deep, well-drained, nearly level to sloping soils. These soils formed in loamy alluvium mostly on the terraces along the Rappahannock River. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. The Wickham soils are used mainly for farming.

In a representative profile the plow layer is dark-brown fine sandy loam about 8 inches thick. The subsoil is about 35 inches thick. The upper 6 inches is reddish-brown, friable fine sandy loam. The next 20 inches is reddish-brown, firm clay loam. The lower 9 inches is reddish-brown, firm sandy clay loam. The substratum begins at a depth of 43 inches and extends to a depth of 90 inches or more. It is made up of layers of sand and gravel.

Wickham soils have a medium acid to strongly acid subsoil. They have moderate organic-matter content and natural fertility. The subsoil is moderately permeable, and the available moisture capacity is moderate.

Representative profile of Wickham fine sandy loam, 0 to 2 percent slopes, 100 yards south of Route 3, one-half mile west of Route 605, in southwestern King George County:

Ap—0 to 8 inches, dark-brown (7.5YR 4/4) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; common fine roots; few, fine, rounded quartz pebbles; common fine flakes of mica; strongly acid; clear, smooth boundary.

B1—8 to 14 inches, reddish-brown (5YR 4/4) fine sandy loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; common fine and medium pores; few, fine, rounded quartz pebbles; common fine flakes of mica; few, thin, patchy clay films; medium acid; clear, smooth boundary.

B21t—14 to 34 inches, reddish-brown (5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine roots; common fine pores; few, fine, rounded quartz pebbles; common fine flakes of mica; thin patchy clay films; medium acid; clear, smooth boundary.

B22t—34 to 43 inches, reddish-brown (5YR 4/4) sandy clay loam; moderate, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; few fine roots; few fine pores; few, fine, rounded quartz pebbles; common fine flakes of mica; thin patchy clay films; strongly acid; clear, smooth boundary.

IIC—43 to 90 inches, brown and yellowish-brown sand and gravel; many fine flakes of mica; medium acid.

The solum ranges from 40 to 52 inches in thickness. In many places fine, rounded quartz pebbles make up less than 1 percent to 10 percent, by volume, of the solum. The A horizon has a hue of 7.5YR, values of 4 and 5, and chromas of 2 to 4. Textures are commonly fine sandy loam, but range to sandy loam and loam. The Bt horizon has a hue of 5YR, values of 4 and 5, and chromas of 3 and 4. The C horizon, in places, includes thin layers of silty and clayey materials.

Wickham soils are near Altavista, Augusta, and Roanoke soils. They are better drained than the Altavista and Augusta soils. They are better drained and have a coarser textured subsoil than the Roanoke soils.

Wickham fine sandy loam, 0 to 2 percent slopes (WmA).—This soil is on broad terraces. It has the profile described as representative of the Wickham series.

Included with this soil in mapping were small areas of Altavista soil.

If this soil is adequately limed and fertilized, it is well suited to locally grown crops. It has little or no hazard of erosion. Capability unit I–1; woodland suitability group 4.

Wickham fine sandy loam, 2 to 6 percent slopes (WmB).—This soil has a profile similar to the one described as representative of the Wickham series.

Included with this soil in mapping were small areas of Altavista soil and small areas of soils that have a gravelly surface layer and subsoil.

Runoff is slow to medium on this soil, and erosion is a moderate hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is well suited to most locally grown crops. Capability unit IIe–2; woodland suitability group 4.

Wickham fine sandy loam, 6 to 12 percent slopes, eroded (WmC2).—The surface layer is commonly 4 to 6 inches thick, and ranges up to 8 inches in a few places, but the profile otherwise is similar to the one described as representative of the Wickham series.

Included with this soil in mapping were small areas of soils that have a gravelly surface layer and subsoil.

Runoff is medium on this soil. Further erosion is a severe hazard if the soil is clean tilled or exposed. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–2; woodland suitability group 4.

Wickham Series, Thin Solum Variant

Soils of the Wickham series, thin solum variant, are deep, well drained, and nearly level to sloping. These soils formed in sandy and loamy alluvium, mostly on the terraces along the Rappahannock River. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. These soils are used mainly for farming.

In a representative profile the plow layer is dark-brown sandy loam about 10 inches thick. The subsoil is about 20 inches thick. The upper 9 inches is dark-brown, friable sandy loam. The lower 11 inches is reddish-brown, friable sandy clay loam. The substratum begins at a depth of 30 inches and continues to a depth of 72 inches or more. It is reddish-brown and brown sand and gravel.

Wickham soils, thin solum variant, have a strongly acid subsoil. These soils are low in natural fertility and organic-matter content. The subsoil has moderately rapid permeability, and the available moisture capacity is moderate to low.

Representative profile of Wickham sandy loam, thin solum variant, 0 to 2 percent slopes, one-half mile southwest of the end of Route 660, in southern King George County:

Ap—0 to 10 inches, dark-brown (7.5YR 4/4) sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine roots; common fine flakes of mica; few, fine, rounded quartz pebbles; strongly acid; clear, smooth boundary.

B1—10 to 19 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; common fine pores; common fine flakes of mica; few, fine, rounded quartz pebbles; common clay coatings on sand grains, some bridging; strongly acid; clear, smooth boundary.

B2t—19 to 30 inches, reddish-brown (5YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; common fine pores; common fine flakes of mica; few, fine, rounded quartz pebbles; clay coatings on sand grains; bridging; strongly acid; clear, smooth boundary.

IIC—30 to 72 inches, reddish-brown and brown sands and gravels; common fine flakes of mica; strongly acid.

The solum ranges from 26 to 34 inches in thickness. In places fine, rounded quartz pebbles make up 1 percent to 15 percent, by volume, of the solum. The A horizon has hues of 7.5YR, a value of 4, and chromas of 2 to 5. It is commonly sandy loam but ranges to loamy sand. The Bt horizon has hues of 5YR and 7.5YR, values of 4 and 5, and chromas of 2 to 4. It is commonly sandy clay loam but ranges to heavy sandy loam. The C horizon, in places, contains thin layers of silty and clayey materials.

Wickham soils, thin solum variant, are near Altavista and Wickham soils. They are better drained and are coarser textured than the Altavista soils. They have a coarser textured and thinner solum than the Wickham soils.

Wickham sandy loam, thin solum variant, 0 to 2 percent slopes (WnA).—This soil is on broad terraces. It has the profile described as representative of the Wickham series, thin solum variant.

Included with this soil in mapping were small areas of Wickham soil, small areas of soils that have a loamy sand surface layer and subsoil, and small areas of soils that have a gravelly surface layer and subsoil.

This soil is droughty during the growing season. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIs–1; woodland suitability group 4.

Wickham sandy loam, thin solum variant, 2 to 6 percent slopes (WnB).—This soil has a profile similar to the one described as representative of the Wickham series, thin solum variant.

Included with this soil in mapping were small areas of Wickham soil, small areas of soils that have a loamy sand surface layer and subsoil, and small areas of soils that have a gravelly surface layer and subsoil.

Runoff is slow on this soil. It is more droughty during the growing season than soils of the Wickham series that do not have a thin solum. Where this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIs–1; woodland suitability group 4.

Wickham sandy loam, thin solum variant, 6 to 12 percent slopes (WnC).—This soil has a profile similar to the one described as representative of the Wickham series, thin solum variant.

Included with this soil in mapping were small areas of Wickham soil, small areas of soils that have a loamy sand surface layer and subsoil, and small areas of soils that have a gravelly surface layer and subsoil.

Runoff is slow to medium on this soil, and erosion is a severe hazard if the soil is clean tilled or exposed. It is

droughty during the growing season. If this soil is adequately limed and fertilized, it is suited to most locally grown crops. Capability unit IIIe–2; woodland suitability group 4.

Woodstown Series

The Woodstown series consists of deep, moderately well drained, nearly level to gently sloping soils. These soils formed in loamy Coastal Plain sediment. The native vegetation is largely oaks, hickory, and yellow-poplar, but stands of Virginia pine and loblolly pine are on farmland that is reverting to woodland. These soils are used for general farming and woodland.

In a representative profile the plow layer is dark grayish-brown fine sandy loam about 9 inches thick. The subsoil is about 31 inches thick. The upper 12 inches is yellowish-brown, friable sandy clay loam. The next 10 inches is yellowish-brown, friable sandy clay loam that is mottled with light brownish gray. The lower 9 inches is gray, firm sandy clay loam that is mottled with yellowish brown. The substratum begins at a depth of 40 inches and continues to a depth of 96 inches or more. It is gray fine sandy loam and sandy clay loam that is mottled with yellowish brown and strong brown. Thin layers of clay loam and sandy clay are in the substratum.

Woodstown soils have a medium acid to very strongly acid subsoil. They are low in natural fertility and organic-matter content. The subsoil is moderately permeable, and the available moisture capacity is moderate. The seasonal high water table is at a depth of 1½ to 2½ feet.

Representative profile of Woodstown fine sandy loam, 0 to 2 percent slopes, 200 yards south of Route 647, 1 mile east of Route 3, in eastern King George County:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) fine sandy loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine roots; slightly acid; clear, smooth boundary.

B21t—9 to 15 inches, yellowish-brown (10YR 5/4) light sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slighty plastic; common fine roots; few fine pores; few, thin, patchy clay films; medium acid; clear, smooth boundary.

B22t—15 to 21 inches, yellowish-brown (10YR 5/6) sandy clay loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; common fine pores; thin patchy clay films; strongly acid; clear, smooth boundary.

B23t—21 to 31 inches, yellowish-brown (10YR 5/8) sandy clay loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; common fine pores; thin, patchy clay films; very strongly acid; clear, smooth boundary.

B3g—31 to 40 inches, gray (10YR 6/1) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; few fine roots; few fine pores; very strongly acid; gradual, wavy boundary.

Cg—40 to 96 inches, gray (10YR 6/1) fine sandy loam and sandy clay loam that has thin layers of clay loam and sandy clay; few, medium, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/8) mottles; massive, firm, slightly sticky and slightly plastic; very strongly acid.

The solum ranges from 30 to 40 inches in thickness. In many places fine, rounded quartz pebbles make up less than 1 percent to about 5 percent, by volume, of the solum. The A horizon has a hue of 10YR, values of 4 and 5, and chromas of 2 to 4. It is commonly fine sandy loam but ranges to sandy loam. The Bt horizon is commonly sandy clay loam but ranges to heavy loam. It has a hue of 10YR, a value of 5 in most places but also values of 4 and 6, and chromas of 4 to 8. Gray or light brownish-gray mottles occur in the upper 24 inches. The B3g horizon has a hue of 10YR, values of 4 to 6, and chromas of 1 and 2. In places in this horizon and in the Cg horizon are mottles of yellowish brown and strong brown.

Woodstown soils commonly are near Bertie, Sassafras, and Tetotum soils. They are better drained than the Bertie soils and lack gray mottles in the upper 10 inches of the subsoil. They are more poorly drained than the Sassafras soils. They are slightly coarser textured, contain more sand and have a thinner solum than the Tetotum soils.

Woodstown fine sandy loam, 0 to 2 percent slopes (WoA).—This soil has the profile described as representative of the Woodstown series.

Included with this soil in mapping were small areas of Bertie and Sassafras soils.

This soil is seasonally wet, and artificial drainage is beneficial if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. Alfalfa can be grown but is short lived because wetness is excessive in winter and spring. Capability unit IIw–1; woodland suitability group 4.

Woodstown fine sandy loam, 2 to 6 percent slopes (WoB).—This soil has a profile similar to the one described as representative of the Woodstown series.

Included with this soil in mapping were small areas of Bertie, Caroline, and Sassafras soils and small areas of similar soil that has a gravelly subsoil.

Runoff is slow to medium on this soil, and erosion is a moderate hazard if the soil is clean tilled or exposed. Artificial drainage is desirable if the soil is used for farming. If this soil is adequately drained, limed, and fertilized, it is suited to most locally grown crops. Alfalfa is short-lived because wetness is excessive in winter and spring. Capability unit IIe–4; woodland suitability group 4.

Worsham Series

The Worsham series consists of deep, poorly drained, nearly level soils of the Piedmont Province. These soils formed in material weathered from granite and gneiss in upland depressions and around the heads of drainageways. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. These soils are mostly in pasture and woodland.

In a representative profile the surface layer is dark grayish-brown loam about 11 inches thick that is mottled with grayish brown in the lower 6 inches. The subsoil is about 39 inches thick. The upper 7 inches is firm, light brownish-gray heavy clay loam that is mottled with yellowish brown. The next 18 inches is firm, light olive-gray clay that is mottled with strong brown. The lower 14 inches is firm, gray sandy clay loam that is mottled with yellowish brown. The substratum begins at a depth of 50 inches and continues to a depth of 96 inches or more. It is very strongly weathered gray, brown, and strong-brown granite gneiss.

Worsham soils have a strongly acid subsoil. They are low in natural fertility and organic-matter content. The subsoil is slowly permeable, and the available moisture

capacity is moderate. The seasonal high water table ranges from the surface to 1 foot below the surface.

Representative profile of Worsham loam, 400 yards south of Route 627, one-half mile east of Route 616, in northwestern Stafford County:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots: few fine flakes of mica; slightly acid; clear, smooth boundary.

A2—5 to 11 inches, dark grayish-brown (10YR 4/2) loam; common, medium, faint, grayish-brown (2.5YR 5/2) mottles; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; common fine roots; few fine pores; few fine flakes of mica; few, fine, black concretions; medium acid; clear, smooth boundary.

B1tg—11 to 18 inches, light brownish-gray (2.5Y 6/2) heavy clay loam; common, fine, distinct, yellowish-brown (10YR 5/8) motles; weak, medium, subangular blocky structure; firm, sticky and plastic; common fine roots; few fine pores; few, thin, patchy clay films; few fine flakes of mica; few, fine, black concretions; strongly acid; clear, smooth boundary.

B2tg—18 to 36 inches, light olive-gray (5Y 6/2) clay; many, fine, prominent, strong-brown (7.5YR 5/8) mottles; moderate, medium, angular blocky structure; firm, sticky and plastic; few fine roots; common fine pores; thin and moderately thick, continuous, gray (5Y 6/1) clay films; common fine flakes of mica; strongly acid; clear, smooth boundary.

B3g—36 to 50 inches, gray (5Y 5/1) sandy clay loam; common, medium, prominent, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; firm, sticky and plastic; few fine roots; few fine pores; few, thin, patchy clay films; fine flakes of mica; thin lines of black organic staining on ped surfaces; strongly acid; gradual, wavy boundary.

C—50 to 96 inches, very strongly weathered granite gneiss that is gray (10YR 5/1), brown (10YR 5/3), and strong brown (7.5YR 5/6); crushes easily to fine sandy loam; rock-controlled structure; few, fine, angular quartz fragments; strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to hard rock is more than 5 feet. The A horizon has hues of 10YR and 2.5Y, values of 4 and 5, and chromas of 2 and 1. It is commonly loam but ranges to sandy loam and fine sandy loam. The Bt horizon has hues of 2.5Y and 5Y, or is neutral, values of 4 to 6, and chromas of 0 to 2. The Bt horizon has common to many mottles that have hues of 7.5YR and 10YR, values of 4 and 5, and chromas of 4 to 8. The C horizon is sandy loam, fine sandy loam, or loam. In many places, thin veins of quartz extend up into the solum.

Worsham soils commonly are near Appling and Elbert soils. They are more poorly drained than Appling soils. They have more sand and less silt and are more acid than the Elbert soils.

Worsham loam (Wr).—This is the only Worsham soil mapped in Stafford and King George Counties. Slopes are dominantly 0 to 2 percent.

Included with this soil in mapping were small areas of Colfax and Elbert soils and Alluvial land, wet. Also included were small areas of similar soil that has a 2- to 6-inch brown loamy overwash.

This soil has a seasonal high water table that ranges from the surface to a depth of 1 foot. Artificial drainage is necessary if the soils are used for farming, but in places drainage outlets are difficult to locate. Ponding occurs on some areas of this soil. If it is adequately drained, limed, and fertilized, this soil has a limited suitability for some locally grown crops. It is not suited to alfalfa and similar deep-rooted crops. Capability unit IVw-1; woodland suitability group 5.

Zion Series, Deep Variant

Soils of the Zion series, deep variant, are deep, well-drained, and gently sloping to sloping. These soils are on uplands. They formed in material weathered from fine-grained basic rocks. The native vegetation is largely oaks and hickory, but stands of Virginia pine are on farmland that is reverting to woodland. Zion soils are mostly in pasture and woodland.

In a representative profile the surface layer is brown and dark-brown loam about 7 inches thick. The subsoil is about 15 inches thick. The upper 4 inches is strong-brown, friable clay loam. The lower 11 inches is yellowish-brown, firm clay. The substratum begins at a depth of 22 inches and extends to a depth of 64 inches or more. It is brown and yellowish-brown, very strongly weathered, soft, fine-grained basic rock.

Zion soils, deep variant, have a medium acid subsoil. The substratum is moderately alkaline. These soils are moderate in natural fertility and low in organic-matter content. The subsoil has moderately slow permeability, and the available moisture capacity is moderate.

Representative profile of Zion loam, deep variant, 2 to 6 percent slopes, 20 yards west of Route 675, one-half mile north of Route 610, in north central Stafford County:

Ap1—0 to 2 inches, dark-brown (10YR 4/3) loam; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; few, fine, black concretions; slightly acid; clear, smooth boundary.

Ap2—2 to 7 inches, brown (10YR 5/3) loam; moderate, medium, granular structure; friable, slightly sticky and slightly plastic; many fine roots; common fine pores; few, fine, black concretions; slightly acid; clear, smooth boundary.

B1—7 to 11 inches, strong-brown (7.5YR 5/8) clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; few fine pores; few, thin, patchy clay films; common, fine, black concretions; medium acid; clear, smooth boundary.

B2t—11 to 22 inches, yellowish-brown (10YR 5/8) clay; moderate, fine, angular blocky structure; firm, sticky and plastic; few fine roots; few fine pores; thin continuous clay films; medium acid; gradual, irregular boundary.

C—22 to 64 inches, brown and yellowish-brown speckled with black, very strongly weathered, soft, fine-grained basic rock; thin and moderately thick, yellowish-brown clay flows in seams and cracks in upper part of horizon; slightly acid at 30 inches, moderately alkaline at 60 inches.

The solum ranges from 20 to 30 inches in thickness. Depth to hard rock ranges from 4 to 6 feet. In many places a few small fragments of strongly weathered rock and a few small angular fragments of quartz are in the solum. The Bt horizon has hues of 10YR and 7.5YR, a value of 5, and chromas of 4 to 8. The C horizon is very strongly weathered basic rock. Texture of weathered material is loam or silt loam. Thin veins of quartz extend up into the solum in many places.

Zion soils, deep variant, are near Cullen and Orange soils. They have a thinner profile than both these soils and are better drained than the Orange soils. They are not so red in the subsoil as Cullen soils.

Zion loam, deep variant, 2 to 6 percent slopes (ZlB).—This soil has the profile described as representative of the Zion series, deep variant.

Included with this soil in mapping were small areas of Cullen, Mecklenburg, and Orange soils. Also included were small areas where weathered rock is only a few inches below the surface.

Runoff from this soil is medium, and erosion is a moderate hazard if the soil is clean tilled or exposed. If it is adequately fertilized, this soil is suited to most locally grown crops. Capability unit IIe–3; woodland suitability group 3.

Zion loam, deep variant, 6 to 10 percent slopes, eroded (ZlC2).—The surface layer is commonly 4 to 5 inches thick, but the profile otherwise is similar to the one described as representative of the Zion series, deep variant.

Included with this soil in mapping were small areas of Bremo, Cullen, and Mecklenburg soils. Also included were small areas where weathered rock is only a few inches below the surface.

Runoff is medium to rapid on this soil. Further erosion is a severe hazard if the soil is clean tilled or exposed. If this soil is adequately fertilized, it is suited to most locally grown crops. Capability unit IIIe–3; woodland suitability group 3.

Use and Management of the Soils

In this section management of the soils for crops and pasture is discussed and facts about the woodland and wildlife in the county are given. Then, use of the soils for engineering and for town and country planning is described. The information is based on studies made in different parts of the county by the Virginia Polytechnic Institute and State University and the Soil Conservation Service.

Management for Crops and Pasture

In the pages that follow, basic practices of soil management are discussed, the system of capability classification used by the Soil Conservation Service is explained, and use and management of the soils in each capability unit are discussed. Following this, estimated yields to be expected under two levels of management are given.

Basic practices of management

Differences among the soils in such properties as slope, soil texture, depth to rock, fertility, and wetness result in differences in crop suitability and management needs. On most of the soils, however, the management problems are general enough that basic practices can be applied. In the paragraphs that follow, basic practices of management for all soils of Stafford and King George Counties suitable for crops and pasture are discussed. Technical assistance in planning and applying practices suitable for the soils on a particular farm can be obtained from a local representative of the Soil Conservation Service or from the county agricultural agent.

Maintaining fertility.—Most soils of Stafford and King George Counties are strongly acid to very strongly acid, and have a pH range of 4.5 to 5.5. The intensity or degree of acidity or alkalinity in soils is measured and expressed in terms of pH values. A value between pH 6.0 and 6.5 is generally considered optimum for most plant growth. Liming is needed to bring the pH up to the desired range in most soils.

Most of the soils of Stafford and King George Counties are low in natural fertility, and fertilization is required for consistent yields. Fertilization gives the best results when the amount of fertilizer required and the time of application are determined by the crop or vegetation grown, and the soil or soils on which the crop or vegetation is grown. For instance, crops on sandy soils often do best with smaller applications of fertilizer applied several times during the growing season. Crops on loamy soils do equally as well with fertilizer applied in one or two applications.

Field crops, small grain, grasses, and legumes all do best if adapted species are used in seeding. Crops, grasses, and legumes generally have the best growth on the nearly level to gently sloping, loamy, well-drained soils. Plant growth decreases on somewhat excessively drained soils and on moderately well drained to poorly drained soils. Plant growth also decreases as slopes increase, and as erosion and erosion hazard increase.

Alfalfa is well suited to most well-drained soils. Lespedeza and red, crimson, and ladino clovers are well suited to well-drained to somewhat poorly drained soils. Bermudagrass, orchardgrass, and fescue are the major adapted grasses. Because of the climate, growth of finer grasses, such as Kentucky bluegrass, is limited.

Maintaining content of organic matter.—The soils of Stafford and King George Counties were never very high in content of organic matter, and it is not economical to attempt to build up large amounts of organic matter in them. It is important, however, to maintain a constant supply.

Returning farm manure and crop residues to the soil, growing cover crops, green manure crops, and sod crops in the cropping system, and using other conservation practices helps maintain the content of organic matter.

Tillage.—The two major purposes of tillage are to prepare a seedbed and to control weeds. The planting, cultivating, and harvesting operations generally help to destroy the structure of the soil. Overcultivation of the soils should be avoided. Maintenance of organic-matter content and minimum tillage aid in maintaining the structure of the soil.

Conserving soil and water.—If they are used for cultivated crops, all gently sloping or steeper soils in Stafford and King George Counties are subject to erosion. Sheet erosion causes a loss of surface soil that generally contains a larger part of organic matter and plant nutrients. Gullies form on areas receiving concentrated water flow unless proper erosion-control measures are applied.

On soils where erosion is a hazard, the excessive soil and water losses generally occur during the period a cultivated crop is growing. Use of a cropping system in combination with other erosion-control practices helps to reduce soil and water losses. Contour farming, terracing, stripcropping, diversion terraces, grassed waterways, and minimum tillage are needed to control erosion. Leaving all crop residue on the surface, growing cover crops, and applying fertilizer and lime to improve plant growth also help to control erosion.

Combinations of erosion control measures that are effective vary among the different kinds of soils. Also, several combinations would be equally effective on the same soil. The factors to consider in determining what practices or combinations of practices will be effective on a particular soil are: (1) relative total effectiveness of each of the

practices to reduce erosion; (2) relative erodibility of the soil; (3) eroding characteristics and distribution of rainstorms during the year; (4) length of slope; (5) steepness of slope; and (6) average annual soil loss that can be tolerated.

Drainage.—Yields of most crops, particularly of cultivated crops, can be increased on wet soils by removing excess water. Open ditches are used in places to remove excess water. Tile drains generally provide more satisfactory drainage but are more expensive to install.

Soils that have a fragipan or clay subsoil are difficult to drain. Tile drains are only slightly effective in these soils. Open ditches are effective if they intercept water that moves laterally on top of the fragipan or clay layer. Wet soils that have a deep, permeable root zone generally are productive if they are drained, and if they are fertilized. A drainage system of ditches or tile cannot be installed, however, unless a suitable outlet is available.

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 for 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. (None in Stafford and King George Counties.)

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

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, 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, 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 the following pages the capability units in Stafford and King George Counties are described and suggestions for the use and management of the soils are given. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. The names of all the soils in any given capability unit can be found in the "Guide to Mapping Units" at the back of this survey. Cut and fill land was not assigned to a capability unit, however, because of its variable soil properties.

CAPABILITY UNIT I–1

This unit consists of well-drained, nearly level soils of the Kempsville, Sassafras, Turbeville, and Wickham series. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is moderately fine textured or fine textured.

The available moisture capacity and permeability of these soils are moderate. Natural fertility and organic-matter content are low to moderate. These soils are

strongly acid to very strongly acid unless they are limed.

The soils in this unit are well suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond well to lime and fertilizer.

CAPABILITY UNIT IIe–1

This unit consists of well-drained, gently sloping soils of the Appling, Caroline, Cecil, Cullen, Elioak, Nason, and Turbeville series that are slightly eroded and moderately eroded. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is mainly fine textured.

The available moisture capacity of these soils is moderate to high. Permeability is moderate in all except the Caroline soil, which has moderately slow permeability. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid unless they are limed.

The soils in this unit are well suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond well to lime and fertilizer. If these soils are cultivated, further erosion is a moderate hazard.

CAPABILITY UNIT IIe–2

This unit consists of well-drained, gently sloping soils of the Fairfax, Kempsville, Marr, Sassafras, and Wickham series. The surface layer of these soils is moderately coarse textured to medium textured, and the subsoil is mainly moderately fine textured.

The available moisture capacity is moderate to high. The permeability is moderate. Natural fertility and organic-matter content are low to moderate. These soils are medium acid to very strongly acid unless they are limed.

The soils in this unit are well suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond well to lime and fertilizer. If these soils are cultivated, erosion is a moderate hazard.

CAPABILITY UNIT IIe–3

This unit consists of well-drained, gently sloping soils of the Mecklenburg and Zion series that are slightly eroded and moderately eroded. The surface layer of these soils is medium textured, and the subsoil is mainly fine textured.

The available moisture capacity of these soils is moderate. Permeability is moderately slow to slow. Natural fertility is moderate, and organic-matter content is low to moderate. These soils are medium acid to neutral.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond to lime and fertilizer. If these soils are cultivated, further erosion is a moderate hazard.

CAPABILITY UNIT IIe–4

This unit consists of moderately well drained, gently sloping soils of the Altavista, Dogue, Tetotum, and Woodstown series. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is moderately fine textured or fine textured. The seasonal high water table of these soils is at a depth of 1½ to 3½ feet. The available moisture capacity is moderate to high. Permeability is moderate in all except the Dogue soil, which has moderately slow permeability. Natural fertility and organic-matter content are low to moderate. These soils are medium acid to very strongly acid unless they are limed.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond well to lime and fertilizer. If alfalfa is grown, it is commonly short lived, because wetness is excessive in winter and in spring. If these soils are cultivated, erosion is a moderate hazard.

CAPABILITY UNIT IIw–1

This unit consists of moderately well drained, nearly level soils of the Altavista, Dogue, Tetotum, and Woodstown series. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is moderately fine textured or fine textured. The seasonal high water table of these soils is at a depth of 1½ to 3½ feet.

The available moisture capacity is moderate to high. Permeability is moderate in all except the Dogue soil, which has moderately slow permeability. Natural fertility and organic-matter content are low to moderate. These soils are medium acid to very strongly acid unless they are limed.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond well to lime and fertilizer. If alfalfa is grown, it is short lived, because wetness is excessive.

CAPABILITY UNIT IIw–2

This unit consists of well drained or moderately well drained, nearly level and very gently sloping soils of the Congaree, Iuka, Meadowville, and State series. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is moderately coarse textured to moderately fine textured. The seasonal high water table of these soils is at a depth of 2½ to 5 feet.

The available moisture capacity is moderate to high. These soils are either frequently flooded, or they receive seepage and runoff from surrounding uplands. Permeability is moderate in all except the State soil, which has moderately rapid permeability. Natural fertility and organic-matter content are low to moderate. These soils are medium acid to very strongly acid unless they are limed.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond well to lime and fertilizer. If alfalfa is grown on Iuka soil, it is commonly short lived, because wetness is excessive.

CAPABILITY UNIT IIs–1

This unit consists of well-drained, gently sloping soils of the Aura and Westphalia series, and nearly level to gently sloping soils of the Wickham series, thin solum variant. The surface layer of these soils is coarse textured to medium textured, and the subsoil is moderately coarse textured to moderately fine textured.

The available moisture capacity is moderate to low. Permeability is moderate to moderately rapid. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid unless they are limed.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond to lime and fertilizer. These soils are droughty during the growing season. If these soils are cultivated, erosion is a slight to moderate hazard.

CAPABILITY UNIT IIIe–1

This unit consists of well-drained, sloping and strongly sloping, eroded soils of the Appling, Caroline, Cecil, Cullen, Elioak, Nason, and Turbeville series. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is mainly fine textured.

The available moisture capacity of these soils is moderate to high. Permeability is moderate in all except the Caroline soil, which has moderately slow permeability. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid unless they are limed.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond well to lime and fertilizer. If these soils are cultivated, erosion is a severe hazard.

CAPABILITY UNIT IIIe–2

This unit consists of well drained to moderately well drained, sloping, eroded soils of the Altavista, Aura, Kempsville, Marr, Sassafras, Tetotum, and Wickham series, and Wickham series, thin solum variant. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is mainly moderately fine textured. Altavista and Tetotum soils are moderately well drained and have a seasonal high water table at a depth of 1½ to 3½ feet.

The available moisture capacity is moderate in all except Wickham soil, thin solum variant, which has moderate to low available moisture capacity. Permeability is moderate to moderately rapid. Natural fertility and organic-matter content are low to moderate. These soils are medium acid to very strongly acid unless they are limed.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area. If alfalfa is grown on Altavista and Tetotum soils, it generally is short lived because wetness is excessive. Artificial drainage generally is beneficial on Altavista and Tetotum soils, and crops on them respond well to lime and fertilizer. Wickham soil, thin solum variant, is droughty during the growing season, and crop response to lime and fertilizer is not as good as on the other soils. If these soils are cultivated, erosion is a severe hazard.

CAPABILITY UNIT IIIe–3

This unit consists of well-drained, sloping, moderately eroded soils of the Mecklenburg and Zion series. The surface layer of these soils is medium textured, and the subsoil is mainly fine textured.

The available moisture capacity is moderate. Permeability is moderately slow to slow. Natural fertility is low to moderate, and organic-matter content is moderate. These soils are medium acid to neutral.

The soils in this unit are suited to all field crops, grasses, and legumes adapted to this area, and crops on them respond to lime and fertilizer. If these soils are cultivated, erosion is a moderate to severe hazard.

CAPABILITY UNIT IIIe–4

This unit consists of moderately well drained to somewhat poorly drained, gently sloping soils of the Craven, Lignum, and Orange series. The surface layer of these soils is medium textured and the subsoil is fine textured. The seasonal high water table of the soils is at a depth of 1 to 5 feet.

The available moisture capacity is moderate to high. The Craven and Orange soils have slow permeability, and the Lignum soil has moderately slow permeability. Natural fertility and organic-matter content are low. Craven and Lignum soils are strongly acid to very strongly acid, unless they are limed. Orange soil is medium acid to strongly acid, but it is neutral in the substratum.

The soils in this unit are suited to most field crops, grasses, and legumes adapted to this area, and crops on them respond to lime and fertilizer. Alfalfa is commonly short lived because wetness is excessive. If these soils are cultivated, erosion is a severe hazard.

CAPABILITY UNIT IIIe–5

This unit consists of moderately well drained, gently sloping and sloping, slightly eroded and moderately eroded soils of the Atlee, Bourne, and Colfax series. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is mainly moderately fine textured. A fragipan is at a depth of 18 to 35 inches. The seasonal high water table of these soils is at a depth of 1½ to 2½ feet.

The available moisture capacity is low to moderate. Permeability of the fragipan is slow to very slow. The fragipan limits movement of water and penetration of plant roots. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid, unless they are limed. They are droughty during the growing season.

The soils in this unit are suited to most field crops, grasses, and legumes adapted to this area. Alfalfa is short lived because of rooting restrictions and excess wetness. If these soils are cultivated, erosion is a severe hazard.

CAPABILITY UNIT IIIw–1

This unit consists of moderately well drained to somewhat poorly drained, nearly level soils of the Craven, Lignum, Orange, Pooler, and Wahee series. The surface layer of these soils is medium textured, and the subsoil is fine textured. The seasonal high water table of these soils is at a depth of 1 to 5 feet.

The available moisture capacity is moderate to high. Permeability is slow in all except the Lignum soils, which have moderately slow permeability. Natural fertility is low to moderate, and organic-matter content is low. These soils, except Orange, are strongly acid to very strongly acid, unless they are limed. The Orange soil is medium acid to strongly acid in the subsoil and generally is neutral in the substratum.

The soils in this unit are suited to most field crops, grasses, and legumes adapted to this area. Alfalfa is commonly short lived because wetness is excessive.

CAPABILITY UNIT IIIw–2

This unit consists of moderately well drained to poorly drained, nearly level and very gently sloping soils of the Augusta, Bertie, Cartecay, and Fallsington series. The surface layer of these soils is moderately coarse textured to medium textured, and the subsoil is moderately coarse textured to moderately fine textured. Depth of the seasonal high water table ranges from 0 to 1½ feet. Cartecay soils are frequently flooded, and drainage outlets are difficult to locate on all of these soils.

The available moisture capacity is moderate to high. Permeability is moderate in all except the Cartecay soil, which has moderately rapid permeability. Natural fertility and organic-matter content are low to moderate. The Augusta soil is strongly acid, and the Bertie and Fallsington soils are strongly acid to extremely acid, unless they are limed. The Cartecay soil is slightly acid to medium acid.

The soils in this unit are suited to most field crops, grasses, and legumes adapted to this area. Alfalfa is short lived because wetness is excessive.

CAPABILITY UNIT IIIw–3

This unit consists of moderately well drained to somewhat poorly drained, nearly level soils of the Atlee and Bourne series and gently sloping soils of the Colfax series. The surface layer of these soils is moderately coarse textured to medium textured, and the subsoil is mainly moderately fine textured. A fragipan is at a depth of 18 to 35 inches. The fragipan restricts movement of water and penetration of plant roots. The seasonal high water table of these soils is at a depth of 1 to 2½ feet. The available moisture capacity is low to moderate.

The fragipan is slowly to very slowly permeable. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid unless they are limed. They are droughty during the growing season.

The soils in this unit are suited to most field crops, grasses, and legumes adapted to this area. Alfalfa is short lived because of rooting restrictions and excessive wetness.

CAPABILITY UNIT IVe–1

This unit consists of well-drained, strongly sloping, eroded soils of the Aura, Caroline, Kempsville, Marr, and Sassafras series; sloping and strongly sloping soils of the Westphalia series; and strongly sloping soils of the Caroline-Sassafras complex. The surface layer of these soils is moderately coarse textured, and the subsoil is mainly moderately fine textured, but the Caroline soil has a fine-textured subsoil, and the Westphalia soil has a medium-textured subsoil.

The available moisture capacity is moderate in all these soils except Westphalia, which ranges from moderate to low. Permeability is moderate in all except the Caroline soil, which has moderately slow permeability, and the Westphalia soil, which has moderate to moderately rapid permeability. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid unless they are limed.

The soils of this unit are suited to most field crops, grasses, and legumes adapted to this area, and crops on them respond to lime and fertilizer. If these soils are cultivated, erosion is a very severe hazard.

CAPABILITY UNIT IVe–2

This unit consists of well-drained, sloping to strongly sloping, severely eroded soils of the Appling, Caroline, Cecil, Cullen, Elioak, Mecklenburg, and Nason series; moderately well drained, sloping, eroded soils of the Orange series; and moderately well drained, gently sloping to sloping, moderately eroded to severely eroded soils of the Susquehanna series. The surface layer of these soils is mainly moderately fine textured, and the subsoil is fine textured.

The available moisture capacity of these soils is moderate to high. The Appling, Cecil, Nason, Cullen, Elioak, and Nason soils are moderately permeable. Permeability of the Caroline soil is moderately slow, and permeability of Mecklenburg, Orange, and Susquehanna soils is slow or very slow. Natural fertility is low to moderate, and organic-matter content is low. These soils are strongly acid to very strongly acid, unless they are limed, but the Mecklenburg soil is medium acid to slightly acid, and the Orange soil is medium acid to strongly acid in the subsoil, but it is generally neutral in the substratum.

The soils in this unit are suited to most field crops, grasses, and legumes adapted to this area, and crops on them respond to lime and fertilizer. If these soils are cultivated, erosion is a very severe hazard. They are better suited to close-growing crops than to row crops.

CAPABILITY UNIT IVe–3

This unit consists of well-drained to excessively drained, sloping and strongly sloping soils of the Ashlar and Manor series. The surface layer of these soils is moderately coarse textured or medium textured, and the subsoil is moderately coarse textured or medium textured.

The available moisture capacity of these soils is low to moderate. Permeability is moderately rapid to rapid. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid, unless they are limed. They are droughty during the growing season.

The soils in this unit are poorly suited to most field crops adapted to this area; however, crops on them respond to lime and fertilizer. Those soils are better suited to close growing crops than to row crops. Where these soils are cultivated, erosion is a very severe haard.

CAPABILITY UNIT IVw–1

This unit consists of poorly drained, nearly level soils of the Bladen, Elbert, Roanoke, and Worsham series. The surface layer of these soils is medium textured, and the subsoil is fine textured. Depth of the seasonal high water table ranges from 0 to 1 foot. Drainage outlets are difficult to locate.

The available moisture capacity is moderate. Permeability is slow to very slow. Natural fertility and organic-matter content are low to moderate. These soils are strongly acid to very strongly acid, but the Elbert soil is medium acid to slightly acid.

The soils in this unit are poorly suited to field crops, but are suited to grasses and legumes that can tolerate wetness.

CAPABILITY UNIT IVw–2

Wehadkee very fine sandy loam is the only soil in this unit. It is poorly drained and nearly level. The surface layer and the subsoil of this soil are medium textured. Depth of the seasonal high water table ranges from 0 to 1 foot. Drainage outlets are difficult to locate, and this soil is subject to frequent flooding.

The available moisture capacity is high, and permeability is moderate. Natural fertility and organic-matter content are low. This soil is strongly acid.

This soil is poorly suited to field crops, grasses, and legumes adapted to this area.

CAPABILITY UNIT VIe–1

This unit consists of well-drained to somewhat excessively drained, strongly sloping to moderately steep soils of the Aura, Caroline, Marr, Sassafras, and Westphalia series that are moderately to severely eroded. It also consists of sloping to moderately steep soils of the Aura-Galestown-Sassafras complex, the Caroline-Sassafras complex, and the Galestown-Sassafras complex. The surface layer of these soils ranges from coarse textured to moderately fine textured, and the subsoil ranges from coarse textured to fine textured.

The available moisture capacity of these soils is moderate to low. Permeability ranges from rapid to moderately slow. Natural fertility and organic-matter content are low. These soils are strongly acid to very strongly acid.

The soils in this unit are suited to pastures of adapted grasses and legumes, or to woodland. They have a severe erosion hazard unless a thick plant cover is maintained.

CAPABILITY UNIT VIe–2

This unit consists of well-drained to excessively drained, sloping, strongly sloping, and moderately steep soils of the Ashlar, Bremo, Manor, and Watt series. The surface layer and subsoil of these soils are moderately coarse textured to medium textured.

The available moisture capacity of these soils is low to moderate. Permeability is moderately rapid to rapid. Natural fertility and organic-matter content are low. These soils are medium acid to extremely acid. They are droughty during the growing season.

The soils in this unit are suited to pastures of adapted grasses and legumes, or to woodland. They have a severe hazard of erosion unless a thick plant cover is maintained.

CAPABILITY UNIT VIw–1

This unit consists of poorly drained, nearly level to gently sloping soils of the Bibb series and Alluvial land, wet. The surface layer and subsoil of these soils is mainly moderately coarse textured. Depth of the seasonal high water table ranges from 0 to 1 foot. They are very frequently flooded.

The available moisture capacity is moderate, and permeability is moderate to rapid. Natural fertility is low, and organic-matter content is low to moderate. These soils are medium acid to very strongly acid.

The soils in this unit are best suited to pastures of water-tolerant grasses and legumes, or to woodland. They are frequently flooded or too wet to be suited to other crops.

CAPABILITY UNIT VIIe–1

This unit consists of well-drained to excessively drained, moderately steep to steep soils of the Ashlar, Bremo, and Watt series, and moderately steep and steep soils of the Galestown-Sassafras complex, and Sandy and clayey land, steep, Sassafras and Caroline materials. The surface layer of these soils is coarse textured to medium textured, and the subsoil is coarse textured to fine textured.

The availability moisture capacity is moderate to low. Permeability ranges from rapid to moderately slow. Natural fertility and organic-matter content are low. These soils are medium acid to extremely acid.

The soils in this unit are suited to native pasture or to woodland. They have a very severe erosion hazard unless a thick plant cover is maintained.

CAPABILITY UNIT VIIw–1

Fresh water swamp is the only area in this unit. The texture of this land is variable, but it is commonly a mixture of sand, silt, clay, and muck. The surface is covered by water much of the time.

Fresh water swamp is so wet and its reclamation so impractical and expensive that its use for farming is improbable. Some timber or other woodland products may be obtained, but its use is commonly limited to woodland and to wildlife habitat.

CAPABILITY UNIT VIIs–1

This unit consists of Alluvial land, sandy and gravelly, Sand and gravel pits, Stony rolling land, and Stony steep land. These miscellaneous land types are quite variable as to texture, drainage, available moisture capacity, permeability, fertility, and acidity. Use and management of these land types need onsite determination.

CAPABILITY UNIT VIIIw–1

Tidal marsh is the only area in this unit. It is subject to regular flooding by tidal waters, and is not suited to farming. It does not support trees of commercial value in its natural conditions. Its most common use is for wildlife habitat, particularly waterfowl and muskrats.

Estimated yields

The soils of Stafford and King George Counties vary a great deal in suitability for crops. Some of them consistently produce fairly high yields of most cultivated crops. Others, though suitable for cropping, produce lower yields. Some soils are better suited to less intensive use.

Estimates of yields of specified general crops on most soils in the county are shown in table 2 using two levels of management. In columns A are estimated ordinary yields per acre obtained using the management common to the counties. In columns B are the estimated average yields using improved management.

Yields in columns B of table 2 are those that can be expected when the farmer uses the improved management listed in the paragraphs that follow.

1. Contour tillage, stripcropping, terracing, minimum tillage, or similar measures are used where needed to help control erosion; the soils

that need drainage are drained; excess water is disposed of safely.
2. Cropping systems are adequately planned to permit their use within the capabilities of the soil and to meet the needs of the farm operator.
3. Manure and crop residue are turned under to supply nitrogen, other nutrients, and organic matter so that the physical condition of the soil is improved and erosion is reduced.
4. Fertilizer and lime are applied according to the needs indicated by soil tests.
5. Tillage is kept to a minimum, but suitable methods of plowing, preparing the seedbed, and cultivating are used.
6. Planting, cultivating, and harvesting are done at the proper time and in the proper way.
7. Weeds, diseases, and insects are controlled.

The yields shown in columns B are not presumed to be the highest yields obtainable, but they set a goal that is practical for most farmers if they use improved management. Yields on the same soil can be expected to vary because of differences in the kind of management, in the weather, in the crop varities used, and in the numbers and kinds of insects and diseases.

More information about management practices needed to obtain good yields is found in the subsections "Capability Grouping" and "Use and Management of the Soils."

Woodland Uses of the Soils [2]

Approximately 185,628 acres, or 69 percent of the land area of Stafford and King George Counties, is wooded. Most of this is second-growth hardwoods, Virginia pine, and loblolly pine.

In the western half of Stafford County, on the Piedmont Plateau, the original tree growth consisted of mixed stands of chestnut oak, white oak, post oak, scarlet oak, black oak, northern red oak, southern red oak, and hickory, and yellow-poplar on the more moist sites. Shortleaf pine and Virginia pine were scattered throughout these hardwood stands. Poorly drained areas were covered by mixed stands of green ash, sweetgum, blackgum, boxelder, and red maple.

In the eastern half of Stafford County and all of King George County, on the Atlantic Coastal Plain, the original tree growth consisted of approximately the same mixed growth of hardwoods with Virginia pine and loblolly pine scattered throughout these hardwood stands. Shortleaf pine generally did not occur in the Coastal Plain forests.

Most of the original woodland was cleared and the soils cultivated as the lands were settled and consolidated into farm holdings. The present stands of mixed hardwoods, Virginia pine, and loblolly pine are mostly the results of the abandoning of farmland.

Woodland suitability groups

The soils of Stafford and King George Counties have been placed in 13 woodland suitability groups to help the farmer in planning the use of his soils. Each group is made up of soils that produce similar kinds of wood crops, need similar management, and have about the same potential productivity. Also, all the soils in one group are limited to about the same degree by the hazard of seedling mortality, plant competition, use of equipment, erosion, and windthrow. The names of soil series represented are mentioned in the description of each woodland suitability group, but this does not mean that all soils of a given series appear in the unit. The names of all soils in any given group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Potential productivity is expressed in terms of site index. The site index for a given soil is the height, in feet, that trees of a specified kind can be expected to reach in 50 years growing on a specified soil. The site indexes given in descriptions of woodland suitability groups are based on field data and field observation made cooperatively by the Virginia Division of Forestry and the Soil Conservation Service.

Hazards and limitations that affect management are rated in the relative terms of *slight*, *moderate*, and *severe*. These hazards and limitations are explained in the following paragraphs.

Seedling mortality refers to the expected degree of mortality of desirable natural or planted seedlings. A *slight* rating indicates that the expected loss of planted seedlings does not exceed 25 percent, and that adequate natural regeneration is expected. A *moderate* rating indicates that a loss of 25 to 50 percent of planted seedlings is expected, and that natural regeneration is not relied upon for adequate immediate stocking. A *severe* rating indicates that expected loss of planted seedlings exceeds 50 percent, and that natural regeneration of desirable species is unreliable.

Plant competition refers to the invasion and growth of undesirable species if openings are made in the canopy. This is significant to adequate restocking and growth of desired tree species. A *slight* rating indicates that invasion by undesirable species does not hinder natural regeneration or planted seedlings. A *moderate* rating indicates that competition will not prevent establishment of desirable species, but that some simple management practices, such as release of seedlings, is needed. A *severe* rating indicates that plant competition is so limiting that desirable natural regeneration or planted seedlings do not survive, unless site preparation, such as disking, harrowing, girdling, poisoning, or replanting, is made.

Equipment limitation refers to the difficulty in the use of equipment. Factors considered are soil slope, soil drainage, coarse fragments, texture of the surface layer of the soil, and the seasons of use. A *slight* rating indicates that the kind of equipment and season of use are not restricted. A *moderate* rating indicates that the kind of equipment or the operation of equipment is limited by one or more of the following: slope, coarse fragments, seasonal wetness, surface layer texture, soil stability, and tree injury. A *severe* rating indicates that the kind of, or the operation of, equipment is severely limited by one or more of the factors listed for the moderate rating, and by operational safety.

[2] By LUITPOLD W. KEMPF, woodland conservationist, Soil Conservation Service.

TABLE 2.—*Estimated average acre yields of*

[Yields in columns A are for ordinary management; those in columns B are for improved management.

Soil	Corn		Soybeans		Wheat	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Alluvial land, sandy and gravelly						
Alluvial land, wet						
Altavista fine sandy loam, 0 to 2 percent slopes	90	130	20	35	35	70
Altavista fine sandy loam, 2 to 6 percent slopes	80	120	20	35	35	70
Altavista fine sandy loam, 6 to 10 percent slopes, eroded	50	80	20	30	30	60
Appling fine sandy loam, 2 to 6 percent slopes	65	110	20	35	30	65
Appling fine sandy loam, 6 to 15 percent slopes, eroded	65	90	20	30	25	60
Appling gravelly fine sandy loam, 2 to 6 percent slopes	60	105	20	35	30	65
Appling gravelly fine sandy loam, 6 to 10 percent slopes, eroded	60	85	20	30	25	60
Appling clay loam, 6 to 15 percent slopes, severely eroded					15	40
Ashlar fine sandy loam, 6 to 15 percent slopes						
Ashlar fine sandy loam, 15 to 25 percent slopes						
Ashlar fine sandy loam, 25 to 35 percent slopes						
Atlee silt loam, 0 to 2 percent slopes	50	80	20	30	35	60
Atlee silt loam, 2 to 6 percent slopes	50	80	20	30	35	60
Augusta loam	70	100	25	35		
Aura gravelly fine sandy loam, 2 to 6 percent slopes	50	90	20	35	25	50
Aura gravelly fine sandy loam, 6 to 10 percent slopes, eroded	40	75	20	30	25	50
Aura gravelly fine sandy loam, 10 to 18 percent slopes, eroded	45	70	10	20	20	40
Aura gravelly fine sandy loam, 18 to 35 percent slopes, eroded						
Aura-Galestown-Sassafras complex, 6 to 15 percent slopes						
Aura-Galestown-Sassafras complex, 15 to 30 percent slopes						
Bertie very fine sandy loam, 0 to 3 percent slopes	60	100	20	35		
Bibb fine sandy loam						
Bladen loam	40	75				
Bourne fine sandy loam, 0 to 2 percent slopes	45	80	20	30	30	55
Bourne fine sandy loam, 2 to 6 percent slopes	45	80	20	30	30	50
Bourne fine sandy loam, 6 to 10 percent slopes, eroded	40	80	20	30	25	40
Bourne loam, rock substratum, 2 to 6 percent slopes	45	80	20	30	30	50
Bourne loam, rock substratum, 6 to 10 percent slopes, eroded	40	75	20	30	30	45
Bourne fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes	40	70	15	25	25	40
Bourne fine sandy loam, gravelly subsoil variant, 6 to 10 percent slopes, eroded	30	55	15	25	20	35
Bremo loam, 6 to 15 percent slopes						
Bremo loam, 15 to 35 percent slopes						
Caroline fine sandy loam, 2 to 6 percent slopes, eroded	70	110	20	30	30	60
Caroline fine sandy loam, 6 to 10 percent slopes, eroded	65	90	20	30	25	55
Caroline fine sandy loam, 10 to 18 percent slopes, eroded	45	70	10	20	20	40
Caroline clay loam, 6 to 10 percent slopes, severely eroded					15	35
Caroline clay loam, 10 to 18 percent slopes, severely eroded						
Caroline-Sassafras complex, 10 to 15 percent slopes	40	60	10	20	20	40
Caroline-Sassafras complex, 15 to 30 percent slopes						
Cartecay fine sandy loam	70	100	25	35		
Cecil fine sandy loam, 2 to 6 percent slopes, eroded	65	110	20	35	30	70
Cecil fine sandy loam, 6 to 15 percent slopes, eroded	65	90	20	35	25	60
Cecil gravelly fine sandy loam, 2 to 6 percent slopes, eroded	65	120	20	35	30	70
Cecil clay loam, 6 to 15 percent slopes, severely eroded					15	40
Colfax fine sandy loam, 2 to 6 percent slopes	45	70	20	30	30	50
Colfax fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes	40	80	20	30	30	45
Congaree loam	100	140	30	40	35	70
Craven loam, 0 to 2 percent slopes	55	100			25	50
Craven loam, 2 to 6 percent slopes	65	100	15	25	25	50
Cullen loam, 2 to 6 percent slopes, eroded	70	110	25	40	30	70
Cullen loam, 6 to 15 percent slopes, eroded	70	100	20	30	30	65
Cullen clay loam, 6 to 15 percent slopes, severely eroded					20	45
Cut and fill land						
Dogue loam, 0 to 2 percent slopes	90	120	20	35	35	70
Dogue loam, 2 to 6 percent slopes	80	120	20	35	35	70
Elbert silt loam, thin solum variant	40	75				

See footnote at end of table.

principal crops under two levels of management

Absence of data indicates stated crop is not grown or the soil is not suited to it]

Barley		Oats		Hay				Pasture			
				Alfalfa		Red clover		Orchardgrass and ladino clover		Fescue and ladino clover	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
										85	140
30	65	40	75			2. 0	3. 0	190	260	200	285
30	65	40	75			2. 0	3. 0	190	260	200	285
25	55	30	60			1. 5	2. 5	100	140	110	190
30	60	35	70	2. 5	4. 0	2. 0	3. 0	180	240	200	270
25	55	30	60	2. 5	4. 0	1. 5	2. 5	185	250	200	270
30	55	35	65	2. 5	4. 0	2. 0	3. 0	180	240	200	260
25	50	25	50	2. 0	3. 5	1. 5	2. 5	170	235	190	260
15	35	15	30	1. 0	2. 0	. 5	1. 5	90	170	100	190
								40	90	80	135
25	55	25	50			1. 0	2. 0	70	140	90	170
25	55	25	50			1. 0	2. 0	70	140	90	170
						1. 5	3. 0	130	220	170	250
25	50	30	50	1. 5	2. 5	1. 5	2. 0	90	170	110	190
25	50	30	50	2. 0	3. 0	1. 5	2. 0	80	130	90	170
20	40	25	40	1. 5	2. 5	1. 0	2. 0	75	120	80	150
								70	110	90	140
						2. 0	3. 0	110	190	150	240
										90	160
						1. 0	2. 5	80	150	90	170
20	50	25	45			1. 0	2. 0	70	140	85	160
20	40	25	40			1. 0	2. 0	70	130	80	160
20	40	25	40			. 5	1. 5	60	110	70	150
20	40	25	40			1. 0	2. 0	70	130	80	160
20	40	15	30			. 5	1. 5	60	110	60	145
15	35	20	35			1. 0	2. 0	70	130	80	160
15	25	15	25			. 5	1. 0	55	100	60	140
								70	120	90	150
30	60	35	65	2. 0	3. 5	2. 0	2. 5	190	260	200	270
25	55	30	55	2. 0	3. 5	1. 5	2. 5	180	250	200	270
20	40	25	40	1. 5	2. 5	1. 0	2. 0	70	130	90	160
15	35	15	30	1. 0	2. 0	. 5	1. 5	90	170	100	190
								70	140	90	170
20	40	25	40	1. 5	2. 5	1. 0	2. 0	70	120	90	160
						2. 0	3. 0	140	230	175	270
30	65	35	70	2. 5	4. 0	2. 0	3. 0	180	240	200	270
25	65	30	55	2. 5	4. 0	1. 5	2. 5	185	250	200	270
30	65	35	70	2. 5	4. 0	2. 0	3. 0	180	240	200	270
15	40	15	30	1. 0	2. 0	. 5	1. 5	90	170	100	190
25	45	25	45			1. 0	2. 0	70	140	90	170
20	40	25	40			1. 0	2. 0	70	125	75	160
45	70	45	70			2. 0	3. 0	140	240	190	290
30	50	35	55			2. 0	3. 0	100	180	110	190
30	55	30	55			2. 0	3. 0	120	190	120	180
30	65	35	70	2. 5	4. 0	2. 0	3. 0	180	240	200	280
25	55	30	60	2. 5	4. 0	1. 5	2. 5	170	240	200	280
20	40	15	35	1. 0	2. 0	. 5	1. 5	90	160	110	200
											260
30	65	40	75			2. 0	3. 0	190	260	200	285
30	65	40	75			2. 0	3. 0	190	260	200	285
						1. 0	2. 5	80	150	90	170

TABLE 2.—*Estimated average acre yields of principal*

Soil	Corn		Soybeans		Wheat	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Elioak silt loam, 2 to 6 percent slopes, eroded	60	100	20	30	35	60
Elioak silt loam, 6 to 15 percent slopes, eroded	55	80	20	30	25	50
Elioak silty clay loam, 6 to 15 percent slopes, severely eroded					20	40
Fairfax loam, 2 to 6 percent slopes	70	100	20	20	30	60
Fallsington very fine sandy loam	40	75				
Fresh water swamp						
Galestown-Sassafras complex, 6 to 15 percent slopes						
Galestown-Sassafras complex, 15 to 30 percent slopes						
Galestown-Sassafras complex, 30 to 45 percent slopes						
Iuka fine sandy loam, local alluvium	90	130	25	35	30	60
Kempsville fine sandy loam, 0 to 2 percent slopes	80	130	20	40	40	70
Kempsville fine sandy loam, 2 to 6 percent slopes	80	120	20	40	35	60
Kempsville fine sandy loam, gravelly substratum, 2 to 6 percent slopes	70	110	20	35	35	60
Kempsville fine sandy loam, gravelly substratum, 6 to 10 percent slopes, eroded	60	90	15	30	35	55
Kempsville fine sandy loam, gravelly substratum, 10 to 18 percent slopes, eroded	45	70	10	20	20	40
Lignum silt loam, 0 to 2 percent slopes	60	90			25	45
Lignum silt loam, 2 to 6 percent slopes	60	80	10	20	25	40
Manor silt loam, 6 to 15 percent slopes						
Manor silt loam, 15 to 35 percent slopes						
Marr very fine sandy loam, 2 to 6 percent slopes	75	110	20	40	35	60
Marr very fine sandy loam, 6 to 10 percent slopes, eroded	55	90	15	25	30	45
Marr very fine sandy loam, 10 to 15 percent slopes, eroded	40	65	10	20	15	40
Marr very fine sandy loam, 15 to 30 percent slopes, eroded						
Meadowville silt loam	90	130	25	40	35	70
Mecklenburg loam, 2 to 6 percent slopes, eroded	60	90	20	30	30	60
Mecklenburg loam, 6 to 10 percent slopes, eroded	60	85	20	25	30	65
Mecklenburg clay loam, 6 to 10 percent slopes, severely eroded					20	45
Nason silt loam, 2 to 6 percent slopes	60	90	20	30	30	60
Nason silt loam, 6 to 15 percent slopes, eroded	55	80	20	30	25	50
Nason silty clay loam, 6 to 10 percent slopes, severely eroded					15	35
Orange loam, 0 to 2 percent slopes	55	90			30	50
Orange loam, 2 to 6 percent slopes	65	90	15	25	25	45
Orange loam, 6 to 10 percent slopes, eroded					15	35
Pooler loam, thin solum variant	65	100	25	35	30	50
Roanoke silt loam	40	75				
Sand and gravel pits						
Sandy and clayey land, steep, Sassafras and Caroline materials						
Sassafras fine sandy loam, 0 to 2 percent slopes	80	130	20	40	40	70
Sassafras fine sandy loam, 2 to 6 percent slopes	80	120	20	40	35	60
Sassafras fine sandy loam, 6 to 10 percent slopes, eroded	65	100	15	35	35	60
Sassafras fine sandy loam, 10 to 15 percent slopes, eroded	40	70	10	25	20	45
Sassafras fine sandy loam, 15 to 35 percent slopes, eroded						
State fine sandy loam, local alluvium	90	130	25	40	35	70
Stony rolling land						
Stony steep land						
Susquehanna soils, 2 to 10 percent slopes					15	40
Tetotum fine sandy loam, 0 to 2 percent slopes	80	120	20	35	35	70
Tetotum fine sandy loam, 2 to 6 percent slopes	80	120	20	35	35	70
Tetotum fine sandy loam, 6 to 10 percent slopes, eroded	65	100	15	25	30	60
Tidal marsh						
Turbeville loam, 0 to 2 percent slopes	90	140	25	45	45	80
Turbeville loam, 2 to 6 percent slopes	75	120	25	45	35	80
Turbeville loam, 6 to 15 percent slopes, eroded	70	100	20	30	30	65
Wahee silt loam	60	90			25	40
Watt silt loam, gray surface variant, 10 to 15 percent slopes						
Watt silt loam, gray surface variant, 15 to 35 percent slopes						
Wehadkee very fine sandy loam	40	80				
Westphalia loamy very fine sand, 2 to 6 percent slopes	50	80	20	25	30	50
Westphalia loamy very fine sand, 6 to 15 percent slopes, eroded	40	65	10	20	15	30
Westphalia loamy very fine sand, 15 to 30 percent slopes, eroded						

See footnote at end of table.

crops under two levels of management—Continued

Barley		Oats		Hay				Pasture			
				Alfalfa		Red clover		Orchardgrass and ladino clover		Fescue and ladino clover	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
30	60	35	60	2.0	3.5	2.0	3.0	160	230	180	260
25	50	30	50	2.0	3.5	1.0	2.0	160	220	180	240
20	30	20	35	1.0	1.5	.5	1.0	80	160	90	190
30	60	35	60	2.0	3.5	2.0	3.0	160	220	180	250
						1.0	2.5	110	200	140	220
								60	110	90	150
40	65	40	65			2.0	3.0	130	220	180	275
35	75	40	75	2.5	4.0	1.5	3.0	180	250	200	280
35	75	40	75	2.5	4.0	1.5	3.0	160	250	200	280
35	65	40	65	2.5	4.0	1.5	3.0	180	250	200	280
30	60	35	60	2.5	3.5	1.5	3.0	110	200	120	200
20	40	25	40	1.5	2.5	1.0	2.0	85	140	90	170
25	50	30	50			1.5	2.5	90	160	100	180
25	50	30	50			1.5	2.5	120	200	130	220
								50	110	75	130
35	60	35	60	2.0	3.5	1.5	3.0	170	240	200	270
30	55	30	55	2.0	3.5	1.5	2.5	110	200	120	200
20	40	20	35	1.0	2.5	1.0	1.5	80	120	90	170
								75	120	80	150
35	70	40	70			2.0	3.0	150	260	210	285
30	60	35	60	2.0	3.5	2.0	3.0	160	220	180	250
30	55	30	60	2.0	3.5	1.0	2.0	170	240	180	250
20	40	20	35	1.0	2.0	.5	1.5	90	160	90	170
30	55	35	60	2.0	3.5	2.0	3.0	100	220	180	250
25	50	25	50	1.5	3.0	1.0	2.0	150	230	170	250
15	30	15	25	1.0	2.0	.5	1.5	80	160	90	170
30	45	30	50			1.0	2.5	90	160	95	170
30	40	35	50			1.5	3.0	110	180	120	170
15	30	20	40			1.0	2.0	90	140	90	170
25	45	35	60			2.0	3.0	170	220	220	285
						1.0	2.5	90	160	100	190
35	75	40	75	2.5	4.0	1.5	3.0	180	250	200	280
35	75	40	75	2.5	4.0	1.5	3.0	180	250	200	280
30	65	35	65	2.0	3.5	1.5	2.5	100	190	110	190
20	40	25	45	1.5	2.5	1.0	1.5	80	130	90	170
								70	120	90	180
35	70	40	70			2.0	3.0	160	260	210	285
15	30	15	30			.5	1.5	90	160	100	190
30	65	40	75			2.0	3.0	190	260	220	285
30	65	40	75			2.0	3.0	190	260	210	285
25	55	30	55			1.5	2.5	100	200	120	200
40	80	45	80	3.0	4.5	2.0	3.0	190	260	210	285
35	75	40	75	3.0	4.5	2.0	3.0	190	260	210	285
25	55	30	65	2.5	4.0	1.5	2.5	180	240	190	255
25	40	35	60			1.5	3.0	90	150	100	170
								60	100	80	120
						1.0	2.5	80	150	90	170
30	55	30	50	1.0	2.5	1.0	2.0	80	170	90	180
25	40	20	35	1.0	2.0	.5	1.5	65	100	80	140
								70	100	80	120

TABLE 2.—*Estimated average acre yields of principal*

Soil	Corn		Soybeans		Wheat	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Wickham fine sandy loam, 0 to 2 percent slopes	90	140	25	45	45	80
Wickham fine sandy loam, 2 to 6 percent slopes	85	120	25	45	35	75
Wickham fine sandy loam, 6 to 12 percent slopes, eroded	65	100	20	35	30	65
Wickham sandy loam, thin solum variant, 0 to 2 percent slopes	60	80	20	30	35	55
Wickham sandy loam, thin solum variant, 2 to 6 percent slopes	60	80	20	30	30	55
Wickham sandy loam, thin solum variant, 6 to 12 percent slopes	50	70	15	25	20	50
Woodstown fine sandy loam, 0 to 2 percent slopes	80	120	20	35	35	70
Woodstown fine sandy loam, 2 to 6 percent slopes	80	110	20	35	30	55
Worsham loam	40	75				
Zion loam, deep variant, 2 to 6 percent slopes	55	90	20	30	25	55
Zion loam, deep variant, 6 to 10 percent slopes, eroded	50	70	20	25	25	55

[1] A term used to express the carrying capacity of pasture. It is the number of animal units carried per acre multiplied by the days of grazing for 2 cows has a carrying capacity of 60 cow-acre-days.

Erosion hazard refers to the potential hazard of erosion where damage is done to soils by the construction, use, and maintenance of roads, trails, and landings. Factors considered are soil slope, soil drainage, soil thickness, texture of the surface layer and subsoil, and soil stability. A *slight* rating indicates that roads, trails, and landings can be constructed and used with minimum soil damage. A *moderate* rating indicates that some restrictions on the construction of roads, trails, and landings are needed to limit excessive soil erosion or damage. A *severe* rating indicates that the construction and use of roads, trails, and landings must be restricted to prevent excessive soil erosion and damage, and that erosion-control practices must be installed.

Windthrow hazard refers to the danger of trees being blown over by normal wind. Factors considered are soil thickness, texture of the surface layer and subsoil, wetness, rooting zone restrictions, kinds of trees, thinning, cutting, protective borders, and other forestry practices. A *slight* rating indicates that root development is normal and trees are not expected to be blown down in commonly occurring winds. A *moderate* rating indicates that root development is adequate for stability, except for periods of excessive soil wetness and high wind. A *severe* rating indicates that rooting depth does not give adequate stability. The rooting restriction may be excessive wetness, a restrictive layer in the soil, or unstable soil materials. Individual trees can blow over if released on all sides.

WOODLAND SUITABILITY GROUP 1

This group consists of deep, well drained and moderately well drained soils of the Appling, Congaree, Cullen, Iuka, Meadowville, State, and Turbeville series. These soils have a surface layer of fine sandy loam, silt loam, or loam and a subsoil of loam to clay. Permeability and available moisture capacity are moderate. Organic-matter content and natural fertility are low to moderate.

Species to favor on these soils are loblolly pine, yellow-poplar, red and white oaks, Virginia pine, and shortleaf pine. The preferred species for planting are loblolly pine and yellow-poplar.

These soils are well suited to pine and hardwoods. The site indexes for loblolly pine are 85 to 95, for Virginia pine 65 to 75, for shortleaf pine 65 to 75, for yellow-poplar 95 plus, and for oaks 65 to 75.

Seedling mortality is slight, and ample moisture generally is available for seedlings to develop. Equipment limitations and the hazard of erosion are slight because these soils are loamy and well drained and moderately well drained, and slopes are fairly gentle. Windthrow is slight, for the depth to which roots can penetrate is not restricted. Plant competition is moderate because growth of seedlings is somewhat restricted by existing vegetation.

WOODLAND SUITABILITY GROUP 2

This group consists of deep, moderately well drained and somewhat poorly drained soils of the Bertie, Craven, Lignum, Pooler, and Wahee series. These soils have a surface layer of loam, silt loam, or very fine sandy loam and a subsoil of clay loam to clay. They have moderate to slow permeability and moderate to high available moisture capacity. Organic-matter content and natural fertility are low.

Species to favor on these soils are loblolly pine, Virginia pine, red and white oaks, and sweetgum. The preferred species for planting is loblolly pine.

These soils can be managed for both pine and hardwoods. The site index for loblolly pine is 85 to 95.

Seedling mortality is slight, and ample moisture generally is available for seedlings to develop. Equipment limitations are moderate in wet seasons because of a frequent seasonal high water table. The hazard of erosion is slight because slopes are fairly gentle. Windthrow is slight, for the depth to which roots can penetrate is

crops under two levels of management—Continued

Barley		Oats		Hay				Pasture			
				Alfalfa		Red clover		Orchardgrass and ladino clover		Fescue and ladino clover	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
40	80	45	80	3.0	4.5	2.0	3.0	190	260	210	285
35	75	40	75	3.0	4.5	2.0	3.0	190	260	210	285
25	65	30	70	2.5	3.5	1.5	2.5	110	200	120	200
30	55	35	55	1.5	2.5	1.0	2.0	80	170	100	190
30	55	35	55	1.5	2.5	1.0	2.0	80	170	100	190
30	50	30	55	1.0	2.0	.5	1.5	80	110	80	170
30	65	40	70	----------	----------	2.0	3.0	180	240	190	270
30	60	35	70	----------	----------	1.5	2.5	170	240	190	260
----------	----------	----------	----------	----------	----------	1.0	2.0	80	145	90	170
30	50	30	55	1.5	3.0	1.5	2.5	150	210	160	235
30	50	30	55	1.5	2.5	.5	1.5	140	200	150	220

[1] number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30

not restricted. Plant competition is moderate because growth of seedlings is somewhat restricted by existing vegetation.

WOODLAND SUITABILITY GROUP 3

This group consists of deep, well-drained soils of the Mecklenburg and Zion series. These soils have a loam surface layer and a subsoil of clay loam to clay. Permeability is moderately slow to slow, and available moisture capacity is moderate. Organic-matter content is low to moderate, and natural fertility is moderate.

Species to favor on these soils are loblolly pine, Virginia pine, and shortleaf pine. The preferred species for planting is loblolly pine.

These soils are well suited to loblolly pine and Virginia pine, but they are limited in the production of hardwoods and shortleaf pine. The site indexes for loblolly pine are 65 to 75, for Virginia pine 65 to 75, for shortleaf pine 55 to 65, for oaks 55 to 65, and for yellow-poplar 65 to 75.

Seedling mortality is slight, and ample moisture generally is available for seedlings to develop. Equipment limitations and the hazard of erosion are slight because these soils are well drained and slopes are fairly gentle. Windthrow is slight, for the depth to which roots can penetrate is not restricted. Plant competition is slight because growth of seedlings is restricted only slightly by existing vegetation.

WOODLAND SUITABILITY GROUP 4

This group consists of deep, well drained and moderately well drained soils of the Cecil, Dogue, Elioak, Fairfax, Kempsville, Nason, Sassafras, Tetotum, Wickham, and Woodstown series. These soils have a surface layer of sandy loam, fine sandy loam, gravelly fine sandy loam, loam, or silt loam, and a subsoil of sandy clay loam to clay. They have moderately rapid to moderately slow permeability, and moderate to high available moisture capacity. Organic-matter content and natural fertility are low.

Species to favor on these soils are loblolly pine, red and white oaks, yellow-poplar, Virginia pine, and shortleaf pine. Preferred species for planting are loblolly pine and yellow-poplar. The site indexes for loblolly pine are 75 to 85, for oaks 75 to 85, for yellow-poplar 85 to 95, for Virginia pine 65 to 75, and for shortleaf pine 65 to 75.

Seedling mortality is slight, and ample moisture generally is available for seedlings to develop. The hazard of erosion is slight on slopes less than 12 percent and moderate to severe on slopes of more than 12 percent. Equipment limitations are slight on slopes less than 12 percent and moderate on slopes of more than 12 percent. Windthrow is slight, for the depth to which roots can penetrate is not restricted. Plant competition is slight because growth of seedlings is restricted only slightly by existing vegetation.

WOODLAND SUITABILITY GROUP 5

This group consists of deep, poorly drained soils of the Bibb, Bladen, Fallsington, Roanoke, Wehadkee, and Worsham series and Alluvial land, wet. These soils have a surface layer of loam, silt loam, or very fine sandy loam, and a subsoil of fine sandy loam to clay. They have moderately rapid to slow permeability and moderate available moisture capacity. Organic-matter content and natural fertility are low to moderate.

Species to favor on these soils are loblolly pine, red and white oaks, yellow-poplar on higher elevations, and sweetgum. The preferred species for planting is loblolly pine.

These soils can be managed for loblolly pine and water-loving hardwoods. The site indexes for loblolly pine are 75 to 85, for oaks 65 to 75, for yellow-poplar 75 to 85, and for sweetgum 75 to 85.

Seedling mortality and plant competition are moderate to severe because of the seasonal high water table, and because growth is restricted by existing vegetation. The hazard of erosion and windthrow are slight. Equipment limitations are moderate to severe because of the seasonal high water table (fig. 6).

WOODLAND SUITABILITY GROUP 6

This group consists of deep, moderately well drained to somewhat poorly drained soils of the Altavista, Augusta, and Cartecay series. These soils have a surface layer of fine sandy loam or loam and a subsoil of fine sandy loam to clay loam. They have moderately rapid to moderate permeability and moderate available moisture capacity. Organic-matter content and natural fertility are low to moderate.

Species to favor on these soils are loblolly pine, oaks, sweetgum, yellow-poplar, and Virginia pine. The preferred species for planting is loblolly pine.

These soils can be managed for both pine and hardwoods. The site indexes for loblolly pine are 75 to 85, for Virginia pine 65 to 75, for oaks 70 to 80, for sweetgum 80 to 90, and for yellow-poplar 80 to 90. The site index of yellow-poplar is on Altavista and Cartecay soils only.

Seedling mortality and plant competition are moderate because of the seasonal high water table, and because growth is restricted by existing vegetation. The hazard of erosion is slight. Equipment limitations are moderate because of the seasonal high water table. Windthrow is slight to moderate because the depth to which roots can penetrate is somewhat restricted.

WOODLAND SUITABILITY GROUP 7

This group consists of moderately deep, well-drained to excessively drained soils of the Ashlar, Bremo, Manor, and Watt series. These soils have a surface layer and subsoil of fine sandy loam, loam, or silt loam. They have moderately rapid to rapid permeability and a low to moderate available moisture capacity. Organic-matter content and natural fertility are low.

***Figure 6.*—Equipment used in harvesting trees cut deep ruts in the Fallsington soil late in winter and early in spring when the water table was high.**

Species to favor on these soils are loblolly pine, Virginia pine, and shortleaf pine. Hardwoods commonly grow well at the base of slopes and in pockets where soil materials have accumulated to form deeper soils. The preferred species for planting is loblolly pine.

These soils are primarily managed for loblolly pine. The site indexes for loblolly pine are 75 to 85, for Virginia pine 65 to 75, for shortleaf pine 55 to 65, and for oaks 55 to 65.

Seedling mortality is moderate because the soils are droughty. Plant competition is slight. The hazard of erosion is slight on slopes of less than 15 percent and moderate on slopes of more than 15 percent. Windthrow is moderate, because the depth to which roots can penetrate is restricted. Equipment limitations are slight to moderate depending on steepness and length of slope.

WOODLAND SUITABILITY GROUP 8

This group consists of moderately well drained to somewhat poorly drained soils that have a fragipan. These soils are of the Atlee, Bourne, and Colfax series. They have a surface layer of fine sandy loam, loam, or silt loam and a subsoil of thin sandy clay loam, clay loam, or silt loam. The fragipan is at a depth of 18 to 35 inches. These soils have a slowly to very slowly permeable fragipan and a low to moderate available moisture capacity. Organic-matter content and natural fertility are low.

Species to favor on these soils are loblolly pine and Virginia pine. The preferred species for planting is loblolly pine.

These soils are managed only for pine. The site index for loblolly pine is 65 to 75.

Seedling mortality, plant competition, and the hazard of erosion are slight. Equipment limitations are moderate because the water table is perched during wet seasons. Windthrow generally is moderate to severe because of the limiting effect of the fragipan on root penetration.

WOODLAND SUITABILITY GROUP 9

This group consists of deep, somewhat poorly drained to moderately well drained soils of the Orange series. These soils have a surface layer of loam and a subsoil of clay. They have slow permeability and moderate available moisture capacity. Organic-matter content and natural fertility are low.

Species to favor on these soils are loblolly pine and Virginia pine. The preferred species for planting is loblolly pine.

These soils are managed only for loblolly pine and Virginia pine. The site indexes for species are as follows: loblolly pine 65 to 75, Virginia pine 55 to 65, and oaks 55 to 65.

Seedling mortality, the hazard of erosion, plant competition, and windthrow are slight. Equipment limitations are moderate because these soils are slowly permeable and are soft during wet periods.

WOODLAND SUITABILITY GROUP 10

This group consists of deep, well drained to excessively drained soils of the Aura, Caroline, Galestown, Marr, and Westphalia series and of Sandy and clayey land, steep, Sassafras and Caroline materials. These soils have a surface layer of very fine sandy loam, fine sandy loam, gravelly fine sandy loam, loamy very fine sand, or loamy sand. The subsoil ranges from loamy sand and very fine sandy loam to clay loam and clay. These soils have moderately slow to rapid permeability and low to moderate available moisture capacity. Organic-matter content and natural fertility are low.

Species to favor on these soils are loblolly pine and Virginia pine. The preferred species for planting is loblolly pine.

These soils are managed mostly for pine and are not recommended for hardwood. The site indexes are as follows: loblolly pine 65 to 75, and Virginia pine 55 to 65.

Seedling mortality, plant competition, and the hazard of erosion are slight. Equipment limitations are slight on slopes less than 12 percent and moderate on slopes of more than 12 percent. Windthrow is slight.

WOODLAND SUITABILITY GROUP 11

This group consists of deep, well drained and moderately well drained, severely eroded soils of the Appling, Caroline, Cecil, Cullen, Elioak, Mecklenburg, Nason, and Susquehanna series. These soils have a surface layer of loam, clay loam, silty clay loam, and clay and a subsoil mainly of clay. They have moderate to very slow permeability and moderate to high available moisture capacity. Organic-matter content and natural fertility are low.

Species to favor on these soils are loblolly pine and Virginia pine. Shortleaf pine is subject to little leaf disease on these soils; it should be cut when it reaches pulpwood size. The preferred species for planting is loblolly pine.

These soils are best managed for loblolly pine and Virginia pine. The site indexes for loblolly pine are 65 to 75, for Virginia pine 55 to 65, for shortleaf pine 55 to 65, and for oaks less than 55.

Seedling mortality is slight because moisture generally is ample for seedling development. Plant competition and windthrow are slight. The hazard of erosion is slight on slopes of less than 12 percent and moderate to severe on slopes of more than 12 percent. Equipment limitations are moderate on slopes of less than 12 percent and severe on slopes of more than 12 percent.

WOODLAND SUITABILITY GROUP 12

Elbert silt loam, thin solum variant, is the only soil in this group. It is deep and poorly drained and has a silt loam surface layer and a clay subsoil. This soil has slow to very slow permeability and moderate available moisture capacity. Organic-matter content and natural fertility are moderate.

Species to favor on this soil are water-loving hardwoods and Virginia pine. The preferred species for planting is Virginia pine, if some surface drainage is provided.

These soils are limited in woodland management. The site indexes for oaks are 55 to 65 and are less than 55 for Virginia pine.

Seeding mortality, plant competition, and equipment limitation are all severe because of the seasonal high

water table and clay subsoil. Windthrow is rated moderate because the depth to which roots can penetrate is restricted.

WOODLAND SUITABILITY GROUP 13

This group consists of miscellaneous land types Alluvial land, sandy and gravelly; Cut and fill land; Fresh water swamp; Sand and gravel pits; Stony rolling land; Stony steep land; and Tidal marsh.

Properties and characteristics that govern woodland management are quite variable, and not subject to a common interpretation. Preferred species, species to plant, and woodland management practices should be determined by onsite investigation.

Wildlife [3]

Stafford and King George Counties have a large and varied population of fish and wildlife. Small game birds and animals are abundant, deer are common, and many kinds of waterfowl inhabit the streams, rivers, and other bodies of water in the area.

Most of the fish are warm-water species. Fresh-water fish, such as largemouth bass, smallmouth bass, bream, crappie, catfish, carp, and eastern pickerel are common in streams throughout the counties. The Rappahannock River above the fall line in southern Stafford County is famous for its smallmouth bass fishing. The Potomac River, along the eastern boundary of Stafford County and the northern and eastern boundaries of King George County provides good fishing for white perch, catfish, rockfish, bluefish, weakfish, spot, King William perch, and croakers, and also furnishes crabs and oysters. The spring spawning runs of herring and shad up the Rappahannock River and the smaller streams emptying into the Rappahannock and Potomac Rivers have been noted throughout history, and still continue, although somewhat abated.

Wildlife is divided into three major groups, based mostly on the habitat best suited to that species. These are openland wildlife, woodland wildlife, and wetland wildlife. About 69 percent of the land area of Stafford and King George Counties is in woodland. Thus, woodland wildlife is the most important of these groupings. The whitetailed deer is the only big game animal in the two-county area, and is common throughout both counties. Wild turkeys inhabit both counties, but are more prevalent in western Stafford County, west of Interstate 95, where there are larger areas of unbroken woodland and the habitat is more suitable. Gray squirrels are abundant throughout both counties, and are the most popular of the small-game animals.

Quail inhabit both wooded and open areas, but are most common in pastures, hayfields, and brushlands along the edges of wooded areas, and in woodland clearings. Doves are common throughout the two-county area, but are most abundant in the harvested cornfields along the Rappahannock River in southern Stafford and King George Counties.

Wood ducks inhabit small bodies of water in wooded areas, such as water holes in abandoned sand and gravel pits, water holes in small drainageways, and beaver ponds. There is a moderate resident population of ducks, such as black ducks and mallards, on the larger streams of the two-county area. During spring and fall migrations, large flights of both ducks and geese pass through the area and visit the Rappahannock and Potomac Rivers and the lower courses of the larger streams.

Several endangered species are still present in Stafford and King George Counties. American eagles maintain some nesting sites along the Potomac River in a few relatively undisturbed areas. Pileated woodpeckers are still common in large areas of mature woodland that have enough dead standing timber to provide a food supply. The outlook for their continued existence is not good.

The wildlife population of any area depends upon the availability of food, cover, and water in suitable combination. The lack of any of these requirements, an unfavorable balance between them, or an inadequate distribution of them can seriously limit or make impossible the use of a tract as a habitat for desired species of wildlife.

Most wildlife habitats are created, improved, or maintained by establishing and manipulating vegetation, and by providing food and water in suitable places. Information about the soils is essential in carrying out these measures. Such information is also useful in broad-scale planning for parks, nature areas, or other recreational or educational developments in which wildlife populations are important. It is an important aid in planning for the acquisition of land for development of wildlife habitat or protection of wildlife.

Interpretations of the usefulness of soils for wildlife habitat are helpful in selecting sites that are suitable for wildlife management and in determining the level of management needed to achieve satisfactory results. Interpretations may also reveal reasons that make a particular area unsuited for a specific kind of wildlife. Table 3 rates the soils of Stafford and King George Counties according to their suitability for eight elements of wildlife habitat and for three classes of wildlife.

Habitat suitability ratings

Meanings of the numerical ratings used in Table 3 are as follows:

1, *well suited;* 2, *suited;* 3, *poorly suited;* and 4, *unsuited. Well suited* means that habitats generally are easily created, improved, or maintained; that the soil has few or no limitations that affect management; and that satisfactory results can be expected. *Suited* means that habitats can be created, improved, or maintained in most places; that the soil has moderate limitations that affect management; and that moderate intensity of management and fairly frequent attention are commonly required for satisfactory results. *Poorly suited* means that habitats can be created, improved, or maintained in most places; that the soil has rather severe limitations; that habitat management is difficult and expensive, requiring intensive effort; and that results are not always satisfactory. *Not suited* means that under present levels of economy and technology, creating, improving, or maintaining habitats is impractical or impossible, and that unsatisfactory results are probable.

[3] By R. F. DUGAN, biologist, Soil Conservation Service.

TABLE 3.—*Suitability of the soils for wildlife habitat and for kinds of wildlife*

[Not included in this table, because its soil properties are too variable to rate, is cut and fill land. Investigation of each site is needed to determine its suitability for the habitat elements and kinds of wildlife]

Soil	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wild herbaceous wetland plants	Shallow-water developments	Shallow excavated ponds	Openland	Woodland	Wetland
Alluvial land, sandy and gravelly	3	3	3	3	3	4	4	4	3	3	4
Alluvial land, wet	4	3	3	2	2	1	2	2	3	2	1
Altavista fine sandy loam, 0 to 2 percent slopes	2	1	1	1	1	3	3	3	1	1	2
Altavista fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Altavista fine sandy loam, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Appling fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Appling fine sandy loam, 6 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Appling gravelly fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Appling gravelly fine sandy loam, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Appling clay loam, 6 to 15 percent slopes, severely eroded	2	2	2	1	1	4	4	4	2	1	4
Ashlar fine sandy loam, 6 to 15 percent slopes	3	2	2	3	3	4	4	4	2	3	4
Ashlar fine sandy loam, 15 to 25 percent slopes	4	2	2	3	3	4	4	4	3	3	4
Ashlar fine sandy loam, 25 to 35 percent slopes	4	3	2	3	3	4	4	4	3	3	4
Atlee silt loam, 0 to 2 percent slopes	2	1	1	2	2	3	3	3	1	2	2
Atlee silt loam, 2 to 6 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Augusta loam	2	2	1	1	1	3	2	2	2	1	2
Aura gravelly fine sandy loam, 2 to 6 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Aura gravelly fine sandy loam, 6 to 10 percent slopes, eroded	2	1	1	2	2	4	4	4	1	2	4
Aura gravelly fine sandy loam, 10 to 18 percent slopes, eroded	2	1	1	2	2	4	4	4	1	2	4
Aura gravelly fine sandy loam, 18 to 35 percent slopes, eroded	4	2	1	2	2	4	4	4	2	2	4
Aura-Galestown-Sassafras complex, 6 to 15 percent slopes	3	2	2	3	3	4	4	4	2	3	4
Aura-Galestown-Sassafras complex, 15 to 30 percent slopes	4	2	2	3	3	4	4	4	3	3	4
Bertie very fine sandy loam, 0 to 3 percent slopes	2	2	1	1	1	3	3	3	2	1	2
Bibb fine sandy loam	3	2	2	2	2	2	1	1	2	2	1
Bladen loam	1	2	2	2	2	2	1	1	2	2	1
Bourne fine sandy loam, 0 to 2 percent slopes	2	1	1	2	2	3	3	3	1	2	2
Bourne fine sandy loam, 2 to 6 percent slopes	2	1	1	2	2	3	4	4	1	2	4
Bourne fine sandy loam, 6 to 10 percent slopes, eroded	3	3	2	3	3	4	4	4	3	3	4
Bourne fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes	2	1	1	2	2	3	4	4	1	2	4
Bourne fine sandy loam, gravelly subsoil variant, 6 to 10 percent slopes, eroded	3	3	2	3	3	4	4	4	3	3	4
Bourne loam, rock substratum, 2 to 6 percent slopes	2	1	1	2	2	3	4	4	1	2	4
Bourne loam, rock substratum, 6 to 10 percent slopes, eroded	3	3	2	3	3	4	4	4	3	3	4
Bremo loam, 6 to 15 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Bremo loam, 15 to 35 percent slopes	4	2	2	2	2	4	4	4	3	2	4
Caroline fine sandy loam, 2 to 6 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Caroline fine sandy loam, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Caroline fine sandy loam, 10 to 18 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4

TABLE 3.—*Suitability of the soils for wildlife habitat and for kinds of wildlife*—Continued

Soil	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wild herbaceous wetland plants	Shallow-water developments	Shallow excavated ponds	Openland	Woodland	Wetland
Caroline clay loam, 6 to 10 percent slopes, severely eroded	2	2	2	1	1	4	4	4	2	1	4
Caroline clay loam, 10 to 18 percent slopes, severely eroded	2	2	2	1	1	4	4	4	2	1	4
Caroline-Sassafras complex, 10 to 15 percent slopes	2	2	2	1	1	4	4	4	2	1	4
Caroline-Sassafras complex, 15 to 30 percent slopes	4	2	2	1	1	4	4	4	3	1	4
Cartecay fine sandy loam	2	2	2	1	1	2	4	2	2	1	2
Cecil fine sandy loam, 2 to 6 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Cecil fine sandy loam, 6 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Cecil gravelly fine sandy loam, 2 to 6 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Cecil clay loam, 6 to 15 percent slopes, severely eroded	2	2	2	1	1	4	4	4	2	1	4
Colfax fine sandy loam, 2 to 6 percent slopes	3	2	2	3	3	2	3	3	2	3	2
Colfax fine sandy loam, gravelly subsoil variant, 2 to 6 percent slopes	3	2	2	3	3	4	4	4	2	3	4
Congaree loam	2	1	1	1	1	4	4	4	1	1	4
Craven loam, 0 to 2 percent slopes	2	1	1	1	1	3	3	3	1	1	2
Craven loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Cullen loam, 2 to 6 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Cullen loam, 6 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Cullen clay loam, 6 to 15 percent slopes, severely eroded	2	2	2	1	1	4	4	4	2	1	4
Dogue loam, 0 to 2 percent slopes	2	1	1	1	1	3	3	3	1	1	2
Dogue loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	3
Elbert silt loam, thin solum variant	3	2	2	3	3	2	2	1	2	3	1
Elioak silt loam, 2 to 6 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Elioak silt loam, 6 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Elioak silty clay loam, 6 to 15 percent slopes, severely eroded	2	1	1	1	1	4	4	4	1	1	4
Fairfax loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Fallsington very fine sandy loam	3	2	2	2	2	1	2	2	2	2	1
Fresh water swamp	4	4	4	4	4	1	1	1	4	4	1
Galestown-Sassafras complex, 6 to 15 percent slopes	3	2	2	3	3	4	4	4	2	3	4
Galestown-Sassafras complex, 15 to 30 percent slopes	4	2	2	3	3	4	4	4	3	3	4
Galestown-Sassafras complex, 30 to 45 percent slopes	4	3	2	3	3	4	4	4	3	3	4
Iuka fine sandy loam, local alluvium-	2	1	1	1	1	3	3	3	1	1	2
Kempsville fine sandy loam, 0 to 2 percent slopes	1	1	1	1	1	4	4	4	1	1	4
Kempsville fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Kempsville fine sandy loam, gravelly substratum, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Kempsville fine sandy loam, gravelly substratum, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Kempsville fine sandy loam, gravelly substratum, 10 to 18 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Lignum silt loam, 0 to 2 percent slopes	2	2	1	1	1	3	2	2	2	1	2
Lignum silt loam, 2 to 6 percent slopes	2	2	1	1	1	4	4	4	2	1	4
Manor silt loam, 6 to 15 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Manor silt loam, 15 to 35 percent slopes	4	2	2	2	2	4	4	4	3	2	4
Marr very fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Marr very fine sandy loam, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1		4

TABLE 3.—*Suitability of the soils for wildlife habitat and for kinds of wildlife*—Continued

Soil	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wild herbaceous wetland plants	Shallow-water developments	Shallow excavated ponds	Openland	Woodland	Wetland
Marr very fine sandy loam, 10 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Marr very fine sandy loam, 15 to 30 percent slopes, eroded	4	2	1	1	1	4	4	4	2	1	4
Meadowville silt loam	1	1	1	1	1	4	4	4	1	1	4
Mecklenburg loam, 2 to 6 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Mecklenburg loam, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Mecklenburg clay loam, 6 to 10 percent slopes, severely eroded	2	2	2	1	1	4	4	4	2	1	4
Nason silt loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Nason silt loam, 6 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Nason silty clay loam, 6 to 10 percent slopes, severely eroded	2	1	1	1	1	4	4	4	1	1	4
Orange loam, 0 to 2 percent slopes	2	2	1	2	2	3	2	2	2	2	2
Orange loam, 2 to 6 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Orange loam, 6 to 10 percent slopes, eroded	3	3	2	3	3	4	4	4	2	3	4
Pooler loam, thin solum variant	2	2	2	1	1	2	2	2	2	1	2
Roanoke silt loam	3	2	2	2	2	2	2	2	2	2	2
Sand and gravel pits	4	4	4	4	4	4	4	4	4	4	4
andy and clayey land, steep, Sassafras and Caroline materials	4	3	2	2	2	4	4	4	3	2	4
Sassafras fine sandy loam, 0 to 2 percent slopes	1	1	1	1	1	4	4	4	1	1	4
Sassafras fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Sassafras fine sandy loam, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Sassafras fine sandy loam, 10 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Sassafras fine sandy loam, 15 to 35 percent slopes, eroded	4	2	1	1	1	4	4	4	2	1	4
State fine sandy loam, local alluvium	1	1	1	1	1	4	4	4	1	1	4
Stony rolling land	4	3	2	2	3	4	4	4	3	2	4
Stony steep land	4	3	2	2	3	4	4	4	3	2	4
Susquehanna soils, 2 to 10 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Tetotum fine sandy loam, 0 to 2 percent slopes	2	1	1	1	1	3	3	3	1	1	2
Tetotum fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Tetotum fine sandy loam, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Tidal marsh	4	4	4	4	4	1	1	1	4	4	1
Turbeville loam, 0 to 2 percent slopes	1	1	1	1	1	4	4	4	1	1	4
Turbeville loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Turbeville loam, 6 to 15 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Wahee silt loam	2	2	1	1	1	2	2	2	2	1	2
Watt silt loam, gray surface variant, 10 to 15 percent slopes	2	2	2	3	3	4	4	4	2	3	4
Watt silt loam, gray surface variant, 15 to 35 percent slopes	4	2	2	3	3	4	4	4	3	3	4
Wehadkee very fine sandy loam	4	3	3	2	2	1	4	2	3	2	1
Westphalia loamy very fine sand, 2 to 6 percent slopes	3	2	2	3	3	4	4	4	2	3	4
Westphalia loamy very fine sand, 6 to 15 percent slopes, eroded	3	2	2	3	3	4	4	4	2	3	4
Westphalia loamy very fine sand, 15 to 30 percent slopes, eroded	4	2	2	3	3	4	4	4	3	3	4
Wickham fine sandy loam, 0 to 2 percent slopes	1	1	1	1	1	4	4	4	1	1	4
Wickham fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4

TABLE 3.—*Suitability of the soils for wildlife habitat and for kinds of wildlife*—Continued

Soil	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wild herbaceous wetland plants	Shallow-water developments	Shallow excavated ponds	Openland	Woodland	Wetland
Wickham fine sandy loam, 6 to 12 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4
Wickham sandy loam, thin solum variant, 0 to 2 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Wickham sandy loam, thin solum variant, 2 to 6 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Wickham sandy loam, thin solum variant, 6 to 12 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Woodstown fine sandy loam, 0 to 2 percent slopes	2	1	1	1	1	3	3	3	1	1	2
Woodstown fine sandy loam, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Worsham loam	3	2	2	2	2	3	3	3	2	2	3
Zion loam, deep variant, 2 to 6 percent slopes	2	1	1	1	1	4	4	4	1	1	4
Zion loam, deep variant, 6 to 10 percent slopes, eroded	2	1	1	1	1	4	4	4	1	1	4

Habitat elements

The eight elements of wildlife habitat listed in Table 3 are described in the following paragraphs:

Grain and seed crops refers to domestic grains or other seed-producing annual plants that are suitable as food for wildlife. Examples are corn, sorghum, wheat, oats, barley, millet, buckwheat, cowpeas, soybeans, sunflower.

Grasses and legumes refers to domestic perennial grasses and herbaceous legumes that are established by planting, and which furnish wildlife cover and food. Some examples are fescue, bluegrass, lovegrass, switchgrass, brome, timothy, orchardgrass, clover, alfalfa, trefoil, crownvetch.

Wild herbaceous upland plants are native or naturally established grasses and forbs (including weeds) that provide food and cover for upland wildlife. Examples include bluestem, indiangrass, goldenrod, beggarweed, partridgepea, pokeweed, dandelion, wild strawberry.

Hardwood woody plants are nonconiferous trees, shrubs, and vines that produce nuts or other fruits, buds, catkins, twigs, bark, or foliage used extensively as food by wildlife. Many of these plants have secondary value as nesting or escape cover. They are often established naturally, but may be planted or transplanted. Examples include oak, beech, hickory, cherry, dogwood, wild plum, hawthorn, grape, honeysuckle, viburnum, greenbriers, roses, blackberry, blueberry.

Coniferous woody plants refers to cone-bearing trees and shrubs which furnish wildlife cover, or supply food in the form of browse, seeds, or fruitlike cones. These are commonly established through natural processes, but may be planted. Examples include pine, spruces, hemlocks, firs, yews, cedars, junipers. The ratings obtained for coniferous plants are valid only when such plants are used as food; or as cover for only a short time. On sites which are poorly suited or unsuited, conifers grow rapidly and canopy closure is relatively quick. Once the canopy has closed, self-pruning of the lower branches destroys most of the wildlife cover value. It is also harder to keep hardwoods out of these sites.

Wild herbaceous wetland plants are annual perennial wild herbaceous plants on moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover used extensively by wetland forms of wildlife. Examples include smartweeds, wild millet, rushes, sedges, reeds, wildrice, cutgrass, cordgrasses, saltgrass, cattails.

Shallow-water developments are areas of surface water having an average depth of less than five feet, which contain, or are near, wildlife food and cover. They can be formed by dams or levees (sometimes in combination with some excavation) or by water-control devices in marshes or streams. They are distinguished from excavated ponds because they always include some means of controlling water levels at or above the natural water table. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, wildlife ponds, beaver ponds.

Shallow excavated ponds are areas of surface water with average depths of less than five feet, which contain, or are near, wildlife food and cover. They can be formed by blasting or other excavation methods, but do not provide for storage of water above the natural water tables. Examples are blasted potholes, dugouts for waterfowl, level ditches, excavated wildlife ponds or watering facilities.

Kinds of wildlife

The three kinds or classes of wildlife for which the soils are rated are defined in the following paragraphs.

Openland wildlife refers to birds and mammals that normally live on cropland, pasture, meadow, lawns, and areas overgrown with grasses, herbs, and vines or shrubby growth. Examples are quail, pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox, and woodchuck.

Ratings in this column are a weighted average of the ratings for habitat elements of grain and seed crops; grasses and legumes; wild herbaceous upland plants; and hardwood trees, shrubs, and vines.

Woodland wildlife refers to birds and mammals normally found in wooded areas made up of hardwoods or conifers, or a mixture of both. Examples of woodland wildlife include wild turkey, ruffed grouse, woodcock, thrush, vireo, woodpecker, squirrel, gray fox, raccoon, white-tailed deer, and black bear.

Ratings in this column are obtained by weighing and averaging the ratings for grasses and legumes; wild herbaceous upland plants; hardwood trees, shrubs and vines; and coniferous woody plants.

Wetland wildlife refers to birds and mammals that normally live in such wet areas as swamps, marshes, or areas of open water. Examples are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, beaver, and otter.

Ratings in this column are obtained by averaging the rating for wild herbaceous wetland plants with the rating for one type of shallow water, or in some instances averaging the ratings for shallow water, or in some instances that for grain and seed crops.

It should be emphasized that the ratings of soil mapping units for the production of habitat elements are much more accurate and more useful for planning and site selection than are the ratings for the three kinds of wildlife habitat. The latter are broad generalizations and should be treated as such.

Engineering Uses of the Soils [4]

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

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

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

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

Most of the information in this section is presented in tables 4, 5, and 6 which show, respectively, several estimated soil properties significant to engineering; interpretations for various enginering uses; and results of engineering laboratory tests on soil samples. This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 4, 5, and 6. It also can be used to make other useful maps.

The engineering interpretations made in this soil survey do not eliminate the need for sampling and testing at the site selected for engineering works, especially works that involve heavy loads or that require excavations that are deeper than the depths of layers here reported. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly constrasting properties and different suitabilities or limitations for soil engineering. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Some of the terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many of these terms commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*7*) used by the SCS engineers, Department of Defense, and others, and the AASHO system (*1*) adopted by the American Association of State Highway Officials.

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

[4] RICHARD A. GALLO, assistant State conservation engineer, Soil Conservation Service, assisted in the preparation of this section.

TABLE 4.—*Estimated soil properties*

[Not included in this table, because their properties are too variable to estimate, are the land types Cut and fill land (Cw), Fresh water steep land (StE), and Tidal marsh (Tm). An asterisk in the first column indicates that at least one mapping unit of this series is made up to follow carefully the instructions for referring to the series that appear in the first column of this table. >= greater than; <= less than]

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Alluvial land, sandy and gravelly: Ad	>5	3–5	0–10	Gravelly loamy sand, loamy sand.	SM, GM, SW–SM	A–1, A–2
			10–70	Very gravelly loam, sand, loamy sand.	SM, GM, SW–SM	A–1, A–2
Alluvial land, wet: Ae	4–5	0–1	0–10	Fine sandy loam, loam, loamy fine sand.	SM, SM–SC	A–2, A–4
			10–48	Loamy fine sand, fine sand, loamy sand.	SM, SM–SC	A–2, A–4
Altavista: AfA, AfB, AfC2	>5	2½–3½	0–9	Fine sandy loam	SM, ML	A–2, A–4
			9–44	Sandy clay loam, clay loam.	CL	A–6
			44–96	Fine sandy loam, loamy fine sand, gravelly sand.	SM	A–2, A–4
Appling: AlB, AlC2, AnB, AnC2, ApC3.	>5	>5	0–9	Fine sandy loam	ML, SM	A–4
			9–46	Clay, heavy clay loam	MH, CH	A–7
			46–106	Fine sandy loam, loam	ML, SM	A–4, A–7
Ashlar: AsD, AsE, AsF	2–4	>2	0–9	Fine sandy loam, sandy loam.	SM, ML	A–4
			9–30	Fine sandy loam, sandy loam, gravelly sandy loam.	SM, SM–SC	A–2, A–4
Atlee: AtA, AtB	>5	[1] 1½–2½	0–8	Silt loam	ML	A–4
			8–24	Heavy silt loam	CL	A–6
			24–49	Heavy silt loam	ML, CL	A–6
			49–96	Clay loam, clay	CL	A–6, A–7
Augusta: Au	>5	1–1½	0–9	Loam	SM, ML	A–4
			9–45	Clay loam, sandy clay loam.	ML–CL, CL	A–4, A–6
			45–102	Fine sandy loam, loamy sand, gravelly loamy sand.	SM	A–2, A–4
*Aura: AvB, AvC2, AvD2, AvE2, AwD, AwE. For Galestown and Sassafras parts of AwD and AwE, refer to Galestown and Sassafras series, respectively.	>5	>5	0–12	Gravelly fine sandy loam.	SM	A–2, A–4
			12–84	Gravelly sandy clay loam, sandy clay loam.	SM, SC	A–2, A–6, A–7
			84–144	Gravelly sandy clay loam to gravelly clay loam.	SM, SC	A–2, A–6
Bertie: BaA	>5	1–1½	0–10	Very fine sandy loam	SM, ML	A–4
			10–47	Sandy clay loam, clay loam.	CL	A–6, A–7
			47–70	Loamy fine sand	SM	A–2, A–4
Bibb: Bb	>5	0–1	0–10	Fine sandy loam	SM, ML	A–2, A–4
			10–31	Fine sandy loam, gravelly fine sandy loam.	SM, ML	A–2, A–4
			31–90	Loamy fine sand, gravelly sand.	SM, GM	A–2

See footnotes at end of table.

significant to engineering

swamp (Fs), Sand and gravel pits (Sa), Sandy and clayey land, steep, Sassafras and Caroline materials (ScF), Stony rolling land (StD), Stony of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*			
40–90	30–80	10–40	5–15	>6. 3	0. 04–0. 09	4. 5–5. 5	Low	Low	High.
40–90	20–80	10–35	5–15	>6. 3	0. 04–0. 09	4. 5–5. 5	Low	Low	High.
90–100	85–90	60–80	30–50	2. 0–6. 3	0. 08–0. 14	4. 5–5. 5	Low	High	High.
90–100	85–90	40–60	20–45	2. 0–6. 3	0. 06–0. 10	4. 5–5. 5	Low	High	High.
95–100	90–100	75–95	30–55	2. 0–6. 3	0. 12–0. 15	5. 0–6. 0	Low	Moderate	Moderate.
95–100	95–100	75–95	50–75	0. 63–2. 0	0. 14–0. 18	5. 0–6. 0	Moderate	High	Moderate.
95–100	70–100	60–90	20–50	2. 0–6. 3	0. 06–0. 10	5. 0–6. 0	Low	High	Moderate.
95–100	90–100	60–80	40–60	2. 0–6. 3	0. 12–0. 16	5. 0–5. 5	Low	Low	High.
95–100	90–100	75–90	60–80	0. 63–2. 0	0. 16–0. 18	4. 5–5. 5	Moderate	High	High.
95–100	90–100	60–80	40–60	0. 63–2. 0	0. 12–0. 16	4. 5–5. 0	Low	High	High.
90–100	90–100	70–95	40–55	2. 0–6. 3	0. 12–0. 14	4. 5–5. 5	Low	Low	Moderate.
85–100	80–100	65–90	30–50	2. 0–6. 3	0. 10–0. 14	4. 5–5. 5	Low	Low	High.
95–100	95–100	70–90	60–80	2. 0–6. 3	0. 18–0. 23	5. 0–5. 5	Low	Moderate	Moderate.
95–100	95–100	80–95	70–90	0. 63–2. 0	0. 16–0. 20	4. 5–5. 5	Low	High	High.
95–100	95–100	80–95	70–90	0. 06–0. 20	0. 08–0. 12	4. 5–5. 5	Low	High	High.
100	95–100	80–100	75–95	0. 20–0. 63	0. 12–0. 16	4. 5–5. 0	Moderate	High	High.
95–100	95–100	75–95	40–65	0. 63–2. 0	0. 14–0. 18	5. 0–5. 5	Low	High	Moderate.
95–100	95–100	75–95	50–80	0. 63–2. 0	0. 14–0. 18	5. 0–5. 5	Moderate	High	High.
75–100	65–100	60–90	30–50	0. 63–2. 0	0. 08–0. 14	5. 0–5. 5	Low	High	Moderate.
65–80	50–70	40–60	20–40	2. 0–6. 3	0. 10–0. 14	5. 0–5. 5	Low	Low	Moderate.
75–90	60–85	45–60	30–50	0. 63–2. 0	0. 10–0. 14	4. 5–5. 5	Low	Moderate	Moderate to high.
75–100	70–95	40–60	20–50	2. 0–6. 3	0. 08–0. 14	4. 5–5. 0	Low	Moderate	High.
95–100	90–100	85–95	40–60	0. 63–2. 0	0. 14–0. 20	4. 0–5. 0	Low	High	High.
95–100	90–100	85–100	50–80	0. 63–2. 0	0. 14–0. 18	4. 0–5. 0	Moderate	High	High.
95–100	90–100	80–95	20–40	2. 0–6. 3	0. 06–0. 10	4. 0–5. 0	Low	High	High.
95–100	90–100	60–90	30–60	0. 63–2. 0	0. 12–0. 16	4. 5–6. 0	Low	High	Moderate.
80–100	70–100	40–90	30–60	0. 63–2. 0	0. 12–0. 16	4. 5–5. 5	Low	High	Moderate.
60–100	50–100	40–80	15–35	2. 0–6. 3	0. 04–0. 10	4. 5–5. 5	Low	High	High.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Bladen: Bd	>5	0–1	0–10	Loam, silt loam	ML	A–4
			10–61	Clay	CL, CH	A–7
			61–90	Fine sand	SM	A–2, A–4
Bourne: BmA, BmB, BmC2, BoB, BoC2.	>5	[1] 1½–2½	0–9	Fine sandy loam, loam	SM, ML	A–4
			9–22	Sandy clay loam, clay loam.	SM, CL	A–6
			22–52	Fine sandy loam, loam	SM, ML	A–2, A–4
			52–102	Fine sandy loam to clay	SM, ML, MH	A–4
Bourne, gravelly subsoil variant: BnB, BnC2.	>5	[1] 1½–2½	0–10	Fine sandy loam	SM	A–4
			10–22	Clay loam, sandy clay loam.	CL	A–6
			22–49	Gravelly fine sandy loam, gravelly sandy clay loam.	GM, SM, SC	A–1, A–2
			49–90	Very gravelly clay loam, sandy clay loam.	GM, SC	A–1, A–2
Bremo: BrD, BrE	2½	>2½	0–5	Loam	ML–CL	A–4, A–6
			5–18	Gravelly loam	ML–CL	A–4, A–6
			18–30	Weathered schist, very soft, loamy.	ML–CL, SM–SC	A–2, A–4
*Caroline: CaB2, CaC2, CaD2, CcC3, CcD3, CdD, CdE. For Sassafras part of CdD and CdE, refer to Sassafras series.	>5	>5	0–9	Fine sandy loam	SM, ML	A–4
			9–65	Heavy clay loam, clay	CH	A–7
			65–112	Heavy clay loam, clay	MH–CH	A–7
Cartecay: Ce	>5	1–1½	0–8	Fine sandy loam	SM, ML	A–4
			8–53	Fine sandy loam	SM, ML	A–2, A–4
			53–104	Fine sandy loam, loamy fine sand, gravelly loamy sand.	SM	A–2, A–4
Cecil: CfB2, CfC2, CgB2, ChC3	>5	>5	0–9	Fine sandy loam	SM, ML	A–4
			9–51	Heavy clay loam, clay	MH–CH	A–7
			51–120	Loam, fine sandy loam	SM, ML	A–4, A–7
Colfax: ClB	>5	1–1½	0–12	Fine sandy loam	SM, ML	A–4
			12–27	Clay loam, sandy clay loam.	ML, CL	A–6
			27–54	Sandy clay loam	SC, ML–CL	A–4, A–6
			54–92	Sandy clay loam	SC, SM	A–4, A–6
Colfax, gravelly subsoil variant: CmB	>5	1½–2	0–10	Fine sandy loam	SM	A–4
			10–18	Sandy clay loam, clay loam.	ML, CL	A–6
			18–30	Gravelly sandy loam to gravelly clay loam.	SM, ML, GM	A–2, A–4
			30–96	Gravelly clay loam, gravelly loam.	SM, ML, GM	A–4
Congaree: Cn	>5	>4	0–10	Loam, silt loam, fine sandy loam.	SM, ML	A–4
			10–49	Loam, silty clay loam, fine sandy loam.	ML, CL	A–4, A–6
			49–90	Loam, sandy clay loam, fine sandy loam.	SM, ML, SC	A–4, A–6
Craven: CrA, CrB	>5	2½–5	0–9	Loam	CL	A–6
			9–56	Heavy clay loam, clay	CH	A–7
			56–92	Clay	CH	A–7

See footnotes at end of table.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*			
100	100	95–100	60–80	0. 63–2. 0	0. 16–0. 20	4. 5–5. 0	Low	Moderate	High.
100	100	95–100	75–95	<0. 20	0. 12–0. 16	4. 5–5. 0	Moderate to high.	High	High.
95–100	90–100	60–85	20–45	2. 0–6. 3	0. 04–0. 08	5. 0–5. 5	Low	High	High.
85–100	80–90	60–80	40–60	2. 0–6. 3	0. 12–0. 16	4. 5–5. 5	Low	Moderate	High.
85–100	80–90	60–80	40–70	0. 63–2. 0	0. 14–0. 18	4. 5–5. 5	Moderate	High	High.
90–100	80–90	50–80	30–60	<0. 20	0. 04–0. 08	4. 5–5. 5	Low	High	High.
90–100	85–100	60–90	40–80	0. 20–2. 0	0. 12–0. 16	4. 5–5. 5	Moderate	High	High.
90–100	85–95	60–80	35–50	2. 0–6. 3	0. 12–0. 16	5. 0–5. 5	Low	Moderate	Moderate.
90–100	85–95	70–90	50–70	0. 62–2. 0	0. 14–0. 18	4. 5–5. 5	Moderate	High	High.
50–75	40–65	35–60	10–35	< 0. 20	0. 04–0. 16	4. 5–5. 5	Low	Moderate	High.
50–75	40–65	35–60	10–35	0. 20–0. 63	0. 10–0. 14	4. 5–5. 0	Moderate	Moderate	High.
90–100	90–100	75–90	50–70	2. 0–6. 3	0. 16–0. 20	5. 0–5. 5	Low	Low	Moderate.
80–100	70–95	60–75	50–70	2. 0–6. 3	0. 10–0. 14	5. 5–6. 0	Low	Low	Moderate.
50–75	40–70	35–65	25–55	2. 0–6. 3	0. 08–0. 12	5. 5–6. 0	Low	Low	Moderate.
90–100	90–100	85–100	40–60	2. 0–6. 3	0. 14–0. 16	4. 5–5. 0	Low	Low	High.
90–100	90–100	90–100	65–85	0. 20–0. 63	0. 12–0. 16	4. 5–5. 0	Moderate	High	High.
90–100	90–100	90–100	60–75	<0. 20	0. 12–0. 16	4. 5–5. 0	Moderate	High	High.
90–100	85–100	60–90	45–55	2. 0–6. 3	0. 10–0. 14	5. 5–6. 0	Low	Moderate	Moderate.
90–100	85–100	40–90	30–55	2. 0–6. 3	0. 10–0. 14	5. 0–6. 5	Low	Moderate	Moderate to low.
75–100	60–100	40–80	10–40	2. 0–6. 3	0. 06–0. 10	5. 0–5. 5	Low	High	Moderate.
95–100	90–100	60–80	40–60	2. 0–6. 3	0. 12–0. 16	5. 0–5. 5	Low	Low	Moderate.
95–100	90–100	75–90	65–85	0. 63–2. 0	0. 12–0. 16	4. 5–5. 5	Moderate	High	High.
95–100	90–100	60–80	40–60	0. 63–2. 0	0. 12–0. 18	4. 5–5. 0	Low	High	High.
95–100	90–100	70–85	40–55	2. 0–6. 3	0. 12–0. 14	4. 5–5. 0	Low	High	High.
95–100	90–100	80–95	60–75	0. 63–2. 0	0. 14–0. 18	4. 5–5. 5	Moderate	High	High.
90–100	90–100	80–90	35–60	<0. 20	0. 04–0. 10	4. 5–5. 5	Low	High	High.
90–100	90–100	80–90	35–50	0. 20–0. 63	0. 14–0. 18	4. 5–5. 0	Low	High	High.
90–100	85–100	60–75	40–50	2. 0–6. 3	0. 12–0. 14	4. 5–5. 5	Low	Moderate	High.
90–100	85–100	70–85	60–75	0. 63–2. 0	0. 10–0. 14	4. 5–5. 0	Low	High	High.
70–90	65–85	55–70	30–60	<0. 20	0. 06–0. 10	4. 5–5. 0	Low	High	High.
70–90	65–85	55–70	40–60	0. 20–0. 63	0. 08–0. 14	4. 5–5. 0	Low	High	High.
95–100	90–100	70–100	40–80	0. 63–2. 0	0. 16–0. 21	5. 0–6. 5	Low	Low	Moderate to low.
95–100	90–100	70–100	50–80	0. 63–2. 0	0. 12–0. 20	5. 0–6. 5	Low	Low	Moderate to low.
90–100	85–100	70–100	40–70	2. 0–6. 3	0. 12–0. 18	5. 0–6. 5	Low	Moderate	Moderate to low.
100	100	85–95	60–75	0. 63–2. 0	0. 14–0. 18	5. 0–5. 5	Low	Moderate	Moderate.
100	100	90–100	75–95	0. 06–0. 20	0. 12–0. 16	4. 5–5. 5	High	High	High.
100	100	90–100	75–95	<0. 20	0. 12–0. 16	4. 5–5. 0	High	High	High.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Cullen: CuB2, CuC2, CvC3	>5	>5	0–8	Loam	ML–CL	A–4
			8–57	Clay, heavy silty clay loam, heavy clay loam.	CL, CH	A–7
			57–110	Silt loam, loam	CL, ML	A–6, A–4
Dogue: DoA, DoB	>5	2½–3½	0–10	Loam silt loam	ML–CL	A–4
			10–47	Heavy clay loam, clay	CL	A–7
			47–98	Loamy fine sand to sandy clay loam.	SM, ML	A–4, A–6
Elbert, thin solum variant: Eb	>5	0–1	0–10	Silt loam, loam, clay	CL	A–6
			10–35	Clay	CH	A–7
			35–90	Loam, loamy sand	SM, ML	A–2, A–4
Elioak: ElB2, ElC2, EmC3	>5	>5	0–8	Silt loam	ML	A–4
			8–49	Clay, heavy silty clay	MH, MH–CH	A–7
			49–98	Silt loam	MH, CL	A–6, A–7
Fairfax: FaB	>5	>5	0–11	Loam, silt loam	CL, ML–CL	A–4, A–6
			11–46	Clay loam, silty clay loam, gravelly silty clay loam.	CL	A–7
			46–76	Silt loam, loam	ML, CL	A–4, A–6
Fallsington: Fd	>5	0–1½	0–6	Very fine sandy loam	ML	A–4
			6–30	Sandy clay loam, clay loam.	CL	A–6
			30–110	Very fine sandy loam	SM, ML	A–4
*Galestown; GsD, GsE, GsF. For Sassafras part of all these units, refer to Sassafras series.	>5	>5	0–10	Loamy fine sand	SM	A–2
			10–38	Loamy fine sand	SM	A–2
			38–110	Fine sand, sand, loamy fine sand.	SM	A–2
Iuka: Iu	>5	2½–3½	0–8	Fine sandy loam	SM	A–4
			8–56	Fine sandy loam	SM	A–4
			56–108	Loam, fine sandy loam	SM, ML	A–4
Kempsville: KeA, KeB, KfB, KfC2, KfD2.	>5	>5	0–10	Fine sandy loam	SM, ML	A–4
			10–54	Fine sandy loam, sandy clay loam.	SM, SC, CL	A–4, A–6
			54–112	Loamy fine sand, fine sand.	SM	A–2
Lignum: LgA, LgB	>5	1–2	0–10	Silt loam, loam	MH	A–7
			10–39	Heavy silty clay loam, silty clay.	MH	A–7
			39–104	Silt loam, loam	SM, ML	A–4, A–6, A–7
Manor: MaD, MaE	>5	>5	0–4	Silt loam	ML	A–7
			4–23	Silt loam	MH	A–7
			23–60	Silt loam	ML	A–4
Marr: MdB, MdC2, MdD2, MdE2	>5	>5	0–12	Very fine sandy loam	ML	A–4
			12–36	Sandy clay loam	CL	A–6
			36–72	Loamy very fine sand	SM, ML	A–4
Meadowville: Me	>5	3–5	0–13	Silt loam, loam	ML	A–4
			13–50	Silty clay loam, gravelly sandy clay loam.	CL	A–6, A–7
			50–86	Fine sandy loam	SM, ML	A–4

See footnotes at end of table.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*			
95–100	95–100	85–95	60–75	0. 63–2. 0	0. 16–0. 20	5. 5–6. 0	Low	Moderate	Moderate.
90–100	90–100	85–95	75–95	0. 63–2. 0	0. 14–0. 18	4. 5–6. 0	Moderate	High	Moderate.
95–100	95–100	85–95	60–75	0. 63–2. 0	0. 16–0. 18	4. 5–5. 0	Moderate	Moderate	High.
100	100	85–95	60–75	0. 63–2. 0	0. 16–0. 21	5. 0–5. 5	Low	Moderate	Moderate.
100	100	90–100	75–90	0. 20–0. 63	0. 12–0. 16	4. 5–5. 5	Moderate	High	High.
100	100	85–95	40–60	0. 63–2. 0	0. 08–0. 16	4. 5–5. 0	Low	High	High.
100	100	90–100	70–90	0. 63–2. 0	0. 16–0. 20	5. 5–6. 5	Low	High	Moderate to low.
100	100	90–100	75–95	<0. 20	0. 12–0. 16	5. 5–6. 5	High	High	Moderate to low.
90–100	90–100	80–95	20–65	0. 63–2. 0	0. 08–0. 16	5. 5–6. 5	Low	High	Moderate to low.
95–100	90–100	80–100	55–80	0. 63–2. 0	0. 18–0. 23	5. 0–5. 5	Low	Moderate	Moderate.
95–100	90–100	80–100	70–95	0. 63–2. 0	0. 12–0. 16	4. 5–5. 5	Moderate	High	High.
95–100	90–100	80–100	70–90	0. 63–2. 0	0. 18–0. 22	4. 5–5. 0	Low	High	High.
90–100	90–100	80–100	65–85	2. 0–6. 3	0. 16–0. 20	4. 5–5. 0	Low	Low	High.
85–100	80–95	80–90	75–90	0. 63–2. 0	0. 14–0. 20	4. 5–5. 0	Moderate	Moderate	High.
95–100	95–100	90–100	60–75	0. 63–2. 0	0. 16–0. 20	4. 5–5. 0	Low	Moderate	High.
95–100	95–100	80–95	50–65	0. 63–2. 0	0. 14–0. 18	4. 0–5. 0	Low	High	High.
95–100	95–100	80–95	50–80	0. 63–2. 0	0. 14–0. 18	4. 0–5. 0	Moderate	High	High.
95–100	95–100	80–95	40–60	2. 0–6. 3	0. 10–0. 14	4. 0–5. 0	Low	High	High.
90–100	90–100	50–75	15–30	>6. 3	0. 06–0. 10	4. 5–5. 0	Low	Low	High.
90–100	90–100	50–75	15–30	>6. 3	0. 06–0. 10	4. 5–5. 0	Low	Low	High.
90–100	90–100	50–70	15–30	>6. 3	0. 04–0. 10	4. 5–5. 0	Low	Low	High.
90–100	90–100	70–80	40–50	0. 63–2. 0	0. 10–0. 14	4. 5–5. 5	Low	Moderate	High.
90–100	90–100	70–80	40–50	0. 63–2. 0	0. 10–0. 14	4. 5–5. 5	Low	Moderate	High.
90–100	90–100	70–85	45–55	0. 63–2. 0	0. 12–0. 16	4. 5–5. 5	Low	High	High.
100	100	70–85	40–55	2. 0–6. 3	0. 12–0. 16	4. 5–5. 5	Low	Low	High.
100	95–100	75–85	40–55	0. 63–2. 0	0. 14–0. 18	4. 5–5. 5	Low	Moderate	High.
100	95–100	65–80	20–35	2. 0–6. 3	0. 04–0. 10	4. 5–5. 0	Low	Moderate	High.
100	100	85–95	60–80	0. 63–2. 0	0. 16–0. 20	5. 0–5. 5	Low	High	Moderate.
100	100	95–100	85–95	0. 20–0. 63	0. 12–0. 16	5. 0–5. 5	Moderate	High	Moderate.
100	90–100	65–85	40–60	0. 63–2. 0	0. 14–0. 20	4. 5–5. 0	Moderate	High	High.
95–100	85–100	80–100	70–90	2. 0–6. 3	0. 18–0. 20	4. 5–5. 0	Low	Low	High.
95–100	95–100	90–100	70–90	2. 0–6. 3	0. 18–0. 20	4. 5–5. 0	Low	Low	High.
85–100	85–100	75–100	70–90	2. 0–6. 3	0. 12–0. 18	4. 5–5. 0	Low	Low	High.
100	100	85–95	50–65	2. 0–6. 3	0. 12–0. 16	5. 0–5. 5	Low	Low	Moderate.
100	100	85–95	50–65	0. 63–2. 0	0. 14–0. 18	4. 5–5. 5	Low	Moderate	Moderate.
100	100	80–95	40–60	2. 0–6. 3	0. 08–0. 12	4. 5–5. 0	Low	Low	Moderate
95–100	95–100	85–95	65–80	0. 63–2. 0	0. 16–0. 20	5. 0–6. 0	Low	Moderate	High.
85–100	80–100	75–95	50–85	0. 63–2. 0	0. 14–0. 18	5. 0–6. 0	Moderate	High	High.
95–100	90–100	70–85	40–55	2. 0–6. 3	0. 12–0. 14	5. 0–6. 0	Low	High	High.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Mecklenburg: MkB2, MkC2, MlC3.	>5	>5	0–8	Loam	ML–CL	A–4
			8–33	Heavy clay loam, clay	CH	A–7
			33–86	Silt loam, loam	ML, CL	A–4, A–6
Nason: NaB, NaC2, NcC3	>5	>5	0–5	Silt loam	ML	A–4
			5–40	Clay	MH, MH–CH	A–7
			40–90	Silt loam	ML	A–4, A–5
Orange: OrA, OrB, OrC2	4–6	2–3	0–14	Loam	ML–CL	A–4, A–6
			14–39	Clay	CH	A–7
			39–72	Silty clay loam, clay loam.	ML, CL	A–7
Pooler, thin solum variant: Po	>5	1–1½	0–10	Loam	ML	A–4
			10–44	Clay	CH	A–7
			44–108	Loam, very fine sandy loam.	ML, CL	A–4, A–6
Roanoke: Ro	>5	0–1	0–9	Silt loam, loam	ML, ML	A–4
			9–53	Clay	CH	A–7
			53–116	Sand, fine sand, gravelly sand.	SM	A–2
Sassafras: SfA, SfB, SfC2, SfD2, SfE2.	>5	>5	0–9	Fine sandy loam	SM, ML	A–4
			9–38	Sandy clay loam	SM–SC, CL	A–4, A–6
			38–112	Fine sand, loamy fine sand.	SM–SC, SM	A–2, A–4, A–6
State: Sn	>5	>4	0–8	Fine sandy loam	SM–SC, ML	A–4
			8–50	Clay loam, loam	ML, CL	A–4, A–6
			50–110	Fine sandy loam	SM, ML	A–4
Susquehanna: SuC	>5	3–5	0–8	Loam, clay loam	ML–CL, CL	A–6
			8–150	Clay	CH	A–7
Tetotum: TeA, TeB, TeC2	>5	1½–2½	0–9	Fine sandy loam	SM	A–2, A–4
			9–48	Clay loam, sandy clay loam.	CL	A–6
			48–105	Fine sandy loam, loamy fine sand.	SM	A–2, A–4
Turbeville: TuA, TuB, TuC2	>5	>5	0–15	Loam, fine sandy loam	ML–CL	A–4
			15–116	Heavy clay loam, clay	CL	A–7
Wahee: Wa	>5	1–1½	0–11	Silt loam, loam	CL	A–6
			11–57	Clay	CH	A–7
			57–102	Sandy clay to fine sandy loam.	CL, ML	A–4, A–7
Watt, gray surface variant: WgD, WgE.	1½–3	>1½	0–9	Silt loam	ML	A–4
			9–36	Channery silt loam	GM	A–2, A–4
Wehadkee: Wh	>5	0–1	0–11	Very fine sandy loam, silt loam.	ML	A–4
			11–46	Very fine sandy loam, silt loam.	ML, CL	A–4, A–6
			46–84	Gravelly fine sandy loam, loamy sand.	SM	A–4
Westphalia: WlB, WlD2, WlE2	>5	>5	0–18	Loamy very fine sand	SM	A–2, A–4
			18–28	Very fine sandy loam	SM–SC, ML	A–4
			28–110	Loamy very fine sand, very fine sand.	SM	A–2

See footnotes at end of table.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*			
90–100	90–100	85–95	60–75	0. 63–2. 0	0. 18–0. 20	6. 0–6. 5	Low	Low	Low.
90–100	90–100	90–100	85–95	0. 06–0. 20	1. 02–0. 16	5. 5–6. 5	High	High	Low.
90–100	90–100	85–95	70–90	0. 20–0. 63	0. 16–0. 20	6. 0–7. 3	Low	Moderate	Low.
95–100	85–100	75–90	60–75	2. 0–6. 3	0. 18–0. 23	5. 0–5. 5	Low	Moderate	Moderate.
95–100	95–100	85–95	70–90	0. 63–2. 0	0. 12–0. 16	4. 5–5. 5	Moderate	High	High.
95–100	95–100	80–95	65–85	0. 63–2. 0	0. 16–0. 20	4. 5–5. 0	Low	High	High.
90–100	90–100	80–95	65–80	0. 63–2. 0	0. 12–0. 16	5. 0–6. 0	Low	Moderate	Moderate.
90–100	90–100	80–100	75–95	<0. 20	0. 12–0. 16	5. 0–6. 0	High	High	Moderate.
90–100	90–100	70–95	60–80	0. 20–0. 63	0. 14–0. 18	6. 5–7. 3	Moderate	High	Low.
100	100	85–90	60–75	0. 63–2. 0	0. 16–0. 20	5. 5–6. 0	Low	Moderate	Moderate.
100	100	90–100	75–95	<0. 20	0. 12–0. 16	4. 5–5. 5	High	High	High.
95–100	95–100	85–95	50–70	0. 20–0. 63	0. 10–0. 18	4. 0–4. 5	Low	High	High.
95–100	95–100	85–95	65–80	0. 63–2. 0	0. 16–0. 20	5. 5–6. 0	Low	High	Moderate.
95–100	95–100	85–95	70–90	<0. 20	0. 12–0. 16	4. 5–5. 5	High	High	High.
80–100	70–90	40–60	10–35	2. 0–6. 3	0. 04–0. 08	4. 5–5. 0	Low	High	High.
95–100	95–100	80–100	40–60	2. 0–6. 3	0. 12–0. 16	5. 0–5. 5	Low	Low	Moderate.
95–100	95–100	85–100	40–60	0. 63–2. 0	0. 14–0. 18	4. 5–5. 5	Low	Moderate	High.
95–100	95–100	80–100	30–50	2. 0–6. 3	0. 04–0. 10	4–5–5. 0	Low	Moderate	High.
95–100	95–100	70–85	40–55	2. 0–6. 3	0. 12–0. 16	5. 0–5. 5	Low	Low	Moderate.
95–100	95–100	85–95	60–75	2. 0–6. 3	0. 14–0. 18	4. 5–5. 5	Moderate	Moderate	Moderate.
95–100	95–100	70–85	40–55	2. 0–6. 3	0. 10–0. 14	4. 5–5. 0	Low	Moderate	High.
100	100	85–100	60–80	0. 63–2. 0	0. 16–0. 20	5. 0–5. 5	Low	Moderate	Moderate.
100	100	90–100	75–95	<0. 20	0. 12–0. 16	4. 0–5. 0	High	High	High.
80–100	80–100	60–75	30–50	0. 63–2. 0	0. 12–0. 16	5. 5–6. 0	Low	Moderate	Moderate.
80–100	80–100	65–80	50–70	0. 63–2. 0	0. 14–0. 18	4. 5–5. 5	Moderate	High	High.
80–100	80–100	60–75	20–40	20. 63–2. 0	0. 08–0. 14	4. 5–5. 0	Low	High	High.
100	100	80–95	50–70	0. 63–2. 0	0. 14–0. 18	5. 5–6. 0	Low	Moderate	Moderate.
100	100	80–95	70–90	0. 63–2. 0	0. 12–0. 16	4. 5–6. 0	Moderate	High	Moderate.
100	100	90–100	65–80	0. 63–2. 0	0. 16–0. 20	4. 5–5. 5	Low	Moderate	High.
100	100	90–100	70–90	0. 06–0. 20	0. 12–0. 16	4. 5–5. 5	High	High	High.
100	100	70–95	50–70	0. 20–0. 63	0. 12–0. 18	4. 5–5. 0	Moderate	High	High.
80–100	80–100	70–90	55–80	0. 63–2. 0	0. 18–0. 22	4. 0–5. 0	Low	High	High.
[2] 50–65	45–60	40–55	25–50	0. 63–2. 0	0. 08–0. 12	4. 0–5. 0	Low	High	High.
90–100	90–100	80–90	60–80	0. 63–2. 0	0. 16–0. 20	5. 0–5. 5	Low	High	Moderate.
90–100	90–100	80–90	60–80	0. 20–0. 63	0. 16–0. 22	5. 0–5. 5	Low	High	Moderate.
85–100	70–100	60–90	35–50	2. 0–6. 3	0. 08–0. 14	5. 0–5. 5	Low	High	Moderate.
100	100	90–100	20–40	2. 0–6. 3	0. 12–0. 14	4. 5–6. 0	Low	Low	Moderate.
100	100	90–100	40–60	2. 0–6. 3	0. 12–0. 16	4. 5–5. 5	Low	Low	High.
100	95–100	90–100	10–30	2. 0–6. 3	0. 12–0. 14	4. 5–5. 0	Low	Low	High.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Wickham: WmA, WmB, WmC2	>5	>5	0–8	Fine sandy loam	SM	A–2, A–4
			8–43	Sandy clay loam, clay loam.	SC, CL	A–6
			43–90	Sand and gravel	GW–GM, GM	A–1, A–2
Wickham, thin solum variant: WnA, WnB, WnC.	>5	>5	0–19	Sandy loam, loamy sand	SM	A–2
			19–30	Sandy clay loam	SC	A–2, A–6
			30–72	Sand and gravel	GW–GM, GM	A–1, A–2
Woodstown: WoA, WoB	>5	1½–2½	0–9	Fine sandy loam	SM	A–4
			9–40	Sandy clay loam	SC, CL	A–6
			40–96	Fine sandy loam, sandy clay loam.	SM, SC, CL	A–4, A–6
Worsham: Wr	>5	0–1	0–11	Loam, sandy loam	SM, ML	A–2, A–4
			11–50	Clay, sandy clay, heavy clay loam.	CL, CH	A–7
			50–92	Loam, sandy clay loam	SM, SC, CL	A–4, A–6
Zion, deep variant: ZlB, ZlC2	4–6	>4	0–7	Loam	ML–CL	A–4
			7–22	Clay loam, clay	CL, CH	A–6, A–7
			22–64	Loam, silt loam	ML, CL	A–4

[1] Perched water table.

TABLE 5.—*Estimated engineering*

[Not included in this table, because their properties are too variable to estimate, are the land types Cut and fill land (Cw), Fresh water steep land (StE), and Tidal marsh (Tm). An asterisk in the first column indicates that at least one mapping unit of this series is made necessary to follow carefully the instructions for referring to the series that appear in the first column of this table]

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices for—	
	Topsoil	Sand and gravel	Road fill	Highway location	Winter grading
Alluvial land, sandy and gravelly: Ad.	Poor: coarse-textured material.	Good: few fines.	Fair: A–1, A–2 material, poorly sorted in places.	Seasonal high water table; flooding hazard in places.	Good trafficability.
Alluvial land, wet: Ae	Poor: seasonal high water table.	Generally unsuitable, but fair in places.	Fair: A–2, A–4, material.	Seasonal high water table; flooding hazard.	Poor trafficability; seasonal high water table; flooding hazard.
Altavista: AfA, AfB, AfC2	Fair: upper 12 inches.	Generally poor because of excessive fines, but fair in places.	Fair: A–4, A–6 material, A–2, A–4 below depth of 5 feet.	Seasonal high water table.	Fair trafficability, seasonal high water table.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
N. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*			
90–100	90–100	60–75	30–50	2. 0–6. 3	0. 12–0. 16	5. 0–5. 5	Low	Low	Moderate.
90–100	90–100	75–90	40–60	0. 63–2. 0	0. 14–0. 18	5. 0–6. 0	Moderate	Moderate	Moderate.
35–70	30–65	20–45	5–15	>6. 3	0. 04–0. 08	5. 5–6. 0	Low	Low	Moderate.
85–100	85–95	40–60	20–35	2. 0–6. 3	0. 08–0. 14	5. 0–5. 5	Low	Low	Moderate.
85–100	85–95	70–80	30–50	2. 0–6. 3	0. 10–0. 16	5. 0–5. 5	Low	Low	Moderate.
35–70	30–65	20–45	5–15	>6. 3	0. 04–0. 08	5. 0–5. 5	Low	Low	Moderate.
90–100	90–100	60–75	35–50	2. 0–6. 3	0. 12–0. 16	6. 0–6. 5	Low	Low	Low.
90–100	90–100	70–85	35–55	0. 63–2. 0	0. 14–0. 18	4. 5–6. 0	Low	Moderate	Moderate.
90–100	90–100	70–85	35–55	0. 63–2. 0	0. 12–0. 16	4. 5–5. 0	Low	High	High.
90–100	90–100	60–80	30–60	0. 63–2. 0	0. 12–0. 16	5. 5–6. 5	Low	High	High.
90–100	90–100	85–95	50–80	0. 06–0. 63	0. 12–0. 16	5. 0–5. 5	High	High	High.
90–100	90–100	60–75	35–60	0. 63–2. 0	0. 12–0. 16	5. 0–5. 5	Moderate	High	High.
90–100	90–100	75–90	55–70	0. 63–2. 0	0. 14–0. 18	6. 0–6. 5	Low	Moderate	Low.
90–100	90–100	80–95	60–80	0. 20–0. 63	0. 12–0. 14	5. 5–6. 0	High	High	Low.
90–100	90–100	75–90	60–75	0. 20–0. 63	0. 14–0. 18	6. 0–7. 5	Low	Moderate	Low.

[2] Most of the material retained is more than 3 inches in diameter.

interpretations of the soils

swamp (Fs), Sand and gravel pits (Sa), Sandy and clayey land, steep, Sassafras and Caroline materials (ScF), Stony rolling land (StD), Stony up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is

Soil features affecting engineering practices for—Continued

Construction and maintenance of pipelines	Impoundments		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Seasonal high water table; flooding hazard in places.	Permeable material; seepage.	Poor stability and compaction; poor resistance to piping; seepage.	Well drained; flooding hazard in places.	Rapid intake rate; low productivity.	Coarse-textured material; unstable embankments.	Coarse-textured material; low fertility.
Seasonal high water table; flooding hazard.	Seasonal high water table; flooding hazard; variable material.	Fair stability and compaction; fair resistance to piping.	Seasonal high water table flooding hazard; outlets difficult to locate.	Moderate intake rate; drainage needed.	Susceptible to siltation; outlets difficult to locate.	Seasonal high water table; flooding hazard.
Seasonal high water table.	Seasonal high water table; seepage.	Fair stability and compaction; fair resistance to piping.	Seasonal high water table; moderate permeability.	Moderate intake rate.	Features generally favorable.	Seasonal high water table.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices for—	
	Topsoil	Sand and gravel	Road fill	Highway location	Winter grading
Appling: AlB, AlC2, AnB, AnC2, ApC3.	Fair: upper 10 inches.	Unsuitable	Poor: A–4, A–7 material.	Cuts and fills needed; deeply weathered substratum is erodible when exposed.	Fair trafficability
Ashlar: AsD, AsE, AsF	Poor: sandy material.	Unsuitable	Good: A–4 material.	Cuts and fills needed; rock at depth of 2 to 4 feet.	Good trafficability
Atlee: AtA, AtB	Poor: seasonal high water table; fragipan.	Unsuitable	Poor: A–6, A–7 material; high silt content.	Seasonal high water table; fragipan.	Poor trafficability; seasonal high water table; high silt content.
Augusta: Au	Poor: seasonal high water table.	Poor: excessive fines, fair in places.	Poor: A–4, A–6 material, A–2, A–4 below depth of 5 feet.	Seasonal high water table.	Poor trafficability; seasonal high water table.
*Aura: AvB, AvC2, AvD2, AvE2, AwD, AwE. For Galestown and Sassafras parts of AwD and AwE, refer to Galestown and Sassafras series, respectively.	Poor: high gravel content.	Poor: excessive fines, fair in places.	Variable: A–2, A–6 material; well sorted.	Cuts and fills needed; variable material in substratum; erodible where exposed.	Fair trafficability
Bertie: BaA	Poor: seasonal high water table.	Unsuitable	Poor: A–4, A–6, A–7 material; high silt content.	Seasonal high water table; variable material in substratum.	Poor trafficability; seasonal high water table.
Bibb: Bb	Poor: sandy material; seasonal high table.	Fair: excessive fines in places.	Fair: A–2, A–4 material; well sorted to poorly sorted.	Seasonal high water table; flooding hazard.	Poor trafficability; seasonal high water table; flooding hazard.
Bladen: Bd	Poor: seasonal high water table; ponding.	Unsuitable	Poor: A–4, A–7 material; plastic clays.	Seasonal high water table; ponding; plastic clays.	Very poor trafficability; seasonal high water table; ponding; plastic clays.
Bourne: BmA, BmB, BmC2, BoB, BoC2.	Poor: seasonal high water table; fragipan.	Unsuitable	Poor: A–14, A–6 material, A–7, A–4 below depth of 5 feet.	Seasonal high water table; ponding on level areas; seepage on fragipan.	Poor trafficability; seasonal high water table.

interpretations of the soils—Continued

Soil features affecting engineering practices for—Continued						
Construction and maintenance of pipelines	Impoundments		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Generally favorable conditions.	Generally favorable conditions.	Fair stability and compaction; fair resistance to piping.	Well drained	Moderate intake rate.	Features generally favorable.	Erodible on steeper slopes.
Rock at depth of 2 to 4 feet.	Permeable material; seepage; rock at depth of 2 to 4 feet.	Good stability and compaction; poor resistance to piping; seepage.	Well drained to excessively drained.	Rapid intake rate; steep slopes.	Rock at depth of 2 to 4 feet; steep slopes.	Erodible on slopes.
Seasonal high water table; fragipan.	Seasonal high water table.	Fair to poor stability and compaction; fair resistance to piping.	Seasonal high water table; fragipan; slow permeability.	Slow intake rate; fragipan.	Fragipan; unstable embankments.	Seasonal high water table; fragipan; erodible.
Seasonal high water table.	Seasonal high water table; seepage in substratum.	Fair to poor stability and compaction; fair resistance to piping.	Seasonal high water table; moderate permeability.	Moderate intake rate; drainage needed.	Seasonal high water table; nearly level.	Seasonal high water table.
Steep slopes; variable gravel content.	Permeable material; variable material in substratum; seepage.	Fair to poor stability and compaction; fair resistance to piping.	Well drained	Moderate intake rate; steep slopes.	Fair to poor stability; high gravel content; steep slopes.	High gravel content; erodible on steeper slopes.
Seasonal high water table.	Seasonal high water table; seepage in substratum.	Fair stability and compaction; fair resistance to piping.	Seasonal high water table; outlet difficult to locate; moderate permeability.	Moderate intake rate; drainage needed.	Seasonal high water table.	Seasonal high water table.
Seasonal high water table; flooding hazard.	Seasonal high water table; permeable material; seepage.	Fair to poor stability and compaction; poor resistance to piping; seepage.	Seasonal high water table; flooding hazard; outlets difficult to locate.	Low productivity; drainage needed.	Seasonal high water table; flooding hazard.	Seasonal high water table; flooding hazard.
Seasonal high water table; ponding; plastic clays; variable material in substratum.	Seasonal high water table; seepage in substratum.	Fair to poor stability and compaction; good resistance to piping.	Seasonal high water table; ponding; outlets difficult to locate; slow permeability.	Slow intake rate; drainage needed.	Seasonal high water table; nearly level; clayey subsoil.	Seasonal high water table; clayey subsoil.
Seasonal high water table; fragipan.	Seasonal high water table.	Fair to good stability and compaction; fair resistance to piping.	Seasonal high water table; fragipan; slow to very slow permeability.	Moderate intake rate; fragipan.	Fair stability; fragipan; susceptible to siltation.	Seasonal high water table; fragipan; erodible on slopes.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices for—	
	Topsoil	Sand and gravel	Road fill	Highway location	Winter grading
Bourne, gravelly subsoil variant: BnB, BnC2.	Poor: seasonal high water table; fragipan.	Unsuitable	Fair: A–2, A–4, A–6 material.	Seasonal high water table; seepage on fragipan.	Poor trafficability; seasonal high water table.
Bremo: BrD, BrE	Fair: upper 10 inches.	Unsuitable	Poor: A–4, A–6 material; coarse fragments increase with depth.	Cuts and fills needed; rock at depth of 3 to 6 feet; erodible where exposed.	Fair trafficability
*Caroline: CaB2, CaC2, CaD2, CcC3, CcD3, CdD, CdE. For Sassafras part of CdD and CdE, refer to Sassafras series.	Fair: upper 10 inches gravel in places.	Unsuitable	Poor: A–7 material.	Erodible where exposed; plastic clays in substratum.	Poor trafficability; plastic.
Cartecay: Ce	Poor to fair: coarse material.	Poor: limited quantity; fair in places.	Good: A–2, A–4 material; well drained to poorly sorted.	Seasonal high water table; flooding hazard.	Poor trafficability; seasonal high water table; flooding hazard.
Cecil: CfB2, CfC2, CgB2, ChC3	Fair: upper 10 inches.	Unsuitable	Poor: A–4, A–6, A–7 material.	Deeply weathered substratum; erodible where exposed.	Fair trafficability
Colfax: ClB	Poor: seasonal high water table; fragipan.	Unsuitable	Poor: A–4, A–6 material.	Seasonal high water table; seepage on fragipan.	Poor trafficability; seasonal high water table.
Colfax, gravelly subsoil variant: CmB	Poor: sandy material; fragipan.	Unsuitable	Fair to poor: A–2, A–4, A–6 material.	Seasonal high water table; fragipan.	Poor trafficability; seasonal high water table.
Congaree: Cn	Good: upper 30 inches.	Unsuitable: fair in places.	Fair to poor: A–4, A–6 material.	Flooding hazard; variable material in substratum.	Fair trafficability; flooding hazard.
Craven: CrA, CrB	Fair: upper 10 inches.	Unsuitable	Poor: A–6, A–7 material; plastic clays.	Seasonal high water table; plastic clays.	Poor trafficability; seasonal high water table; plastic clay.
Cullen: CuB2, CuC2, CvC3	Good: upper 10 inches.	Unsuitable	Poor: A–4, A–6, A–7 material; sticky and plastic clays.	Cuts and fills needed; sticky and plastic clays; erodible where exposed.	Poor trafficability; sticky and plastic clay.

interpretations of the soils—Continued

Soil features affecting engineering practices for—Continued						
Construction and maintenance of pipelines	Impoundments		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Seasonal high water table; fragipan.	Seasonal high water table.	Fair stability and compaction; fair resistance to piping; gravel.	Seasonal high water table; fragipan; slow to very slow permeability.	Moderate intake rate; fragipan.	Fair stability; fragipan; susceptible to siltation.	Seasonal high water table; fragipan; erodible on slopes.
Steep slopes; rock at depth of 3 to 6 feet.	Permeable material; seepage in substratum; rock at depth of 3 to 6 feet.	Fair stability; fair to good compaction; fair resistance to piping.	Somewhat excessively drained.	Steep slopes	Rock at depth of 3 to 6 feet; steep slopes.	Rock at depth of 3 to 6 feet; erodible on slopes.
Plastic clays in substratum.	Features generally favorable.	Fair stability and compaction; fair resistance to piping.	Well drained	Slow intake rate.	Fair stability; clayey subsoil.	Erodible on slopes.
Seasonal high water table; flooding hazard.	Permeable material; seepage.	Fair stability and compaction; poor resistance to piping; seepage.	Seasonal high water table; flooding hazard; outlets difficult to locate.	Low productivity; drainage needed.	Flooding hazard; susceptible to siltation.	Seasonal high water table.
Generally favorable contions.	Generally favorable conditions.	Fair stability and compaction; fair resistance to piping.	Well drained	Moderate intake rate.	Generally favorable conditions.	Erodible on slopes.
Seasonal high water table; fragipan.	Seasonal high water table.	Fair to poor stability; fair compaction; fair resistance to piping.	Seasonal high water table; fragipan; slow to very slow permeability.	Moderate intake rate; fragipan.	Fair to poor stability; fragipan.	Seasonal high water table; fragipan; erodible.
Seasonal high water table; fragipan.	Seasonal high water table; seepage in substratum.	Fair stability and compaction; fair to poor resistance to piping.	Seasonal high water table; fragipan; slow to very slow permeability.	Moderate intake rate; fragipan.	Fair stability; fragipan.	Seasonal high water table; fragipan; erodible.
Flooding hazard.	Pervious substratum; flooding hazard.	Fair to poor stability and compaction; poor resistance to piping.	Well drained; flooding hazard.	Features generally favorable.	Features generally favorable.	Features generally favorable.
Seasonal high water table; plastic clay.	Seasonal high water table.	Fair to poor stability and compaction; good resistance to piping; high volume change.	Seasonal high water table; slow permeability.	Slow intake rate.	Clayey subsoil	Seasonal high water table; clayey subsoil.
Sticky and plastic clay.	Permeable substratum; seepage losses.	Fair to poor stability and compaction; fair to good resistance to piping.	Well drained	Moderate intake rate.	Features generally favorable.	Clayey subsoil; erodible.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices for—	
	Topsoil	Sand and gravel	Road fill	Highway location	Winter grading
Dogue: DoA, DoB	Good: upper 10 inches.	Poor: excessive fines; fair in places.	Poor: A–4, A–7 material; A–4, A–6 below depth of 5 feet.	Seasonal high water table; plastic clays.	Poor trafficability; seasonal high water table.
Elbert, thin solum variant: Eb	Poor: seasonal high water table; ponding.	Unsuitable	Poor: A–7 material; very plastic clays.	Seasonal high water table; very plastic clay; ponding.	Very poor trafficability; seasonal high water table; ponding; very plastic clay.
Elioak: ElB2, ElC2, EmC3	Fair: upper 8 inches.	Unsuitable	Poor: A–4, A–7 material; high silt content; plastic clays.	High silt content; deeply weathered micaceous substratum; plastic clays.	Fair to poor trafficability; plastic clays; high silt content.
Fairfax: FaB	Fair: upper 8 inches.	Unsuitable	Poor: A–6, A–7 material; high silt content below depth of 2 feet.	In places micaceous substratum has high silt content.	Fair trafficability.
Fallsington: Fd	Poor: seasonal high water table.	Unsuitable: fair in places.	Poor: A–4, A–6, A–7 material.	Seasonal high water table; variable material in substratum.	Poor trafficability; seasonal high water table.
*Galestown: GsD, GsE, GsF. For Sassafras part of all these units, refer to Sassafras series.	Poor: sandy material.	Fair to poor for sand: excessive fines; fair in places for gravel.	Fair: A–2, A–4 material.	Cuts and fills needed; variable material in substratum; unstable on slopes.	Good trafficability.
Iuka: Iu	Fair: sandy material in places.	Fair in places for sand: unsuitable for gravel.	Fair: A–4 material; often poorly sorted.	Seasonal high water table; variable material in substratum.	Fair trafficability; seasonal high water table.
Kempsville: KeA, KeB, KfB, KfC2, KfD2.	Fair: upper 10 inches; sandy material in places.	Fair in places for sand: unsuitable for gravel.	Fair: A–4, A–6 material; A–2, A–4 below depth of 4 feet.	Erodible on cut slopes.	Fair to good trafficability.
Lignum: LgA, LgB	Fair: upper 10 inches; seasonal high water table.	Unsuitable	Poor: A–6, A–7 material; high silt content.	Seasonal high water table; plastic clays; high silt content.	Poor trafficability; seasonal high water table.
Manor: MaD, MaE	Fair: upper 8 inches.	Unsuitable	Poor: A–7 material; high silt content; micaceous.	High silt content; deeply weathered micaceous substratum.	Fair trafficability; high silt content.

interpretations of the soils—Continued

Soil features affecting engineering practices for—Continued						
Construction and maintenance of pipelines	Impoundments		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Seasonal high water table; plastic clays; variable material in substratum.	Seasonal high water table; permeable substratum; seepage.	Fair to poor stability and compaction; good resistance to piping.	Seasonal high water table; moderately slow permeability.	Slow intake rate.	Features generally favorable.	Seasonal high water table.
Seasonal high water table; very plastic clay; ponding.	Seasonal high water table.	Poor stability and compaction; fair resistance to piping; high volume change.	Seasonal high water table; very slow permeability; ponding.	Slow intake rate; drainage needed.	Seasonal high water table; clayey subsoil.	Seasonal high water table; clayey subsoil; erodible.
Features generally favorable.	Permeable substratum; seepage.	Fair to poor stability and compaction; fair resistance to piping.	Well drained	Moderate intake rate.	Features generally favorable.	Erodible on slopes.
Features generally favorable.	Permeable substratum; seepage.	Fair to poor stability and compaction; good resistance to piping.	Well drained	Moderate intake rate.	Features generally favorable.	Features generally favorable.
Seasonal high water table.	Seasonal high water table; permeable material; seepage.	Fair to poor stability and compaction; fair to poor resistance to piping.	Seasonal high water table; moderately slow permeability; outlet difficult to locate.	Slow intake rate; drainage needed.	Seasonal high water table; nearly level.	Seasonal high water table.
Variable material in substratum; unstable on slopes; steep slopes.	Permeable material; seepage.	Poor stability and compaction; poor resistance to piping; seepage.	Somewhat excessively drained.	Rapid intake rate; steep slopes.	Sandy material; steep slopes.	Erodible; unstable on slopes.
Seasonal high water table; variable material in substratum.	Seasonal high water table; permeable material; seepage.	Fair stability and compaction; fair to poor resistance to piping; seepage.	Seasonal high water table; moderate permeability.	Features generally favorable.	Susceptible to siltation.	Seasonal high water table.
Features generally favorable.	Permeable material; seepage.	Fair stability and compaction; poor resistance to piping; seepage.	Well drained	Features generally favorable.	Features generally favorable.	Erodible on slopes.
Seasonal high water table; plastic clays.	Seasonal high water table; seepage losses in substratum.	Poor stability and compaction; fair resistance to piping.	Seasonal high water table; moderately slow permeability.	Slow intake rate.	Seasonal high water table; clayey subsoil; susceptible to siltation.	Seasonal high water table; clayey subsoil; erodible.
Features generally favorable.	Permeable material; seepage.	Poor stability and compaction; poor resistance to piping.	Well drained to somewhat excessively drained.	Steep slopes	Steep slopes	Unstable on slopes; erodible.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices for—	
	Topsoil	Sand and gravel	Road fill	Highway location	Winter grading
Marr: MdB, MdC2, MdD2, MdE2	Fair: upper 12 inches.	Unsuitable: poorly sorted; excessive fines; fair in places.	Fair to poor: A–4, A–6 material; very poorly sorted.	Very poorly sorted materials; unstable on slopes.	Good trafficability.
Meadowville: Me	Fair to good: upper 30 inches.	Unsuitable	Poor: A–4, A–7 material; high silt content.	Seasonal high water table; high silt content; variable material in substratum.	Poor trafficability; seasonal high water table.
Mecklenburg: MkB2, MkC2, MlC3	Fair to good: upper 8 inches.	Unsuitable	Poor: A–4, A–7 material.	Erodible where exposed.	Fair trafficability.
Nason: NaB, NaC2, NcC3	Fair: upper 8 inches; some coarse fragments.	Unsuitable	Poor: A–4, A–7 material; high silt content.	High silt content; deeply weathered micaceous substratum.	Fair trafficability; high silt content.
Orange: OrA, OrB, OrC2	Fair to poor: upper 12 inches.	Unsuitable	Poor: A–7 material; very plastic clays.	Seasonal high water table; very plastic clays; rock at depth of 4 to 6 feet.	Poor trafficability; seasonal high water table; very plastic clays.
Pooler, thin solum variant: Po	Fair: upper 10 inches; seasonal high water table.	Unsuitable	Poor: A–4, A–7 material; plastic clays.	Seasonal high water table; plastic clays.	Poor trafficability; seasonal high water table; plastic clays.
Roanoke: Ro	Poor: seasonal high water table.	Unsuitable: fair locally.	Poor: A–7 material; plastic clays.	Seasonal high water table; plastic clays; variable material in substratum; ponding.	Poor trafficability; seasonal high water table; plastic clays; ponding.
Sassafras: SfA, SfB, SfC2, SfD2, SfE2.	Fair: upper 10 inches; sandy materials in places.	Fair in places for sand; unsuitable for gravel.	Fair: A–4, A–6 material; A–2, A–4 below depth of 4 feet.	Features generally favorable.	Fair to good trafficability.
State: Sn	Fair to good: upper 30 inches.	Unsuitable	Fair: A–4, A–6, A–7 material.	Variable material in substratum.	Fair trafficability.
Susquehanna: SuC	Fair: upper 8 inches.	Unsuitable	Poor: A–7 material; plastic clays.	Seasonal high water table; plastic clays; aquifers in substratum.	Poor trafficability; seasonal high water; plastic clays.

interpretations of the soils—Continued

Soil features affecting engineering practices for—Continued						
Construction and maintenance of pipelines	Impoundments		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Unstable on slopes; steep slopes.	Permeable material; seepage.	Fair stability and compaction; good resistance to piping; seepage.	Well drained	Steep slopes	Fair to poor stability; sandy substratum; steep slopes.	Unstable on slopes; erodible.
Seasonal high water table.	Permeable material; seepage.	Fair stability and compaction; fair resistance to piping.	Seasonal high water table; moderate permeability.	Moderate intake rate.	Susceptible to siltation.	Seasonal high water table; erodible.
Features generally favorable.	Features generally favorable.	Fair stability and compaction; fair resistance to piping; high volume change.	Well drained	Slow intake rate.	Clayey subsoil.	Erodible on slopes.
Features generally favorable.	Permeable substratum; seepage.	Poor stability and compaction; poor resistance to piping.	Well drained	Moderate intake rate.	Generally favorable conditions.	Erodible on slopes.
Seasonal high water table; very plastic clays; rock at depth of 4 to 6 feet.	Seasonal high water table; rock at depth of 4 to 6 feet.	Poor stability and compaction; good resistance to piping; high volume change.	Seasonal high water table; slow permeability.	Slow intake rate.	Poor stability; clayey subsoil.	Seasonal high water table; clayey subsoil; erodible.
Seasonal high water table; plastic clays.	Seasonal high water table.	Fair to poor stability and compaction; good resistance to piping; high volume change.	Seasonal high water table; slow permeability.	Slow intake rate; drainage needed.	Seasonal high water table; clayey subsoil.	Seasonal high water table; clayey subsoil; erodible.
Seasonal high water table; plastic clays; ponding.	Seasonal high water table; permeable in substratum; seepage.	Fair to poor stability and compaction; good resistance to piping; high volume change.	Seasonal high water table; slow permeability; outlets difficult to locate.	Slow intake rate; drainage needed.	Seasonal high water table; nearly level; clayey subsoil.	Seasonal high water table; clayey subsoil; erodible.
Features generally favorable.	Permeable material; seepage.	Fair stability and compaction; fair resistance to piping; seepage.	Well drained	Features generally favorable; some steep slopes.	Features generally favorable; some steep slopes.	Erodible on slopes.
Features generally favorable.	Permeable material; seepage.	Fair stability and compaction; good resistance to piping.	Well drained	Features generally favorable.	Susceptible to siltation.	Features generally favorable.
Seasonal high water table; plastic clays; aquifers in substratum.	Seasonal high water table; aquifers in substratum.	Poor stability and compaction; good resistance to piping; high volume change.	Seasonal high water table; very slow permeability.	Slow intake rate.	Clayey subsoil.	Seasonal high water table; clayey subsoil; unstable on slopes; erodible; seepage.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices for—	
	Topsoil	Sand and gravel	Road fill	Highway location	Winter grading
Tetotum: TeA, TeB, TeC2	Fair: upper 10 inches.	Unsuitable: fair in places below depth of 4 feet.	Fair: A–4, A–6 material.	Seasonal high water table; variable material in substratum.	Poor trafficability; seasonal high water table.
Turbeville: TuA, TuB, TuC2	Good: upper 12 inches.	Unsuitable	Poor: A–4, A–7 material.	Erodible when exposed; well drained.	Fair trafficability
Wahee: Wa	Poor: seasonal high water table.	Unsuitable	Poor: A–6, A–7 material; plastic clays.	Seasonal high water table; plastic clays; variable material in substratum.	Poor trafficability; seasonal high water table; plastic clays.
Watt, gray surface variant: WgD, WgE.	Poor: acid; coarse fragments.	Unsuitable	Poor: A–4 material; high silt content; coarse fragments.	High silt content; rock at depth of 1½ to 3 feet.	Fair trafficability
Wehadkee: Wh	Poor: seasonal high water table.	Unsuitable: fair in places below depth of 3 to 4 feet.	Fair to poor: A–4, A–6 material.	Seasonal high water table; flooding hazard.	Poor trafficability; seasonal high water table; flooding hazard.
Westphalia: WlB, WlD2, WlE2	Poor: sandy material.	Unsuitable	Fair: A–2, A–4 material; very poorly sorted.	Unstable on slopes; erodible.	Good trafficability
Wickham: WmA, WmB, WmC2	Good: upper 12 inches.	Good: below depth of 4 feet.	Fair to good: A–2, A–4, A–6 material; A–2, A–4 below depth of 4 feet.	Well drained; erodible on cut slopes.	Fair to good trafficability.
Wickham, thin solum variant: WnA, WnB, WnC.	Poor: sandy material.	Good	Fair: A–2, A–4, A–6 material; A–2 below depth of 3 feet.	Well drained; erodible on cut slopes.	Good trafficability.
Woodstown: WoA, WoB	Fair: upper 10 inches; seasonal high water table.	Unsuitable: fair locally.	Fair: A–4, A–6 material; A–4 below depth of 4 feet.	Seasonal high water table; seepage from higher areas.	Poor trafficability; seasonal high water table.
Worsham: Wr	Poor: seasonal high water table.	Unsuitable	Poor: A–6, A–7 material.	Seasonal high water table; seepage from higher areas; plastic material.	Poor trafficability; seasonal high water table.

interpretations of the soils—Continued

Soil features affecting engineering practices for—Continued						
Construction and maintenance of pipelines	Impoundments		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Seasonal high water table; variable material in substratum.	Seasonal high water table; permeable material in substratum; seepage.	Fair stability and compaction; good resistance to piping.	Seasonal high water table; moderate permeability.	Features generally favorable.	Features generally favorable.	Seasonal high water table.
Features generally favorable.	Features generally favorable.	Fair to good stability and compaction; good resistance to piping.	Well drained	Moderate intake rate.	Features generally favorable.	Features generally favorable.
Seasonal high water table; plastic clays; variable material in substratum.	Seasonal high water table.	Fair to poor stability and compaction; good resistance to piping; high volume change.	Seasonal high water table; slow permeability.	Slow intake rate; drainage needed.	Seasonal high water table; nearly level; clayey subsoil.	Seasonal high water table; clayey subsoil.
Rock at depth of 1½ to 3 feet.	Rock at depth of 1½ to 3 feet.	Poor stability and compaction; poor resistance to piping.	Somewhat excessively drained.	Steep slopes; low productivity.	Rock at depth of 1½ to 3 feet.	Rock at depth of 1½ to 3 feet; erodible on slopes.
Seasonal high water table; flooding hazard.	Seasonal high water table; flooding hazard; seepage in substratum.	Fair to poor stability; fair compaction; fair resistance to piping.	Seasonal high water table; flooding hazard; outlet location difficult.	Drainage needed.	Seasonal high water table; flooding hazard; nearly level; susceptible to siltation.	Seasonal high water table; flooding hazard.
Unstable on slopes; steep slopes.	Permeable material; seepage.	Fair stability and compaction; poor resistance to piping.	Well drained	Rapid intake; steep slopes.	Sandy material; steep slopes.	Erodible on slopes.
Features generally favorable.	Permeable material; seepage.	Good stability and compaction; good resistance to piping; seepage.	Well drained	Features generally favorable.	Features generally favorable.	Features generally favorable.
Features generally favorable.	Permeable material; seepage.	Fair stability and compaction; good resistance to piping; seepage.	Well drained	Rapid intake rate.	Coarse material below depth of 3 feet.	Coarse material below depth of 3 feet.
Seasonal high water table; variable material in substratum.	Seasonal high water table; permeable material; seepage.	Fair stability and compaction; fair resistance to piping.	Seasonal high water table; moderate permeability.	Moderate intake rate.	Features generally favorable.	Features favorable.
Seasonal high water table; seepage from higher areas; plastic material.	Seasonal high water table.	Fair to poor stability and compaction; good resistance to piping; high volume change.	Seasonal high water table; slow permeability.	Slow intake rate; drainage needed.	Seasonal high water table; clayey subsoil.	Seasonal high water table; clayey subsoil.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices for—	
	Topsoil	Sand and gravel	Road fill	Highway location	Winter grading
Zion, deep variant: ZIB, ZIC2	Fair: upper 8 inches.	Unsuitable	Poor: A–6, A–7 material; plastic clay.	Plastic materials; rock at depth of 4 to 6 feet; erodible where exposed.	Fair trafficability

TABLE 6.—*Engineering*

[Tests performed by Virginia Department of Highways under a cooperative agreement with the U.S. Department of Commerce, Bureau of samples were taken

Soil name and location	Virginia report No.	Depth	Moisture density [1]		Mechanical analysis [2]			
					Percentage passing sieve—			
			Maximum dry density	Optimum moisture	1 in.	¾ in.	⅜ in.	No. 4 (4.7 mm.)
		Inches	*Pounds per cubic feet*	*Percent*				
Appling fine sandy loam:								
10 yards east of Route 654, 0.5 mile south of Route 655 (modal profile).	SO–50521	0–9	117	12	100	100	100	100
	SO–50522	16–28	100	23				100
	SO–50523	46–64	102	20				100
Ashlar fine sandy loam:								
100 yards south of Route 663, 1 mile southwest of Route 665 (modal profile).	SO–50539	0–5	117	15		100	99	98
	SO–50540	9–18	132	12				100
Aura gravelly fine sandy loam:								
200 yards north of restaurant, 50 yards west of U.S. Highway No. 1 (modal profile).	SO–50547	4–12	123	11	[5] 97	93	75	66
	SO–50548	18–28	105	20	[5] 98	94	89	86
	SO–50549	42–84	114	15		100	97	96
Caroline fine sandy loam:								
20 yards west of Route 603, 300 yards south of Route 218 (modal profile).	SO–50524	4–9	124	10				
	SO–50525	13–22	110	18				
	SO–50526	35–65	107	18				100
Elioak silt loam:								
200 yards east of Route 612, 1.5 miles south of Route 616 (modal profile).	SO–50527	3–8	112	15		100	99	98
	SO–50528	13–27	100	24	100	99	98	97
	SO–50529	49–98	100	22				100
Lignum silt loam:								
200 yards west, 500 yards southwest of junction of Routes 616 and 627 (modal profile).	SO–50536	0–10	103	20				100
	SO–50537	16–33	96	25				
	SO–50538	39–104	111	16		100	100	99
Manor silt loam:								
200 yards south of Route 615, 0.25 mile southwest of Route 614 (modal profile).	SO–50541	0–4	101	22		100	98	97
	SO–50542	8–23	98	23		100	99	99
	SO–50543	23–60	105	18	100	96	91	89

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting engineering practices for—Continued						
Construction and maintenance of pipelines	Impoundments		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Plastic materials; rock at depth of 4 to 6 feet.	Permeable substratum; seepage; rock at depth of 4 to 6 feet.	Fair to poor stability; fair compaction; fair resistance to piping; high volume change.	Well drained	Slow intake rate.	Fair stability; rock at depth of 4 to 6 feet.	Rock at depth of 4 to 6 feet; erodible on slopes.

test data

Public Roads (BPR), in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*). All in Stafford County]

Mechanical analysis [2]—Continued							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Con.			Percentage smaller than—							
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
							Percent			
99	75	49	35	23	4	0	23	[4] NP	A-4(3)	SM
99	82	70	60	56	47	41	70	37	A-7-5(19)	MH-CH
98	75	49	36	29	19	15	48	11	A-7-5(4)	SM
98	91	46	20	10	3	0	21	NP	A-4(3)	SM
99	85	45	29	17	11	5	23	4	A-4(3)	SM-SC
63	44	31	38	28	12	4	20	NP	A-2-4(0)	SM
84	54	44	43	40	38	37	59	16	A-7-5(5)	SM
94	44	33	25	23	21	20	58	17	A-2-7(2)	SM
100	97	56	37	23	10	4	17	NP	A-4(5)	ML
100	98	68	53	45	38	33	50	26	A-7-6(15)	CH
100	96	68	54	46	38	33	50	20	A-7-5(13)	MH-CH
94	81	59	45	31	12	4	27	NP	A-4(5)	ML
96	87	77	72	65	52	42	70	34	A-7-5(20)	MH-CH
100	88	77	69	60	39	26	63	18	A-7-5(16)	MH
100	91	76	53	38	21	12	51	19	A-7-5(14)	MH
100	99	90	75	59	35	21	74	32	A-7-5(20)	MH
93	66	50	41	26	10	3	52	15	A-7-5(6)	SM
97	92	83	67	48	24	12	46	12	A-7-5(10)	ML
98	95	89	76	61	35	22	53	17	A-7-5(14)	MH
87	78	71	54	37	24	0	40	4	A-4(8)	ML

TABLE 6.—*Engineering*

Soil name and location	Virginia report No.	Depth	Moisture density [1]		Mechanical analysis [2]			
					Percentage passing sieve—			
			Maximum dry density	Optimum moisture	1 in.	¾ in.	⅜ in.	No. 4 (4.7 mm.)
		Inches	*Pounds per cubic feet*	*Percent*				
Nason silt loam:								
20 yards north of Route 610, 500 yards east of county line (modal profile).	SO–50530	0–5	105	16	[6] 98	98	97	95
	SO–50531	9–20	99	24	----------	100	100	99
	SO–50532	40–90	105	18	----------	----------	100	100
Orange loam:								
50 yards northwest of junction of Routes 650 and 651 (modal profile).	SO–50533	0–8	116	14	----------	100	99	99
	SO–50534	21–30	86	34	----------	----------	100	100
	SO–50535	72–86	101	23	----------	----------	----------	----------
Sassafras fine sandy loam:								
Ridgetop, 75 yards east of TA–4 mess area, Quantico Marine Corps Reservation (profile thicker than modal).	SO–50544	4–12	120	12	----------	----------	----------	----------
	SO–50545	21–35	112	16	----------	----------	100	100
	SO–50546	50–75	114	16	----------	----------	100	100
Turbeville loam:								
300 yards north of Route 218, 0.25 mile west of Route 605 (modal profile).	SO–50550	0–10	117	12	----------	----------	----------	100
	SO–50551	29–47	112	17	----------	----------	----------	100
Westphalia loamy very fine sand:								
50 yards east of Route 600, 1.25 mile north of Route 218 (modal profile).	SO–50552	0–6	113	12	----------	----------	----------	100
	SO–50553	18–28	118	13	----------	----------	----------	----------
	SO–50554	38–68	105	14	----------	100	100	100

[1] Based on AASHO Designation T–99–57 (*1*).

[2] Mechanical analyses according to AASHO Designation T–88–57 (*1*). Results by this procedure frequently 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 mm. in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 mm. in diameter is excluded from calculations of grain-size fractions. The mechanical analyses data used in this table are not suitable for use in naming textural classes for soil.

test data—Continued

Mechanical analysis [2]—Continued							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Con.			Percentage smaller than—							
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
							Percent			
89	77	63	57	40	14	4	30	NP	A-4(6)	ML
96	88	82	74	64	49	40	62	29	A-7-5(20)	MH-CH
95	80	67	50	25	9	5	42	NP	A-5(7)	ML
98	91	79	61	41	13	4	23	4	A-4(8)	ML-CL
99	97	93	74	60	49	44	105	70	A-7-5(20)	CH
100	92	74	43	23	9	5	50	18	A-7-5(13)	ML
100	96	58	42	29	11	3	18	NP	A-4(5)	ML
99	94	49	34	31	29	26	39	16	A-6(5)	SM-SC
99	96	43	23	21	20	17	37	11	A-6(2)	SM-SC
100	89	63	50	38	12	2	22	4	A-4(6)	ML-CL
100	91	72	59	50	41	35	47	26	A-7-6(15)	CL
100	95	29	15	13	10	0	19	NP	A-2-4(0)	SM
100	97	48	37	31	22	18	29	9	A-4(3)	SM-SC
99	94	17	5	4	3	1	22	NP	A-2-4(0)	SM

[3] Based on AASHO Designation M-145-49 (*1*).
[4] Nonplastic.
[5] The amount of material passing the 1½-inch sieve was 100 percent.
[6] The amount of material passing the 2-inch sieve was 100 percent and that passing the 1½-inch sieve was 98 percent.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soil, with group index numbers in parentheses, is shown in table 6; the estimated classification, without group index numbers, is given in table 4 for all soils mapped in the survey area.

Estimated engineering properties

Several estimated soil properties significant to engineering are given in table 4. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other countries. Following are explanations of some of the columns in table 4.

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

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years. Soils having a fragipan tend to have a perched water table.

Soil texture is described in table 4 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey. Unified and AASHO classifications are also given in table 4.

Permeability is that quality of a soil that enables it to transmit water in a downward direction. It is estimated on basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 4 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

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

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

Shrink-swell potential is an indication of the volume change to be expected of the soil material as moisture content changes. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A high shrink-well potential indicates a hazard to the maintenance of engineering structures constructed in, on, or with material having this rating.

Corrosivity, as used in table 4, indicates the potential danger to uncoated metal or concrete structures through chemical action which dissolves or weakens structural material. Steel and concrete pipes, for example, may corrode if buried in soil, and a given material corrodes more rapidly in some kinds of soil than in others. Pipes that are laid in more than one kind of soil or that pass through more than one soil horizon are more likely to be damaged by corrosion than pipes that are buried entirely in one kind of soil or in only one horizon.

Engineering interpretations of the soils

In table 5 the soils of Stafford and King George Counties are rated according to their suitability as a source of topsoil, sand and gravel, and roadfill. This table also gives soil features that affect suitability of the soils for location of highways, for winter grading, and for engineering structures and practices. The suitability ratings and soil features given are based on the engineering properties of soils shown in table 4, on test data for soils shown in table 6 and for similar soils in counties nearby, and on the experience of engineers and soil scientists with the soils of the two counties.

In estimating the suitability of the soils as a source of topsoil, only the uppermost 10 to 15 inches of soil material was ordinarily considered.

The suitability ratings as a source of sand and gravel are based mainly on knowledge of soils that have provided suitable construction material in the past. The suitability of sand and gravel for base course, for subbase, or for concrete or asphalt mixtures must be determined by inspection of the specific deposits.

Suitability as a source of road fill depends largely on the texture of the soil, the natural content of water, and the behavior of the soil when compacted and used as a subbase for a highway.

Soil features that affect location of highways include depth to rock, stones on or in the soil, natural drainage, flooding hazard, shrink-swell potential, and slope.

Soils that affect "winter grading" are based largely on soil texture, natural content of water, and depth to the water table in winter. Trafficability in winter is a prime consideration. Clayey soils are difficult to work when wet and must be dried to the proper moisture content for compaction.

Construction and maintenance of pipelines are affected by depth to bedrock, stones on or in the soil, rock outcrops, a seasonal high water table, a hazard of flooding, and slope.

Soil features that affect use of a soil for the reservoir area where water is impounded are those of a soil that has not been disturbed. Features that affect use of a soil

for pond embankments relate to soil material that has been moved from its natural position to a place in the embankment of the pond.

Agricultural drainage depends upon those features and qualities of the soil that affect the installation of a drainage system and the performance of surface or subsurface drains. These are slope, height of the water table, permeability, depth to rock, and availability of suitable outlets.

The rate of water intake, permeability, natural drainage, and the available moisture capacity are properties of soils that affect irrigation. A high water table, susceptibility to flooding, slopes, the presence of coarse fragments, and depth to rock are also important.

Terraces and diversions are affected by slope, soil stability, and soil depth. Also important are the ease with which the channel can be protected from siltation and a cover of plants established and maintained.

Soil features that affect establishment and maintenance of waterways are similar to those that affect terraces and diversions. The waterway should be grassed. Therefore, features that affect the establishment and maintenance of a cover of grass are especially important.

Engineering test data

Table 6 gives the results of laboratory tests of samples of soils from 12 series in Stafford County. The tests were performed by the Virginia Department of Highways under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads. They were done to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

The tests to determine liquid limit and plasticity index measure the effect of water on the strength and consistence of 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 soil material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between liquid limit and plastic limit. It indicates the range in moisture content within which a soil material is in a plastic condition.

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Problems in engineering

Some of the soils of Stafford and King George Counties have properties and characteristics that cause problems to their use for engineering. The Atlee, Bourne, and Colfax soils, for example, have a fragipan at a depth of 18 to 35 inches that is brittle and compact in place and slowly to very slowly permeable. During wet seasons, a perched water table forms on top of the fragipan, and the water then moves laterally, downslope.

The Bladen, Craven, Elbert, Orange, Pooler, Roanoke, Susquehanna, and Wahee soils have a heavy clay subsoil that is slowly permeable. The surface layer of these soils is commonly saturated with water during wet periods and causes ponding on nearly level areas. The Craven, Pooler, and Susquehanna soils are underlain by stratified clays that commonly have aquifers of coarser material in them. Deep cuts into these soils are often wet or flooded, and cut banks are wet and unstable.

A seasonal high water table occurs in the moderately well drained to poorly drained soils. Altavista, Craven, Dogue, Iuka, Lignum, Meadowville, Orange, Tetotum, and Woodstown soils are moderately well drained, and generally have a seasonal high water table at a depth of 1½ to 3½ feet. Augusta, Bertie, Cartecay, Pooler, and Wahee soils are somewhat poorly drained and generally have a seasonal high water table at a depth of 1 to 2½ feet. Bibb, Bladen, Elbert, Fallsington, Roanoke, Wehadkee, and Worsham soils are all poorly drained, and generally have a seasonal high water table that ranges from 0 to 1½ feet.

Drainage of areas of these soils depends on the texture of the subsoil and the location of suitable outlets. Generally, either tile systems or surface drainage systems are used in soils having loamy subsoils, such as Altavista and Cartecay. Soils having clayey subsoils, such as Pooler and Roanoke, generally are limited to surface drainage systems. Suitable outlets are commonly lacking on low-lying and flood plain soils, such as Bibb and Wehadkee.

The soils on the flood plains of the drainageways and streams generally are subject to frequent or very frequent flooding. This flooding hazard limits the uses of the flood plain soils, and requires special engineering designs and practices.

If the vegetative cover is removed on slopes greater than 3 percent, most of the soil erodes easily. Soils such as the Appling, Caroline, Cecil, Cullen, Elioak, Mecklenburg, and Nason soils are especially erodible under the above conditions. Application of erosion-control practices is commonly required where large areas of these soils are stripped of their vegetative cover in order to prevent excessive loss of soil materials and to prevent siltation of the drainageways and streams below the cleared areas.

The Marr, Sassafras, and Westphalia soils generally are underlain by stratified, poorly sorted sands. The very fine sands under Marr and Westphalia soils have some use as molding sands. They occur in a small area in eastern Stafford County and western King George County, north of Route 218 and south of Potomac Creek. In a few areas, the sands under the Sassafras soils have cemented to soft sandstones.

The Altavista, Augusta, Dogue, Roanoke, and Wickham soils formed on terraces along the Rappahannock River and the lower courses of Aquia and Potomac Creeks and commonly are underlain by sand and gravel. This sand and gravel is mined for commercial purposes in several areas, especially along the Rappahannock River below Chatham Bridge.

The Aura soils have a high content of coarse fragments. Gravel content ranges up to 35 percent, by volume. These soils generally are underlain by stratified sandy, gravelly, and loamy sediment.

Outcrops of granite, gneiss, and schist commonly are on the steeper slopes of the Ashlar, Manor, and Watt soils, especially along the larger streams of the Rappahannock River. Stony rolling land and Stony steep land have outcrops and boulders of Aquia standstone that cover from 20 to 70 percent of the surface areas. Atlee, Bourne, Colfax, Craven, Orange, Manor, Pooler, Susquehanna, and Watt soils are unstable in deep cuts. Cut banks slough easily. Watt soils both slough and slide in cuts, and where vegetation is removed on steep slopes.

Town and Country Planning

This section was prepared chiefly for planners, developers, landscape architects, builders, zoning officials, realtors, private and potential landowners, and others interested in use of the soils in Stafford and King George Counties for purposes other than farming. The counties are in the tidewater area of Virginia, and their population is increasing as urban areas steadily expand into areas formerly used for farming. In particular, the demand for outdoor recreational facilities is increasing.

Soil and water losses on land areas undergoing urbanization are often excessive. Construction of streets and roads, shopping centers and large buildings, land shaping, and the installation of water and sewage lines remove the vegetation from the soils and leave them exposed to erosion for long periods of time. Increased runoff and downstream siltation extend the damage far beyond the construction area. Soil and water losses in these areas can be reduced by adequate management practices during construction.

Contractors and developers should expose the smallest practical area of land at any one time and keep the exposure to the shortest practical time. Use of temporary vegetation or mulching, sediment basins to control siltation, measures to control increased runoff, and measures to retain and protect natural vegetation help to control erosion.

Table 7 shows the estimated degree and kinds of limitations of the soils of the county for septic tank filter fields; sewage lagoons; building locations; roads; lawns, landscaping, and golf fairways; camping areas; playgrounds; and picnic areas. The degree of limitation is indicated by the words *slight*, *moderate*, and *severe*. A limitation of *slight* indicates that the soil has little or no important limitations for the specified use. A rating of *moderate* indicates that the soil has one or more properties that might increase construction or maintenance costs or contribute to problems in operation. Such limitations should be considered during the initial design. A rating of *severe* indicates that the soil has properties that are both costly and difficult to overcome. Maintenance of projects on soils so rated is likely to be of a continuing nature and costly. Failure to recognize severe limitations commonly results in an early failure or unsuccessful completion of a project. They generally can be compensated for with proper planning.

The rating system provides a basis for comparing soils for various uses and for selecting soils for a specified use. An onsite investigation should be made before using the soils for the purposes specified in table 7, especially if considerable cost is involved.

The ratings in table 7 represent typical conditions for each kind of soil shown on the detailed soil map. The limitation at a particular site or on a particular lot may vary in degree and kind from that listed in table 7 because of natural variation within any one soil area.

The degree of limitation for use as a septic tank filter field is based on depth to rock, slope, permeability, the presence of stone, the hazard of flooding, and the presence or absence of a seasonal high water table. The source of water supply, whether from an individual or a community system, is not considered in the ratings.

The limitations for sewage lagoons are based on permeability, depth to rock, slope, reservoir site materials (unified grouping), coarse fragments less than 6 inches in size, coarse fragments more than 6 inches in size, organic-matter content, and the hazard of flooding. It is assumed that the natural soil is used both for the reservoir site and as a source of embankment materials. Onsite study is needed to determine the specific location of the lagoon.

The limitations for buildings 3 stories, or less, having basements is based on the hazard of flooding, seasonal high water table, slope, permeability, depth to rock, shrink-swell potential, surface texture, and subsoil texture. The ratings are based on undisturbed soils. Alterations, such as grading, smoothing, reshaping, and ditching can create or eliminate problems for homesites (fig. 7).

The limitations for local, hard-surface streets and roads are based on depth to seasonal high water table, slope, depth to rock and whether it is hard or rippable, unified classification, surface rockiness, surface stoniness, and the hazard of flooding.

The limitations for lawns, landscaping, and golf fairways are based on depth to seasonal high water table, slope, depth to rock, surface rockiness, surface stoniness, surface soil texture, and the hazard of flooding. These areas require moderate trafficability. Soil at the site is used, and no fill dirt or topsoil is imported. Traps or roughs are not considered as part of the golf fairways.

Lawns, shrubbery, and home gardens in subdivisions or other areas that have experienced growth often encounter special problems. Soil materials excavated for foundations and basements generally are spread over the surrounding area. This results in a range of textures in the surface layer. The texture generally ranges from loamy to clayey. In addition, the surface layer is often compacted by machinery and other traffic during construction. Lawns and recreation areas are subject to a variety of uses that compact the surface layer and wear away the grass cover.

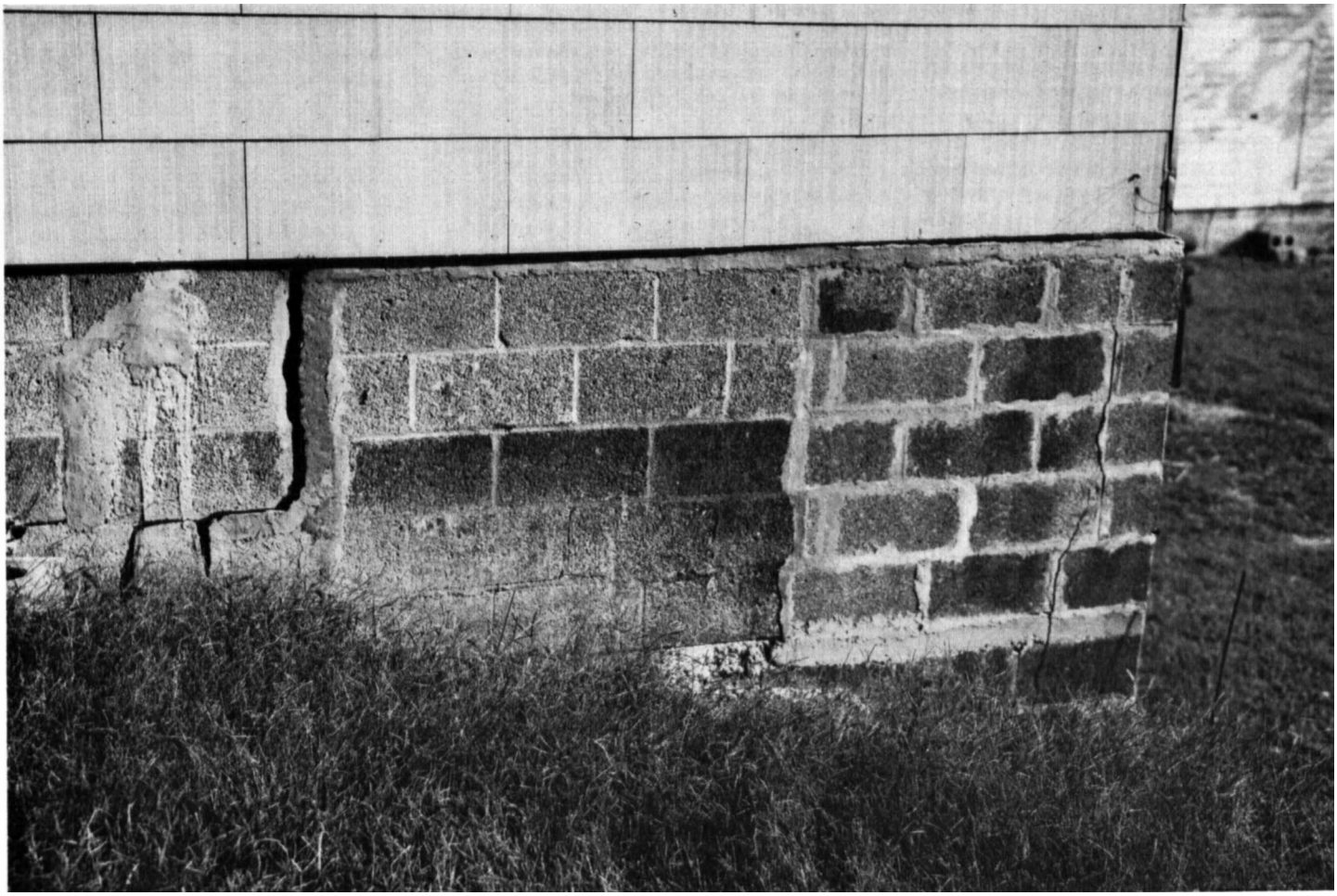

Figure 7.—**House built partly on a cut into a hillside and partly on fill from the cut. The fill settled and caused the foundation and basement walls to break and made costly repairs necessary.**

Preparation of a good seedbed, seeding of adapted grasses, the application of lime and fertilizer, watering as needed, and regulation of use all help to alleviate these problems.

The limitations for intensive use for tents, small camp trailers, and accompanying activities of outdoor use are based on seasonal high water table, the hazard of flooding, permeability, slope, surface soil texture, coarse fragments on the surface, stoniness, and rockiness. Site preparation is limited to shaping and leveling for tents and parking space. The soil should be suited to heavy foot traffic and limited vehicular traffic.

The limitations for soils used intensively for playgrounds are based on depth to seasonal high water table, the hazard of flooding, permeability, slope, surface soil texture, depth to bedrock, coarse fragments on the surface, stoniness, and rockiness. These areas are subject to intensive foot traffic. The most suitable soil is level, well drained, and has a texture that gives a good footing and is free of rock outcrops and coarse fragments.

The limitations for picnic areas are based on the seasonal high water table, flooding hazard, slope, surface texture, coarse fragments on surface, stoniness, and rockiness. It is assumed that vehicular traffic is confined to access roads and that the areas are used as they occur in nature, and that little or no soil is moved (excavated or filled).

Formation, Morphology, and Classification of Soils

In this section the factors that have affected the formation and morphology of the soils in Stafford and King George Counties are discussed. Then the current system of soil classification is explained and the soil series are placed in higher categories. The soil series in the county, including a profile representative of each series, are described in the section, "Descriptions of the Soils."

Formation of the Soils

Soil is formed by weathering and other processes that act upon parent material. The characteristics of the soil at any given point depend upon interaction of parent material, climate, plants, and animals, relief, and time.

TABLE 7.—*Estimated degree and kinds of*

[Not included in this table, because their properties are too variable to estimate, are the land types Cut and fill land (Cw), Sand and gravel An asterisk in the first column indicates that at least one mapping unit of this series is made up of two or more kinds of soil. The for referring to the series that appear in the first column of this table]

Soil series and map symbol	Septic tank filter fields	Sewage lagoons	Buildings, 3 stories or less (with basements)
Alluvial land, sandy, and gravelly: Ad	Severe: rapid permeability; ground water pollution.	Severe: rapid permeability.	Moderate to severe: seasonal high water table; flooding.
Alluvial land, wet: Ae	Severe: seasonal high water table; flooding.	Severe: flooding	Severe: seasonal high water table; flooding.
Altavista:			
AfA	Moderate: seasonal high water table; moderate permeability.	Moderate: moderate permeability.	Moderate: seasonal high water table; moderate shrink-swell potential.
AfB	Moderate: seasonal high water table; moderate permeability.	Moderate: moderate permeability; slope.	Moderate: seasonal high water table; moderate shrink-swell potential.
AfC2	Moderate: slope; seasonal high water table; moderate permeability.	Severe: slope	Moderate: slope; seasonal high water table; moderate shrink-swell potential.
Appling:			
AlB, AnB	Moderate: moderate permeability.	Moderate: slope; moderate permeability.	Moderate: moderate shrink-swell potential.
AlC2, AnC2	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
ApC3	Moderate: Slope; moderate permeability.	Severe: slope	Moderate: Slope; moderate shrink-swell potential.
Ashlar:			
AsD	Severe: shallowness to bedrock.	Severe: shallowness to bedrock; slope.	Severe: shallowness to bedrock.
AsE, AsF	Severe: slope; shallowness to bedrock.	Severe: slope; shallowness to bedrock.	Severe: slope; shallowness to bedrock.
Atlee: AtA, AtB	Severe: slow permeability; seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Augusta: Au	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
*Aura			
AvB	Slight	Moderate: moderate permeability; slope.	Slight
AvC2, AvD2, AwD For Galestown and Sassafras parts of AwD, refer to Galestown and Sassafras series, respectively.	Moderate: slope	Severe: slope	Moderate: slope
AvE2, AwE For Galestown and Sassafras parts of AwE, refer to Galestown and Sassafras series, respectively.	Severe: slope	Severe: slope	Severe: slope
Bertie: BaA	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Bibb: Bb	Severe: seasonal high water table; flooding.	Severe: flooding	Severe: flooding; poorly drained.
Bladen: Bd	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table.	Severe: seasonal high water table; high shrink-swell potential.

limitations for town and country planning

pits (Sa), Sandy and clayey land, steep, Sassafras and Caroline materials (ScF), Stony rolling land (StD), and Stony steep land (StE). soil in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions

Local roads and streets	Lawns, landscaping, and golf fairways	Camping areas	Playgrounds	Picnic areas
Moderate: flooding	Severe: sandy and gravelly surface layer; coarse fragments.	Severe: flooding	Severe: coarse fragments.	Moderate : coarse fragments.
Severe: flooding; poor drainage.	Severe: seasonal high water table; flooding.	Severe: poor drainage; flooding.	Severe: poor drainage; flooding.	Severe: poor drainage; flooding.
Moderate: fair as subgrade material.	Slight	Slight	Slight	Slight.
Moderate: fair as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Moderate: slope; fair as subgrade material.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: fair as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Moderate: fair as subgrade material; slope.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: fair as subgrade material; slope.	Moderate: slope; clay loam surface layer.	Moderate: slope; clay loam surface layer.	Severe: slope	Moderate: slope; loam surface layer.
Moderate: shallowness to bedrock; slope.	Moderate: shallowness to bedrock; slope.	Moderate: slope	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: fair as subgrade material.	Moderate: fragipan at a depth of about 24 inches.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Slight.
Moderate: somewhat poorly drained; fair as subgrade material.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Slight	Slight	Moderate: coarse fragments on surface.	Severe: coarse fragments on surface.	Moderate: coarse fragments on surface.
Moderate: slope	Moderate: slope	Moderate: slope; coarse fragments on surface.	Severe: slope; coarse fragments on surface.	Moderate: slope; coarse fragments on surface.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: somewhat poorly drained; fair as subgrade material.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Severe: poorly drained; flooding.	Severe: flooding; seasonal high water table.	Severe: flooding; seasonal high water table.	Severe: seasonal high water table; flooding.	Severe: flooding; seasonal high water. table.
Severe: poorly drained; poor as subgrade material.	Severe: seasonal high water table.	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table; slow permeability.	Severe: poorly drained; seasonal high water table.

TABLE 7.—*Estimated degree and kinds of*

Soil series and map symbol	Septic tank filter fields	Sewage lagoons	Buildings, 3 stories or less (with basements)
Bourne:			
BmA	Severe: slow to very slow permeability; seasonal high water table.	Slight	Severe: seasonal high water table.
BmB, BnB, BoB	Severe: slow to very slow permeability; seasonal high water table.	Moderate: slope	Severe: seasonal high water table.
BmC2, BnC2, BoC2	Severe: slow to very slow permeability.	Severe: slope	Severe: seasonal high water table.
Bremo:			
BrD	Severe: shallowness to bedrock.	Severe: slope; moderately rapid permeability; shallowness to bedrock.	Severe: shallowness to bedrock.
BrE	Severe: slope; shallowness to bedrock.	Severe: slope; moderately rapid permeability; shallowness to bedrock.	Severe: slope; shallowness to bedrock.
*Caroline:			
CaB2	Severe: moderately slow permeability.	Moderate: slope	Moderate: moderate shrink-swell potential.
CaC2,CaD2,CdD For the Sassafras part of unit CdD, refer to Sassafras series.	Severe: moderately slow permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
CcC3,CcD3	Severe: moderately slow permeability.	Severe: slope	Moderate: moderate shrink-swell potential; slope.
CdE For Sassafras part of the unit, refer to Sassafras series.	Severe: moderately slow permeability; slope.	Severe: slope	Severe: slope
Cartecay: Ce	Severe: flooding; seasonal high water table.	Severe: flooding; moderately rapid permeability.	Severe: flooding; seasonal high water table.
Cecil:			
CfB2, CgB2	Moderate: moderate permeability.	Moderate: slope; moderate permeability.	Moderate: moderate shrink-swell potential.
CfC2	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
ChC3	Moderate: moderate permeability; slope.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
Colfax: ClB, CmB	Severe: slow to very slow permeability; seasonal high water table.	Moderate: slope; seasonal high water table.	Severe: seasonal high water table.
Congaree: Cn	Severe: flooding	Severe: flooding	Severe: flooding
Craven: CrA, CrB	Severe: slow permeability.	Moderate: seasonal high water table; slope.	Severe: high shrink-swell potential.
Cullen:			
CuB2	Moderate: moderate permeability.	Moderate: slope; moderate permeability.	Moderate: moderate shrink-swell potential.
CuC2	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
CvC3	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
Dogue: DoA, DoB	Severe: moderately slow permeability.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; moderate shrink-swell potential.

limitations for town and country planning—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Camping areas	Playgrounds	Picnic areas
Moderate: fair as subgrade material; ponding.	Moderate: fragipan at a depth of about 20 inches.	Severe: slow to very slow permeability.	Severe: slow to very slow permeability.	Slight.
Moderate: fair as subgrade material.	Moderate: fragipan at a depth of about 20 inches.	Severe: slow to very slow permeability.	Severe: slow to very slow permeability.	Slight.
Moderate: slope; fair as subgrade material.	Moderate: fragipan at a depth of about 20 inches; slope.	Severe: slow to very slow permeability.	Severe: slow to very slow permeability; slope.	Moderate: slope.
Moderate: slope; shallowness to bedrock.	Moderate: slope; shallowness to bedrock.	Moderate: slope	Severe: slope; coarse fragments on surface.	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope; coarse fragments on surface.	Severe: slope.
Severe: poor as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Severe: poor as subgrade material.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: poor as subgrade material; slope.	Moderate: clay loam surface layer; slope.	Moderate: clay loam surface layer; slope.	Severe: slope	Moderate: clay loam surface layer; slope.
Severe: slope; poor as subgrade material.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding; seasonal high water table.	Moderate: flooding.
Moderate: fair as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Moderate: fair as subgrade material; slope.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: fair as subgrade material; slope.	Moderate: slope; clay loam surface layer.	Moderate: slope; clay loam surface layer.	Severe: slope	Moderate: slope; clay loam surface layer.
Moderate: somewhat poorly drained; fair subgrade materials.	Moderate: fragipan at a depth of about 24 inches.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding.
Severe: poor as subgrade material; high shrink-swell potential.	Slight	Moderate: slow permeability.	Moderate: slow permeability; slope.	Slight.
Moderate to severe: poor as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Moderate to severe: poor as subgrade material; slope.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Moderate to severe: poor as subgrade material; slope.	Moderate: slope; clay loam surface layer.	Moderate: slope; clay loam surface layer.	Severe: slope	Moderate: slope; clay loam surface layer.
Severe: poor as subgrade material.	Slight	Moderate: moderately slow permeability.	Moderate: slope; moderately slow permeability.	Slight.

TABLE 7.—*Estimated degree and kinds of*

Soil series and map symbol	Septic tank filter fields	Sewage lagoons	Buildings, 3 stories or less (with basements)
Elbert, thin solum variant: Eb	Severe: slow permeability; seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table; high shrink-swell potential.
Elioak:			
ElB2	Moderate: moderate permeability.	Moderate: slope; moderate permeability.	Moderate: moderate shrink-swell potential.
ElC2	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
EmC3	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
Fairfax: FaB	Moderate: moderate permeability.	Moderate: slope; moderate permeability.	Moderate: moderate shrink-swell potential.
Fallsington: Fd	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Fresh water swamp: Fs	Severe: wetness	Severe: wetness	Severe: wetness
*Galestown:			
GsD For Sassafras part of this unit, refer to Sassafras series.	Moderate: slope; possible pollution hazard to ground water supply.	Severe: rapid permeability; slope.	Moderate: slope
GsE, GsF For Sassafras part of these units, refer to Sassafras series.	Severe: slope	Severe: slope; rapid permeability.	Severe: slope
Iuka: Iu	Severe: flooding	Severe: flooding	Severe: flooding
Kempsville:			
KeA, KeB, KfB	Slight	Moderate: moderate permeability; slope.	Slight
KfC2, KfD2	Moderate: slope	Severe: slope	Moderate: slope
Lignum: LgA, LgB	Severe: seasonal high water table; moderately slow permeability.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table.
Manor:			
MaD	Moderate: slope	Severe: moderately rapid permeability; slope.	Moderate: slope
MaE	Severe: slope	Severe: slope; moderately rapid permeability.	Severe: slope
Marr:			
MdB	Slight	Severe: permeable substratum.	Slight
MdC2, MdD2	Moderate: slope	Severe: slope; permeable substratum.	Moderate: slope
MdE2	Severe: slope	Severe: slope	Severe: slope
Meadowville: Me	Moderate: seasonal high water table.	Moderate: moderate permeability.	Moderate: seasonal high water table.
Mecklenburg:			
MkB2	Severe: slow permeability.	Moderate: slope	Severe: high shrink-swell potential.
MkC2, MlC3	Severe: slow permeability.	Severe: slope	Severe: high shrink-swell potential.
Nason:			
NaB	Moderate: moderate permeability.	Moderate: slope; moderate permeability.	Moderate: moderate shrink-swell potential.
NaC2, NcC3	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.

limitations for town and country planning—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Camping areas	Playgrounds	Picnic areas
Severe: poorly drained; poor as subgrade material.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal water high table.
Moderate to severe: poor as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Moderate to severe: poor as subgrade material; slope.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Moderate to severe: poor as subgrade material; slope.	Moderate: silty clay loam surface layer.	Moderate: slope; silty clay loam surface layer.	Severe: slope	Moderate: silty clay loam surface layer.
Moderate: fair as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Severe: poorly drained	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Moderate: slope	Moderate: slope; loamy fine sand surface layer.	Moderate: slope; loamy fine sand surface layer.	Severe: slope	Moderate: slope; loamy fine sand surface layer.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding.
Slight	Slight	Slight	Slight to moderate: slope.	Slight.
Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: poor as subgrade material.	Moderate: seasonal high water table.	Moderate: seasonal high water table; moderately slow permeability.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.
Moderate: slope; fair as subgrade material.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Slight	Slight	Slight	Moderate: slope	Slight.
Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: fair as subgrade material.	Slight	Slight	Slight	Slight.
Severe: poor as subgrade material; high shrink-swell potential.	Slight	Moderate: slow permeability.	Moderate: slope; slow permeability.	Slight.
Severe: poor as subgrade material; high shrink-swell potential.	Moderate: slope; clay loam surface layer.	Moderate: slope; clay loam surface layer; slow permeability.	Severe: slope	Moderate: slope; clay loam surface layer.
Severe: poor as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Severe: poor as subgrade material.	Moderate: slope; silty clay loam surface layer.	Moderate: slope; silty clay loam surface layer.	Severe: slope	Moderate: slope; silty clay loam surface layer.

TABLE 7.—*Estimated degree and kinds of*

Soil series and map symbol	Septic tank filter fields	Sewage lagoons	Buildings, 3 stories or less (with basements)
Orange:			
OrA, OrB	Severe: slow permeability.	Moderate: seasonal high water table; slope.	Severe: high shrink-swell potential; seasonal high water table.
OrC2	Severe: slow permeability.	Severe: slope	Severe: high shrink-swell potential; seasonal high water table.
Pooler, thin solum variant: Po	Severe: slow permeability; seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table; high shrink-swell potential
Roanoke: Ro	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table.	Severe: seasonal high water table; high shrink-swell potential.
Sassafras:			
SfA, SfB	Slight	Severe: permeable substratum.	Slight
SfC2, SfD2	Moderate: slope	Severe: slope; permeable substratum.	Moderate: slope
SfE2	Severe: slope	Severe: slope; permeable substratum.	Severe: slope
State: Sn	Moderate: seasonal high water table.	Severe: moderately rapid permeability.	Moderate: seasonal high water table; moderate shrink-swell potential.
Susquehanna: SuC	Severe: very slow permeability.	Moderate to severe: slope; seasonal high water table.	Severe: high shrink-swell potential.
Tetotum:			
TeA, TeB	Moderate: seasonal high water table.	Moderate: seasonal high water table; moderate permeability.	Severe: seasonal high water table.
TeC2	Moderate: seasonal high water table; slope.	Severe: slope	Severe: seasonal high water table.
Tidal marsh: Tm	Severe: wetness	Severe: wetness	Severe: wetness
Turbeville:			
TuA, TuB	Moderate: moderate permeability.	Moderate: slope; moderate permeability.	Moderate: moderate shrink-swell potential.
TuC2	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential.
Wahee: Wa	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table.	Severe: seasonal high water table; high shrink-swell potential.
Watt, gray surface variant:			
WgD	Severe: shallowness to bedrock.	Severe: shallowness to bedrock; slope.	Severe: shallowness to bedrock.
WgE	Severe: slope; shallowness to bedrock.	Severe: slope; shallowness to bedrock.	Severe: slope; shallowness to bedrock.
Wehadkee: Wh	Severe: seasonal high water table; flooding.	Severe: flooding; seasonal high water table.	Severe: seasonal high water table; flooding.
Westphalia:			
WlB	Slight	Severe: permeable substratum.	Slight
WlD2	Moderate: slope	Severe: permeable substratum; slope.	Moderate: slope
WlE2	Severe: slope	Severe: slope; permeable substratum.	Severe: slope
Wickham:			
WmA, WmB	Slight to moderate: moderate permeability.	Moderate: moderate permeability; slope.	Moderate: moderate shrink-swell potential.
WmC2	Moderate: slope; moderate permeability.	Severe: slope	Moderate: slope; moderate shrink-swell potential

limitations for town and country planning—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Camping areas	Playgrounds	Picnic areas
Severe: poor as subgrade material; high shrink-swell potential.	Moderate: somewhat poorly drained.	Moderate: slow permeability.	Moderate: slope; slow permeability.	Slight.
Severe: poor as subgrade material; high shrink-swell potential.	Moderate: slope; somewhat poorly drained.	Moderate: slope; slow permeability.	Severe: slope	Moderate: slope.
Severe: poor as subgrade material; high shrink-swell potential.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Severe: poorly drained; poor as subgrade material.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Slight	Slight	Slight	Slight to moderate: slope.	Slight.
Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: fair as subgrade material.	Slight	Slight	Moderate: slope	Slight.
Severe: high shrink-swell potential; poor as subgrade material.	Slight to moderate: clay loam surface layer in places; slope.	Moderate: very slow permeability; clay loam surface layer in places.	Moderate to severe: slope; very slow permeability.	Moderate: slope; clay loam surface layer in places.
Moderate: fair as subgrade material.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Slight.
Moderate: slope; fair as subgrade material.	Moderate: slope	Moderate: slope; seasonal high water table.	Severe: slope	Moderate: slope.
Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Severe: poor as subgrade material.	Slight	Slight	Slight to moderate: slope.	Slight.
Severe: poor as subgrade material.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: poor as subgrade material; high shrink-swell potential.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: shallowness to bedrock; slope.	Moderate: slope; shallowness to bedrock.	Moderate: slope	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: flooding; poorly drained.	Severe: flooding; seasonal high water table.	Severe: flooding; seasonal high water table.	Severe: flooding; seasonal high water table.	Severe: flooding; seasonal high water table.
Slight	Moderate: loamy very fine sand surface layer.	Moderate: loamy very fine sand surface layer.	Moderate: slope; loamy very fine sand surface layer.	Moderate: loamy very fine sandy surface layer.
Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: fair as subgrade material.	Slight	Slight	Slight to moderate: slope.	Slight.
Moderate: slope; fair as subgrade material.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.

TABLE 7.—*Estimated degree and kinds of*

Soil series and map symbol	Septic tank filter fields	Sewage lagoons	Buildings, 3 stories or less (with basements)
Wickham, thin solum variant:			
WnA, WnB	Slight: possible pollution hazard to ground water supply.	Severe: permeable substratum.	Slight
WnC	Moderate: slope; possible pollution hazard to ground water supply.	Severe: slope; permeable substratum.	Moderate: slope
Woodstown: WoA, WoB	Moderate: seasonal high water table.	Moderate: moderate permeability; seasonal high water table; slope.	Severe: seasonal high water table.
Worsham: Wr	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table.	Severe: seasonal high water table; high shrink-swell potential.
Zion, deep variant:			
ZIB	Severe: moderately slow permeability.	Moderate: shallowness to bedrock; slope.	Severe: high shrink-swell potential.
ZIC2	Severe: moderately slow permeability.	Severe: slope	Severe: high shrink-swell potential.

Climate and plants and animals are the active forces of soil formation. They act on the parent material accumulated through the weathering of rocks and slowly change it into soil. All five factors come into play in the formation of every soil. The relative importance of each differs from place to place; sometimes one is more important and sometimes another. In extreme cases one factor may dominate in the formation of a soil and fix most of its properties. In general, however, it is the combined action of the five factors that determines the present character of each soil.

Parent material.—Parent material is the unconsolidated mass from which a soil formed. It is largely responsible for the chemical and mineralogical composition of soils. Parent materials in Stafford and King George Counties are of three kinds: residual, fluviomarine, and alluvial (*3*). Residual parent materials are formed in place through the weathering of the underlying rocks, and form the parent materials for soils such as Cecil, Appling, and Cullen. Fluviomarine parent materials are transported materials that have been reworked by stream and marine action. These materials form the parent materials for soils on the Coastal Plain. Alluvial parent materials are stream transported and form the basis for soils such as Altavista, Congaree, or Wickham on terraces and flood plains in both the Piedmont and Coastal Plain areas.

Residual parent materials are located generally to the west of Interstate 95 in Stafford County. These materials have formed principally from such rocks as granite-gneiss, quartz monzonite, blue quartz diorite, quartz schist, hornblende quartz schist, sericite quartz schist, and small dikes of rhyolite, pegmatite, aplite, and diabase. Small areas of graphitic schist occur discontinuously just west of Interstate 95. Granite, granite-gneiss, quartz monzonite, blue quartz diorite, and quartz schist weather into sandy parent materials. Much of the sand is quartz, which weathers very slowly, and soils formed from this material commonly are low in bases and are strongly acid.

The schists and the small dikes commonly weather into parent materials that have a high silt content, and this is reflected in the soils formed from these materials. Quartz schist, sericite quartz schist, and graphitic schist are low in bases and strongly to extremely acid; and the soils formed from their weathered products reflect these conditions. Soils formed from the weathered products of the other schists and small dikes are higher in bases and range from medium acid to mildly alkaline.

Fluviomarine parent materials are located along and to the east of Interstate 95 in Stafford County and throughout King George County. These are composed of transported and reworked sands, silts, and clays that, in places, are gravelly to extremely gravelly. They are in layers, and texture changes commonly are abrupt, both vertically and horizontally. In a few places, sandy layers have been consolidated to form soft standstones.

Some aeolian silts and very fine sands occur along the Potomac River, from the Stafford County line in the north to the vicinity of Fairview Beach in King George County. A large area of very fine sand is located just south of the mouth of Potomac Creek.

Soils formed from fluviomarine materials commonly are strongly acid to very strongly acid and low in bases. The texture of the soils reflects the textures of the layers from which they have formed. Most of the sands are quartz, which weathers very slowly; and soils formed in sandy layers have slight to moderate development.

Alluvial parent materials are of local origin along the smaller streams and drainageways, and of both local and general origin along the Rappahannock River. The alluvium has a mixed lithology because of the wide variety of igneous and metamorphic rocks and fluviomarine deposits

limitations for town and country planning—Continued

Local roads and streets	Lawns, landscaping, and golf fairways	Camping areas	Playgrounds	Picnic areas
Slight	Slight	Slight	Slight to moderate: slope.	Slight.
Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Slight	Slight	Moderate: seasonal high water table.	Moderate: slope seasonal high water table.	Slight.
Severe: poorly drained; high shrink-swell potential; poor as subgrade material.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Severe: poor as subgrade material; high shrink-swell potential.	Slight	Moderate: moderately slow permeability.	Moderate: slope moderately slow permeability.	Slight.
Severe: poor as subgrade material; high shrink-swell potential.	Moderate: slope	Moderate: slope; moderately slow permeability.	Severe: slope	Moderate: slope.

found in the uplands. Total thickness of the alluvium ranges from several feet along drainageways and small streams to many feet along the Rappahannock River. Alluvium along the drainageways and small streams commonly is medium textured to coarse textured. Along the Rappahannock River textures vary widely, ranging from fine-textured slackwater deposits to coarse-textured sand and gravel deposits. The soils formed in alluvium are low to moderate in bases and are medium acid to strongly acid. The well-drained soils formed in medium-textured to moderately fine textured alluvium along the Rappahannock River make up the better farming soils of Stafford and King George Counties.

Climate.—Climate as a genetic factor affects the physical, chemical, and biological relationships in soils, principally through the influence of precipitation and temperature. Water dissolves minerals, supports biological activity, and transports mineral and organic residue through the solum. Temperature determines the types of physical, chemical, and biological activities that take place and the speed at which they act.

Stafford and King George Counties have the rather humid, temperate climate that is typical of most coastal or near-coastal areas of the Middle Atlantic States. Facts about the temperature and precipitation are given in tables in the section "Additional Facts about the Area."

The climate is fairly uniform throughout the counties. Differences in elevation are not significant, and the movement of winds, clouds, and rainstorms is not obstructed. Masses of air generally move through the counties from a northwesterly direction, but they are warmed by air that moves in periodically from the south and southwest.

Because precipitation exceeds evapotranspiration, this humid, rather uniform climate has caused the soils to be strongly leached. Most of the soluble materials that either originally were present or were released through weathering have been removed; therefore, they are mostly strongly acid and low in plant nutrients.

Precipitation is mainly responsible for the subsoil that characterizes most soils in the county. In addition to leaching soluble materials, water that percolates through the soil moves clay from the surface layer to a subsoil layer. Except for soils formed in recent alluvium or sand, soils of 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 peds (aggregates) in the subsoil is caused partly by changes in volume of the soil mass that are primarily the result of alternate wetting and drying and of alternate freezing and thawing.

Weathering of minerals occurs at a rate that is related to temperature and moisture supply. Soils in tropical regions weather more rapidly than those in temperate regions. Soils in humid regions weather more rapidly than those in arid regions. In Stafford and King George Counties, the soils commonly are relatively low in weatherable minerals. No free carbonates are in them, and most of the bases have been leached out. Because many of the soils formed in transported parent materials that had undergone one or more cycles of erosion, these materials may have been highly weathered and leached at the time they were deposited.

Plants and animals.—Important factors in the formation of soils are micro-organisms, vegetation, animals, and man. Before settlement by man, the native vegetation was most important in the complex of living organisms that affect soil development. The settlers found a dense forest that consisted mainly of hardwoods. Oaks were dominant in most parts of the counties. Yellow-poplar, sweetgum, blackgum, holly, hickory, maple, dogwood, loblolly pine, and Virginia pine also were important; but there were

probably few pure stands of pine before the counties were settled. The fairly pure stands of pine that exist today are generally 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 deciduous trees because, in large part, the bases are returned to the soil each year. When the leaves fall and then decompose, the bases re-enter the soil and are again used by plants.

The soils in Stafford and King George Counties, however, have never been very high in bases, and 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 large amounts of calcium and other bases, and their needles do little to restore fertility to the soil.

As farming developed in the county, man became an important factor in the development of the soils. The clearing of the forests, cultivation in some areas, introduction of new kinds of crops and other plants, and improvements in drainage have affected development of the soils and will affect their development in the future.

The most important changes brought about by man are the mixing the upper horizons of the soil to form a plow layer, tilling sloping soils, which has resulted in accelerated erosion, and liming and fertilizing to change the content of plant nutrients, especially in the upper horizons.

Other than accelerated erosion, few results of these changes are as yet reflected in the direction and rates of soil genesis. Some may not be evident for hundreds of years; however, the complex of living organisms affecting soil genesis has been drastically changed as a result of man's activities.

Relief.—The relief of an area is largely determined by the underlying geologic formations, the geologic history of the general region, and the effects of dissection by rivers and streams. It influences soil formation through its effects on moisture relationships, erosion, temperature, and plant cover.

Stafford and King George Counties are in an area of rolling topography, rather deeply incised by the major drainage patterns. In areas of softer geologic formations, this has given rise to long, rather narrow ridges having steep side slopes. A rather wide area of level river terraces occurs along the Rappahannock River from the Falmouth area to the southeast corner of King George County. Stafford County lies astride the Fall Line, with the western section on the Piedmont Plateau and the eastern section on the Coastal Plain. King George County is wholly on the Coastal Plain. Elevations in the area range from less than 20 feet along the Potomac River in the east to about 470 feet in northwestern Stafford County. Generally, the land surface slopes gently to the southeast at an average rate of some 20 feet to the mile.

Stafford County has several drainage systems, which generally flow to the southeast and empty into the Potomac River. King George County is drained by a number of short streams, which empty either into the Potomac River on the north or the Rappahannock River on the south. The drainage pattern is, in general, dendritic, but rather irregularly branched. The general fluvial cycle is in a stage of late youth or early maturity.

Most upland areas are well drained, with drainage ranging to excessive on the steeper slopes. Geologic erosion is active on the steeper slopes, and some of these slopes on softer geologic formations are unstable. Accelerated erosion, caused by cultivation and overgrazing, is apparent on many areas.

Slopes of the broader upland ridges range from 0 to about 10 percent. The narrower ridges range from about 6 to 15 percent. Side slopes range from 10 to 45 percent, and the majority of the slopes are in the 20 to 35 percent range.

Drainage on the terraces ranges from somewhat excessively drained to poorly drained. Drainage is commonly related to the texture and position of the alluvium. Thus, fine-textured slackwater deposits in low positions commonly are poorly drained, while deep deposits of coarse materials are somewhat excessively drained. Layers of fine-textured materials in the alluvium cause fluctuating water tables, and commonly give rise to moderately well drained or somewhat poorly drained areas.

Terrace slopes are dominantly in the 0 to 6 percent range. Slopes of the terrace breaks range from 6 to about 18 percent. Stream banks along the larger streams are commonly very steep and actively eroding.

Time.—As a factor of soil formation, time generally is related to the degree of development or degree of horizon differentiation within the soil. Thus, a soil that has little or no horizon development is considered a young soil, while one that has strongly developed horizons is considered an old or mature soil. The time span of any one soil is directly dependent on the action and interaction of the soil-forming factors.

Relatively speaking, the oldest soils in Stafford and King George Counties are those formed in residuum from basic igneous rock, those formed from fine-textured alluvium and fluviomarine materials, and those soils that have developed fragipans. In general, these soils are in less sloping, relatively stable positions, and have formed in easily weatherable materials. They have a strong degree of horizon differentiation and range from moderately well drained to poorly drained.

Soils that formed in sandy fluviomarine and alluvial materials are mostly quartz sand, which weathers very slowly, and horizon differentiation is weak. These soils commonly are well drained to somewhat excessively drained. Soils formed in recent alluvium have been in place only a relatively short time and show little or no development other than an accumulation of organic matter in the surface layer. They are commonly in layers, due to the method of deposition. Drainage ranges from well drained to poorly drained.

On steeper slopes, geologic erosion removes soil material in a relatively short period of time, and the soils are not in place long enough to develop more than a weak horizon differentiation. Drainage ranges from well drained to somewhat excessively drained.

Most of the upland soils in the Piedmont and Coastal Plain and most of the terrace soils have moderate horizon

differentiation and are moderately developed. They commonly are well drained, but some in low-lying positions are moderately well drained or somewhat poorly drained.

Morphology of the Soils

Soil morphology in Stafford and King George Counties is expressed as moderately pronounced horizons in the majority of the soils, faint horizons in some soils, and strongly pronounced horizons in some soils. The differentiation of horizons in the soils is the result of one or more of the following processes: (1) accumulation of organic matter, (2) leaching of carbonates and salts more soluble than calcium carbonate, (3) chemical weathering of the primary minerals of parent material into silicate clay minerals, (4) translocation of these silicate clay minerals from one horizon to another, (5) layering of parent materials, and (6) reduction and transfer of iron.

In the formation of most soils in Stafford and King George Counties several of these processes have interacted to a varying degree. In some soils only one or two processes have been active and, in some, only to a slight degree.

Some organic-matter content 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 materials from underlying horizons through cultivation. The content of organic matter varies in the different soils and ranges from low to moderate. Sandy soils, such as Galestown and Westphalia, have a weak A1 horizon that contains little organic matter, but soils such as the Altavista and Wickham have an A1 horizon moderate in organic-matter content.

Most of the soils of Stafford and King George Counties have been very strongly leached of carbonates and salts more soluble than calcium carbonate. Most soils are strongly acid to very strongly acid. A few soils, such as Mecklenburg, are medium acid to neutral or mildly alkaline in the lower B and C horizon, and are not as strongly leached. The Coastal Plain soils are formed in unconsolidated fluviomarine sediments. Leaching of carbonate and other salts probably took place in these sediments even before they were deposited and soils formed.

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 Stafford and King George Counties, but kaolinite is recognized as the most common and most characteristic clay mineral in the soils of the county. Other clays, such as illite, montmorillonite, and probably halloysite occur in smaller quantities. A few soils, such as Elbert and Orange, have B horizons that are high in montmorillonite.

Layering influences the formation of soil horizons in several ways. The formation of silicate clays varies directly with the amount of weatherable minerals in each layer. A layer high in slowly weatherable quartz sand forms less silicate clay than a layer high in easily weathered, silt-sized minerals. Water commonly moves more slowly between layers of different textures, and this results in a temporary excess of water in the layer above. As the water slows down, minerals carried down by percolation are deposited or are precipitated, commonly forming either a compact layer or a clay layer that is slowly to very slowly permeable. If the compact layer is high in sand or silt, it is called a fragipan. In some of the soils, the clay layers and fragipans are commonly several feet thick. The Orange soils are an example of a soil having a clayey subsoil, and the Bourne soils are an example of a soil having a fragipan.

Gleying, or the process of chemical reduction and transfer of iron, occurs in soils where drainage is impeded. The naturally wet soils of Stafford and King George Counties have some degree of gleying in one or more of their horizons. Bladen and Wahee are examples of soils that have been affected by gleying because of a high water table. The gleying process involves the reduction and removal of iron from the soil.

Iron that has been reduced in areas where the soil is poorly aerated generally becomes mobile and commonly is removed from the soil. Part of the mobile iron moves either within the horizon where it originated or to another horizon. Part of this iron is segregated and reoxidized to form the red, yellowish-red, strong-brown, and yellowish-brown mottles that are common in some horizons of soils having impeded drainage. The reduction, segregation, and reoxidation of iron has occurred in horizons of the Altavista and Woodstown soils.

When silicate clay forms from primary materials, some iron generally is freed as hydrated oxide. Depending on the degree of hydration, such oxides normally are strongly red. In soils formed in parent material that is highly quartzose, coarse textured, and that lacks sufficient silicate clay minerals to form an argillic horizon, only a small amount of hydrated oxide is required to color the soil material. Such soils generally have a bright-colored B horizon. The Manor soils have a distinctly colored B horizon.

In most well-developed and freely aerated soils that have a clayey B horizon, hydrated iron oxide may color the horizon as strongly as it does a coarser textured B horizon. For example, the clayey subsoil horizon in the Turbeville soils is very strongly colored by free iron oxide. At the other extreme the Roanoke soils, which are poorly aerated, have yellower hues, lower chromas, and generally higher values than the Turbeville soils.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*4*). The system

currently used by the National Cooperative Soil Survey was developed in the early sixties (*3*) and was adopted in 1965 (*6*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of Stafford and King George Counties by family, subgroup, and order, according to the current system. The Great Soil Group category of the 1938 classification system is also given.

ORDERS.—Ten soil orders are recognized. These 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. Three exceptions, the Entisols, Histosols, and Inceptisols, occur in many different climates. The four soil orders in Stafford and King George Counties are Alfisols, Entisols, Inceptisols, and Ultisols.

SUBORDERS.—Each order is divided into groups (suborders) that are based mostly on soil characteristics that seem to produce classes having the greatest similarity from the standpoint of their genesis. Suborders narrow the broad climatic range of soils that are in the orders. Soil characteristics used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from climate or vegetation.

GREAT GROUPS.—Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated, or those that have horizons that interfere with the growth of roots or the movement of water, such as fragipans or claypans. The features are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown in table 8; however, the name of the great group is the last word in the name of the subgroup.

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

FAMILIES.—Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. These adjectives are class names for texture, mineralogy, temperature, etc., that are used as family differentiae (see table 8); an example is the fine-loamy, mixed, thermic family of Typic Hapludults.

TABLE 8.—*Classification of soil series into higher categories*

Series	Current classification			1938 Soil classification
	Family	Subgroup	Order	Great soil group
Altavista	Fine-loamy,mixed, thermic	Aquic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Appling	Clayey, kaolinitic, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Ashlar	Coarse-loamy, mixed, thermic	Typic Dystrochrepts	Inceptisols	Lithosols.
Atlee	Fine-loamy, mixed, thermic	Typic Fragiudults	Ultisols	Red-Yellow Podzolic soils.
Augusta	Fine-loamy, mixed, thermic	Aeric Ochraquults	Ultisols	Low-Humic Gley soils intergrading toward Red-Yellow Podzolic soils.
Aura	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Bertie	Fine-loamy, mixed, thermic	Aquic Hapludults	Ultisols	Low-Humic Gley soils intergrading toward Red-Yellow Podzolic soils.
Bibb	Coarse-loamy, siliceous, acid, thermic.	Typic Fluvaquents	Entisols	Low-Humic Gley soils.
Bladen	Clayey, mixed, thermic	Typic Albaquults	Ultisols	Low-Humic Gley soils.
Bourne	Fine-loamy, mixed, thermic	Typic Fragiudults	Ultisols	Gray-Brown Podzolic soils.
Bourne, gravelly subsoil variant.	Fine-loamy, mixed, thermic	Typic Fragiudults	Uiltsols	Gray-Brown Podzolic soils.
Bremo	Loamy-skeletal, mixed, thermic	Typic Dystrochrepts	Inceptisols	Lithosols.
Caroline	Clayey, mixed, thermic	Typic Paleudults	Ultisols	Red-Yellow Podzolic soils.
Cartecay [1]	Coarse-loamy, mixed, nonacid, thermic.	Aquic Udifluvents	Entisols	Alluvial soils.
Cecil	Clayey, kaolinitic, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.

See footnotes at end of table.

TABLE 8.—*Classification of soil series into higher categories*—Continued

Series	Current classification			1938 Soil classification
	Family	Subgroup	Order	Great soil group
Colfax	Fine-loamy, mixed, thermic	Aquic Fragiudults	Ultisols	Red-Yellow Podzolic soils intergrading toward Low-Humic Gley soils.
Colfax, gravelly subsoil variant.	Fine-loamy, mixed, thermic	Aquic Fragiudults	Ultisols	Red-Yellow Podzolic soils intergrading toward Low-Humic Gley soils.
Congaree	Fine-loamy, mixed, nonacid, thermic.	Typic Udifluvents	Entisols	Alluvial soils.
Craven	Clayey, mixed, thermic	Aquic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Cullen	Clayey, mixed, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils intergrading toward Reddish-Brown Lateritic soils.
Dogue	Clayey, mixed, thermic	Aquic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Elbert, thin solum variant.	Fine, montmorillonitic, mesic	Typic Ochraqualfs	Alfisols	Low-Humic Gley soils.
Elioak [2]	Clayey, kaolinitic, mesic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Fairfax	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Fallsington [3]	Fine-loamy, siliceous, mesic	Typic Ochraquults	Ultisols	Low-Humic Gley soils.
Galestown	Sandy, siliceous, mesic	Psammentic Hapludults	Ultisols	Sols Bruns Acides.
Iuka	Coarse-loamy, siliceous, acid, thermic.	Aquic Udifluvents	Entisols	Alluvial soils.
Kempsville	Fine-loamy, siliceous, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Lignum	Clayey, mixed, thermic	Aquic Hapludults	Ultisols	Planosols.
Manor	Coarse-loamy, micaceous, mesic	Typic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Marr	Fine-loamy, siliceous, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils intergrading toward Red-Yellow Podzolic soils.
Meadowville	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols	Alluvial soils.
Mecklenburg [4]	Fine, mixed, thermic	Ultic Hapludalfs	Alfisols	Red-Yellow Podzolic soils.
Nason	Clayey, mixed, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Orange	Fine, montmorillonitic, thermic	Albaquic Hapludalfs	Alfisols	Planosols.
Pooler, thin solum variant.	Clayey, mixed, thermic	Aeric Ochraquults	Ultisols	Low-Humic Gley soils.
Roanoke	Clayey, mixed, thermic	Typic Ochraquults	Ultisols	Low-Humic Gley soils.
Sassafras	Fine-loamy, siliceous, mesic	Typic Hapludults	Ultisols	Gray-Brown Podzolic soils intergrading toward Red-Yellow Podzolic soils.
State	Fine-loamy, mixed, thermic	Typic Hapludults	Ultisols	Alluvial soils.
Susquehanna [5]	Fine, montmorillonitic, thermic	Vertic Paleudalfs	Alfisols	Red-Yellow Podzolic soils.
Tetotum	Fine-loamy, mixed, thermic	Aquic Hapludults	Ultisols	Gray-Brown Podzolic soils intergrading toward Red-Yellow Podzolic soils.
Turbeville	Clayey, mixed, thermic	Typic Paleudults	Ultisols	Red-Yellow Podzolic soils intergrading toward Reddish-Brown Lateritic soils.
Wahee	Clayey, kaolinitic, thermic	Aeric Ochraquults	Ultisols	Planosols.
Watt, gray surface variant.	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols	Lithosols.
Wehadkee [6]	Fine-loamy, mixed, nonacid, thermic.	Typic Fluvaquents	Entisols	Low-Humic Gley soils.
Westphalia	Coarse-loamy, siliceous, mesic	Ochreptic Hapludults	Ultisols	Gray-Brown Podzolic soils intergrading toward Red-Yellow Podzolic soils.
Wickham	Fine-loamy, mixed, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Wickham, thin solum variant.	Fine-loamy, mixed, thermic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Woodstown	Fine-loamy, siliceous, mesic	Aquic Hapludults	Ultisols	Gray-Brown Podzolic soils intergrading toward Red-Yellow Podzolic soils.
Worsham	Clayey, mixed, thermic	Typic Ochraquults	Ultisols	Low-Humic Gley soils.
Zion, deep variant.	Fine, mixed, thermic	Ultic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.

[1] The Cartecay soils in this survey area are taxadjuncts to the Cartecay series because they have a more strongly acid C horizon than the defined range for the series.

[2] The Elioak soils in this survey area are taxadjuncts to the Elioak series because they have mixed mineralogy.

[3] The Fallsington soils in this survey area are taxadjuncts to the Fallsington series because they have more fine sand than the defined range for the series.

[4] The Mecklenburg soils in this survey area are taxadjuncts to the Mecklenburg series because they have a more yellow A horizon and a less acid subsoil than the defined range for the series.

[5] The Susquehanna soils in this survey area are taxadjuncts to the Susquehanna series because they are more acid in the lower part of the solum than the defined range for the series.

[6] The Wehadkee soils in this survey area are taxadjuncts to the Wehadkee series because they are more acid than the defined range for the series.

Additional Facts About the Counties

Stafford County was formed in 1664, from the western part of Westmoreland County, and named for Staffordshire, England. The first major settlement was made about 1647, along the lower section of Aquia Creek, by settlers from Maryland and eastern Virginia.

King George County, named for King George I, was formed in 1720 out of what was then Richmond County. It originally extended from the present boundary between Richmond and Westmoreland Counties to the present boundary between Stafford and Fauquier Counties and had no contact with the Potomac River.

In 1776, an act was passed that gave Stafford that part of King George County on the Rappahannock River west of Muddy Creek, and King George that part of Stafford County east of Potomac Creek, thus establishing the present boundary between the two counties.

Falmouth, on the Rappahannock River in southern Stafford County, was founded in 1727. This was a busy trading and shipping center in colonial days, as was Port Conway in southern King George County. The county seat of Stafford County, also called Stafford, is located in the east central section. It developed along an important north-south trade route that started out as an Indian trail that became a post road about 1750, and is now U.S. Highway 1. The county seat of King George County, also called King George, is in the central part of the county. It developed along a trade route that is now State Route 3.

The growth of urban centers and rural settlement has closely paralleled the development of farming and agriculturally based trade in the past.

Highway facilities are provided by Interstate 95, U. S. Highway 1, and U. S. Highway 301, the main north-south routes to Washington, D.C., and Richmond and points south.

Although Stafford and King George Counties have little manufacturing except lumber, meat processing, and food products, more people are now employed in manufacturing than in any other field. Chemicals, wearing apparel, and wood products are the main industries.

The two-county area contains approximately 185,628 acres of commercial forest in addition to some 27,600 acres of noncommercial forest. A portion of this noncommercial forest is included in U. S. National Park Service lands and in areas where utilization is incompatible with other uses.

Commercial sand and gravel is produced in large quantities from deposits along the Rappahannock River in the south. A number of other rock and mineral resources, such as iron ore, gold, and pyrite have been mined or produced in the past. Sandstone has been quarried for dimension stone along Aquia Creek and Austin Run near Stafford, and along the Rappahannock River near Falmouth.

Schools and churches are available throughout the two counties. The counties also have modern medical facilities.

Water Supply

Quantity and quality of water are of prime importance in Stafford and King George Counties. Quantity is dependent upon the amount of water in underground reservoirs that is economically available for pumping, the amount of water in surface streams economically available for use, and the amount of water in surface storage reservoirs. Quality is dependent on the chemical content of both underground and surface waters, the tidal influence on the larger surface streams, and the degree of contamination caused by residential and industrial development.

The area is bounded on the north by the Potomac River. Although the Potomac River is a large source of water, it is tidal and brackish in this area and therefore not suited to either municipal or many industrial uses. The two-county area is bounded on the south by the Rappahannock River, which contains fairly large supplies of surface water except during periods of prolonged drought when the flow becomes unusually low. The tributary streams of the area are all rather small and therefore do not provide large supplies of water without the construction of large storage reservoirs (fig. 8).

Reservoirs for storing water have been constructed along Aquia, Chopawamsic, and Potomac Creeks in Stafford County.

The western section of Stafford County, in the Piedmont Plateau, is underlain by metamorphic and igneous rocks that consist primarily of granite, gneiss, schist, and quartzite. The eastern section of Stafford County and all of King George County in the Atlantic Coastal Plain is underlain by layers of clay, marl, sand, and gravel that dip and thicken toward the southeast. The bedrock under this sediment is an extension of the rocks of the Piedmont Plateau.

In the Piedmont, water occurs in the weathered material that overlies the bedrock, and in fissures in the bedrock. In most places, the weathered material yields supplies of water satisfactory for domestic needs. No large yields from bedrock have been reported. Most of the shallow wells produce water of good chemical quality, but water from the deeper wells may have a high content of iron and acid.

In the Atlantic Coastal Plain, water of good quality commonly is encountered at depths less than 80 feet. Shallow sand formations yield 20 gallons per minute or more. Sand formations at depths of approximately 250 and 350 feet have yielded as much as 100 gallons per minute. Except for near-surface water, most water found in formations at depths of less than 250 feet is likely to contain excessive iron. Artesian wells are present in low areas near the Rappahannock River and the Potomac River.

Physiography, Relief, and Drainage

Stafford and King George Counties are in an area of rolling to hilly topography, rather strongly dissected by the major drainage patterns. In areas close to the major streams, this strong dissection has given rise to long, narrow, winding ridges having steep sides. Back from the streams are areas of broad ridges having sides that are much less steep. A rather wide area of level to gently sloping river terraces is along the Rappahannock River in the south, extending from just east of Falmouth in Stafford County to the southeast corner of King George County. Broad, low-lying, level areas occur around Brents

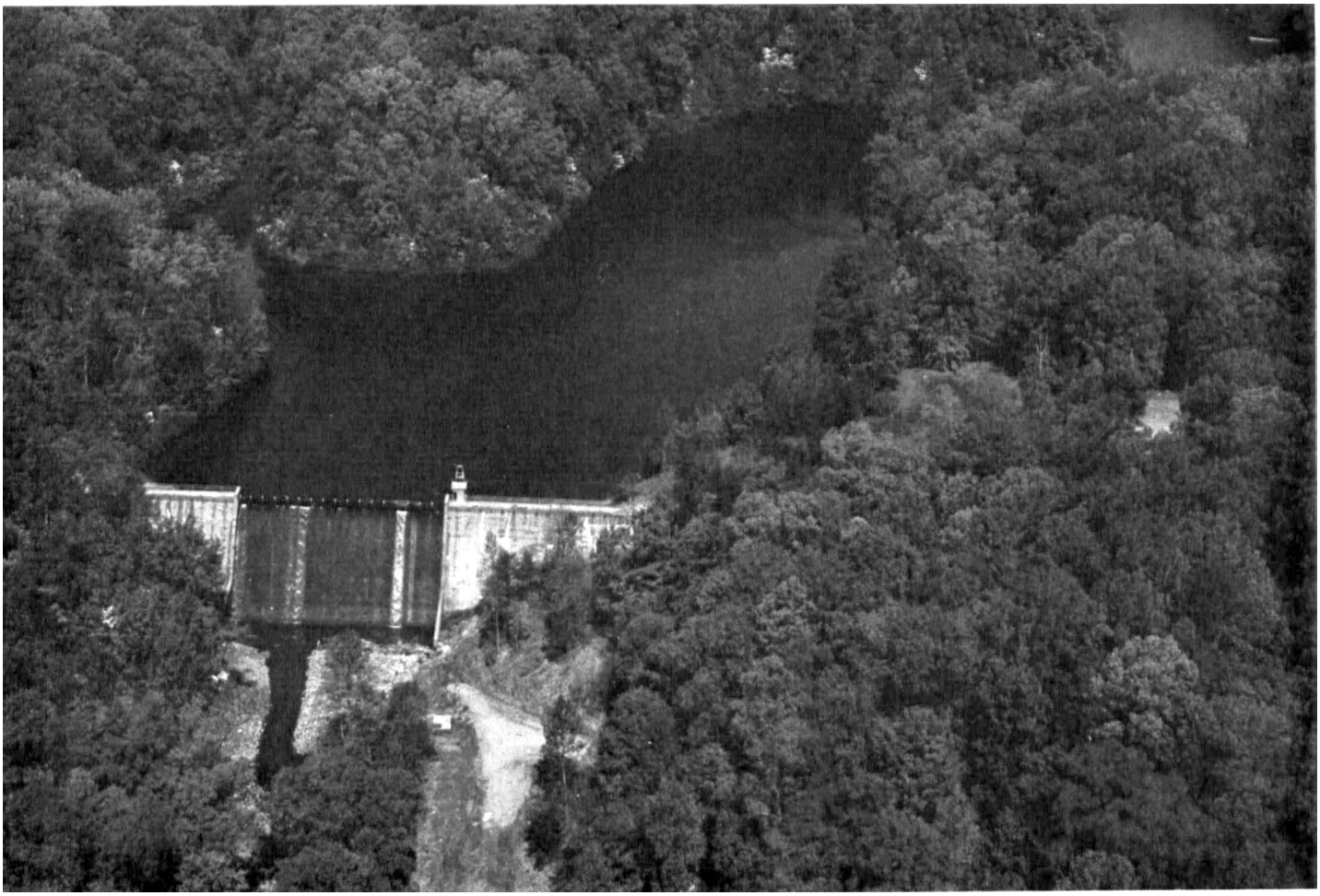

Figure 8.—Reservoir for storing water constructed on Chopawamsic Creek in the northern part of Stafford County.

Point and Marlboro Point in Stafford County, and in northeastern and eastern King George County, from Boyds Hole and Mathias Point to Rosier Creek.

The western section of Stafford County, west of Interstate 95, is on the Piedmont Plateau. The eastern section of Stafford County and all of King George County is on the Atlantic Coastal Plain. Elevations in the two-county area range from less than 20 feet along the Potomac and Rappahannock Rivers to 467 feet at a point in northwestern Stafford County. Generally the land surface slopes gently to the southeast, at an average rate of some 20 feet per mile.

Stafford County has several drainage systems. Generally, all the drainage systems flow to the southeast and empty into the Potomac River, which also flows to the southeast and empties into Chesapeake Bay. The Chopawamsic Creek system drains the extreme north section of the county. The Aquia Creek system drains about one-third of the county area, south of Chopawamsic Creek and north of Potomac Creek. Accokeek Creek drains a small area just south of Stafford Courthouse. The Potomac Creek system drains some 30,000 acres in the south-central section of the county. The southern section is drained by a number of short streams that generally flow south to enter the Rappahannock River.

King George County is drained by a number of short streams. The area north of State Route 218 drains into the Potomac River. The Machodoc Creek system, the largest in the county, drains a section extending from Comorn eastward to the Potomac River. The area between State Route 205 and State Route 3 drains eastward into the Potomac River. The southern section of the county, south of State Route 218, Routes 607 and 608, and State Route 3, drains southward into the Rappahannock River.

The drainage pattern is, in general, dendritic, but is rather irregularly branched. The general fluvial cycle is in a stage of late youth or early maturity.

Climate [5]

Stafford and King George Counties, in common with much of Tidewater Virginia and surrounding areas, have warm summers, relatively mild winters, and normally adequate rainfall. The relatively warm waters of the Atlantic Ocean to the east have a slight moderating effect on the climate, and the Appalachian Mountains to the west tend to lessen the intensity of winter storms.

[5] By M. H. Bailey, climatologist for Virginia, National Weather Service, U.S. Department of Commerce.

The counties lie in the paths of warm, moist air currents moving from the south or southwest, and of cold, dry air currents moving southward and eastward from Canada. These alternating currents frequently bring sharp changes in the daily weather and contribute greatly to the large variations in weather from one season to another. Daily weather sometimes differs in various parts of the counties, but elevation differences are not large enough to cause significant differences in climate. Therefore, the climatological data (table 9) for Dahlgren is considered approximately applicable to all of the two-county area.

Average annual temperatures vary slightly from one year to another but average about 57° F. Temperatures above 95° are infrequent, and temperatures about 100° or below 0° are rare. Prolonged periods of very cold or very warm weather are unusual. Maximum temperatures reach 90° or higher on an average of about 30 days per year. Some mild spells occur in winter, and occasional periods of dry, mild weather relieve stretches of warm, humid weather in summer.

The growing season, defined as the period between the average dates of the last freezing temperature in the spring and the first freezing temperature in the fall, is 222 days. This growing season is long enough to allow proper maturity of a large variety of crops. The pasture season is slightly longer, but the winter months are cold enough to require feed and shelter for livestock. Probabilities of freezing temperatures occurring after the mean date in spring and before the mean date in fall, presented in table 10, are generally applicable over the two counties. The local topography will cause some variation with greater freeze hazard in low areas, where cold air may settle, than on crests and higher slopes.

Annual precipitation averages about 39.5 inches. The amounts vary greatly from one year to another. Over a recent 30-year period, annual precipitation at Dahlgren ranged from 27.4 inches to 54.8 inches, a variation of 100 percent.

Monthly average precipitation ranges from 4.6 inches in July to 2.4 inches in November and February. Amounts vary greatly from year to year for any given month, as can be seen by examining the information in table 9. All months of the year receive light rainfall in some years and excessive amounts in others. Although rainfall is greater during the summer months, it is commonly insufficient because this is the time when vegetation demands the greatest amount of moisture and evaporation is highest. Also, summer rainfall comes mostly in the form of thundershowers, some of which are heavy and result in considerable runoff. The largest rains, usually lasting 2 or 3 days, are associated with hurricanes that have passed inland across the Atlantic coast, but these occur infrequently.

The counties are subject to occasional heavy local rains which sometimes give storm totals of 4 inches or more in a few hours. These may cause some local flash flooding and erosion of soils.

Periods of deficient rainfall are primarily responsible for droughts in the counties. Prolonged dry spells occur in many years resulting in periods of insufficient soil moisture at one or more times during the growing season. Occasionally several dry years occur in succession resulting in serious drought. Wet spells sometimes occur also, but these are less of a problem than drought.

Minor windstorms, often associated with thunderstorms, cause scattered local damage in the counties a few times each year. No tornadoes have been reported in Stafford and King George Counties, and tornado occurrence in the general area is very infrequent. Thunderstorms occur at a given locality on about 40 days per year, and sometimes cause minor lightning damage. Damaging hailstorms occur but are much less frequent than

TABLE 9.—*Temperature and precipitation data*

[Data from records at Dahlgren, King George County, Va.]

Month	Temperature		2 years in 10 will have at least 4 days with—		Precipitation			
	Average daily maximum	Average daily minimum	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Average total	1 year in 10 will have—		Average snowfall
						Less than—	More than—	
	°F.	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
January	45	29	63	17	3.2	1.4	6.0	3.9
February	47	30	64	19	2.4	1.1	3.8	3.4
March	55	36	73	27	3.2	1.5	5.3	1.9
April	65	45	82	37	2.1	1.6	6.0	.1
May	74	55	87	46	3.1	.9	5.5	.0
June	83	64	93	56	3.2	1.1	5.6	.0
July	86	69	94	63	4.6	1.2	7.5	.0
August	84	67	93	61	4.5	.6	10.6	.0
September	79	61	89	51	3.8	.8	11.2	.0
October	68	49	82	40	3.0	1.3	4.8	[1]
November	57	39	72	29	2.4	.7	4.5	.7
December	47	31	61	19	3.0	.9	5.1	2.3
Year	66	48	[2] 98	[3] 12	39.5	30.9	51.8	12.3

[1] Less than 0.05 inch. [2] Average annual highest temperature. [3] Average annual lowest temperature.

TABLE 10.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from records at Dahlgren, King George County, Va.]

Probability	Dates for given probability and temperature				
	32° F. or lower	28° F. or lower	24° F. or lower	20° F. or lower	16° F. or lower
Spring:					
1 year in 10 later than	Apr. 20	Apr. 8	Mar. 27	Mar. 18	Mar. 5.
2 years in 10 later than	Apr. 14	Apr. 1	Mar. 20	Mar. 11	Feb. 22.
5 years in 10 later than	Apr. 3	Mar. 20	Mar. 8	Feb. 25	Feb. 1.
Fall:					
1 year in 10 earlier than	Oct. 27	Nov. 8	Nov. 15	Nov. 25	Dec. 5.
2 years in 10 earlier than	Nov. 1	Nov. 13	Nov. 20	Nov. 30	Dec. 11.
5 years in 10 earlier than	Nov. 11	Nov. 22	Nov. 30	Dec. 11	Dec. 26.

thunderstorms. In a period of several years, one or two hurricanes usually reach the area but have diminished wind velocities causing little damage. Heavy rains from hurricanes sometimes cause flooding of lowlands. A few snowstorms occur in winter and fairly heavy snowstorms, which cause some damage and much inconvenience, occur every few years.

The average annual relative humidity in Stafford and King George Counties is 70 percent. Relative humidity is below 60 percent about one-third of the time, and is 80 percent or above about one-third of the time. Relative humidity throughout the day usually varies inversely with the temperature and is, therefore, highest in early morning and lowest in early afternoon.

Generally, the prevailing wind is from the northwest, but records show that winds from all directions are possible. In summer, southerly winds are more frequent than northerly winds. Average monthly windspeeds vary from about 10 miles per hour in March and April to about 6 miles per hour in August. Winds are commonly lightest during early morning hours and strongest in early afternoon.

Clouds cover about six-tenths of the sky, on the average, between sunrise and sunset. Cloud cover is least in fall and greatest in winter and early spring. Overcast days are considerably less frequent in summer when most clouds are of the cumulus type. Less cloudiness and long hours of daylight allow abundant sunshine during the growing season.

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Glossary

Acidity. See reaction, soil.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available moisture capacity (also termed available water capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

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.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

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 low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur 15 to 40 inches below the surface.

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.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

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

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

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

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and granular. Structureless soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

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

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic USDA textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Upland (geology). Land consisting of material unworked by water in recently geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

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