Series 1954, No. 5

Issued August 1959

SOIL SURVEY

Rockingham County New Hampshire

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Rockingham County has been made to help anyone who wants to know about the soils in the county and how they can be used. This report describes each soil, shows its location on a map, and tells what each soil will do under various kinds of management. It also contains a section about the use of the soils in engineering projects.

For a general view of the soils in the county, look at the map of general soil areas. Descriptions of the general areas are given in the first few pages of the report. The map of general soil areas shows some of the main soils of each locality. To learn about the soils of any particular farm or field, however, you will need to look at the detailed soil map.

Find your farm on the map

In using this report, start with the maps bound in the back of the report. First, examine the index map that represents the entire county. It is divided into rectangles. Each rectangle has an index number. Determine the quadrangle that covers that part of the county in which your farm is located. Now, find the detailed map that has the same index number as the quadrangle. The map shows towns and villages, roads, streams, and other landmarks. They will help you to locate your farm. Each soil is shown by a symbol, such as Ca, and the extent of each area is shown by a boundary line. All areas marked with the same symbol are the same kind of soil wherever they appear on the map. Color patterns also help you pick out the areas of different soils, although each color pattern is used for several soils that resemble each other in some way.

Suppose you have found on your farm an area marked with the symbol Ca. You learn the name of the soil this symbol represents by looking at the map legend. The symbol Ca identifies Charlton loam, 0 to 3 percent slopes.

Learn about the soils on your farm

Charlton loam, 0 to 3 percent slopes, and all the other soils mapped are described in the section, Descriptions of Soils. Soil scientists, as they walked over the fields and through the woodlands, described and mapped the soils. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops, weeds, brush, or trees; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming.

After they mapped and studied the soils, the scientists talked with farmers and others about the use and management each soil should have. Then they placed it in a capability class and in a management group. The capability classification is a means of showing the comparative suitability of the soils for agricultural use. A management group is a group of similar soils that need and respond to about the same kind of management.

Charlton loam, 0 to 3 percent slopes, is in management group 1. Turn to the section, Use and Management, and read what is said about soils of group 1. You will want to study the table which tells you how much you can expect to harvest from Charlton loam, 0 to 3 percent slopes, under two levels of management.

Make a farm plan

For the soils on your farm, compare your yields and farm practices with those given in this report. Look at your fields for signs of runoff and erosion. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for your farm or any other farm in the county.

If you find that you need help in farm planning, consult the local representative of the Soil Conservation Service and the county agricultural agent. Members of the staff of your State agricultural experiment station and others familiar with farming in your county will also be glad to help you.

Fieldwork for the survey was completed in 1954. Unless otherwise specifically indicated, all statements refer to conditions in Rockingham County at that time.

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SOIL SURVEY OF ROCKINGHAM COUNTY, NEW HAMPSHIRE

Fieldwork by ARTHUR E. SHEARIN, DIRK Van der VOET, HUDSON BAILEY, WILLIAM J. CARTER, LLOYD E. GARLAND, J. STEWART HARDESTY, and WALTER H. LYFORD, United States Department of Agriculture, and REESHON FEUER, WILLIAM H. COATES, KENNETH E. GRANT, and C. L. W. SWANSON, New Hampshire Agricultural Experiment Station

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

Location and Extent

Rockingham County, in the southeastern corner of New Hampshire, is roughly fan shaped. It has an approximate area of 691 square miles, or 442,240 acres.

Exeter, the county seat, is in the east-central part of the county. It is about 50 miles north of Boston, Mass., and 35 miles southeast of Concord, N. H. (fig. 1). Portsmouth is the principal city, and there are 36 towns (*7*).[1]

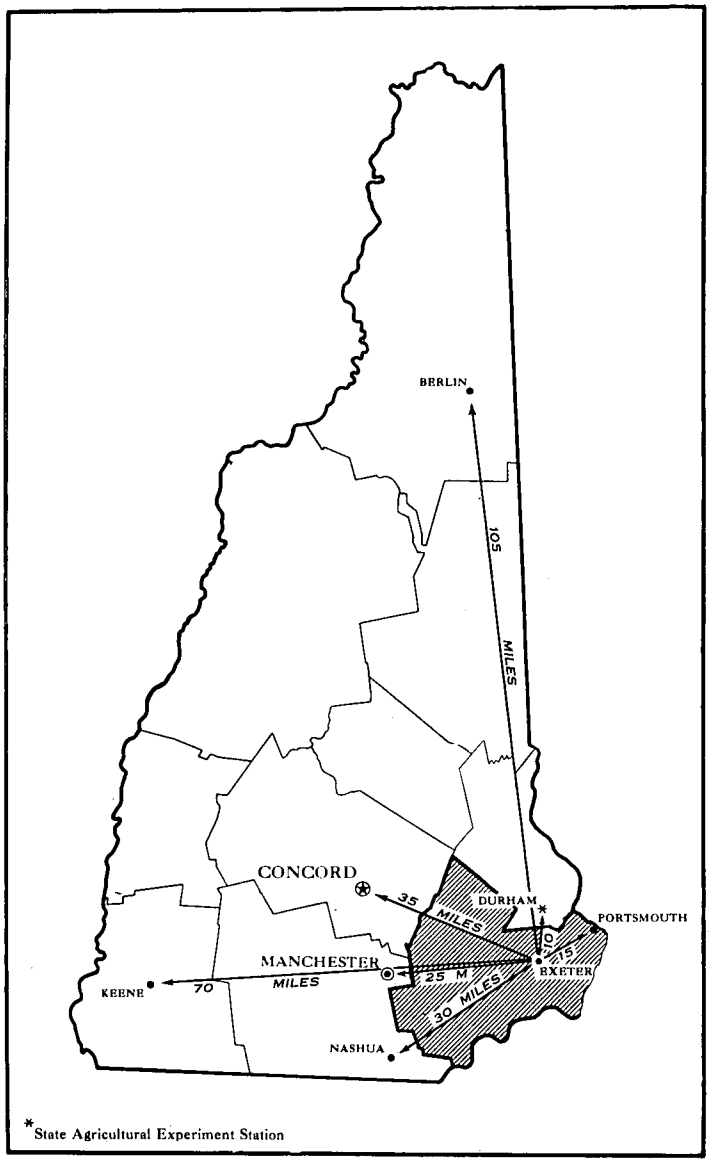

Figure 1.—Location of Rockingham County in New Hampshire.

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines the soils in the field, classifies them in accordance with facts that he observes, maps their boundaries on an aerial photograph or other map, and describes them in his report.

FIELD STUDY.—The soil scientist bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern; they are located according to the lay of the land. Most of them are not more than a quarter of a mile apart, and some are much closer. In most soils each boring, or hole, reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how its differs from others in the profile and to learn things about the soil that will influence its capacity to support plant growth.

Most of the words scientists use in describing soils are familiar words, but they have special meanings in soil science. Some of the words and terms most commonly used in soil reports are discussed in the following pages.

Color is expressed in words and in Munsell notations; for example, gray (10YR 5/1). The Munsell notations record color more exactly than can be done in words and are primarily for the use of soil scientists. Unless otherwise stated, the color given for a soil is its color when moist. Color usually is related to the amount of organic matter in a soil. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

[1] Italic numbers in parentheses refer to Literature Cited, p. 78.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers. The texture for key soils is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate. Sand grains feel gritty to the fingers and are distinguished by the unaided eye without difficulty. Silt, barely visible to the naked eye, has the appearance and feel of flour. The individual particles of the clay fraction are not distinguishable by the eye, and a large proportion of them are too small to be seen under the microscope. Varying proportions of these particles of different sizes determine the classes of soils, or what is known as the soil texture. The following are the principal classes in the order of increasing content of silt and clay: *Sand, loamy sand, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, silty clay loam, clay loam,* and *clay.*

Structure, which is the way the individual soil particles are arranged in larger aggregates and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture. For example, a pan 18 inches below the surface may limit the growth of roots to a shallow surface layer and make the plants more susceptible to damage during prolonged drought. Structure is defined in terms of distinctness, size, and shape of soil aggregates. For example, "moderate medium subangular blocky" means moderately distinct, medium-sized aggregates of subangular blocky shape.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation. Consistence is described according to how sticky or how plastic the soils are when wet; how friable or firm they are when moist; and how soft or hard they are when dry. If moisture conditions are not stated in using any consistence term, the moisture condition is that under which the particular term is defined. Thus "friable," used without a statement of moisture content, means friable when moist; "hard," if used alone, means hard when dry; and "plastic," used alone, means plastic when wet.

Effective depth refers to the thickness of that part of the soil in which water and plant nutrients are readily stored and plant roots readily penetrate. An effective depth of 3 or 4 feet is adequate for most crops.

Drainage (soil) refers to the rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. The following are soil-drainage classes used in this report.

Very Poorly Drained.—Water is removed from soil so slowly that the water table is at or near the surface most of the time. The surface soil is dark colored, and the subsoil is mottled.

Poorly Drained.—Water is removed so slowly that the soil remains wet much of the time. The water table is at or near the surface during a large part of the year. The soil is mottled but is generally gray near the surface and commonly has a light-gray layer just above the subsoil.

Moderately Well Drained.—Water is removed from the soil somewhat slowly, so that the soil is wet for a small but significant part of the time. The surface layer and upper part of the subsoil are free of mottling, but there may be faint mottles in the lower part of the subsoil.

Well Drained.—Water is removed from the soil readily but not rapidly. The surface soil and subsoil are well oxidized and free of mottling, but the underlying material may be faintly mottled or splotched.

Somewhat Excessively Drained.. — Water is removed from the soil rapidly. Soils that have somewhat excessive drainage generally are sandy or shallow over bedrock.

Excessively Drained.—Water is removed from the soil very rapidly. Soils that are excessively drained generally are very sandy and very porous.

Slope is the amount of rise, in feet, for each 100 feet of horizontal distance. It is normally measured with a hand level and is expressed as a percent. A slope of 45° is a slope of 100 percent, since two points 100 feet apart have 100 feet difference in elevation. As slopes become steeper, the hazard of erosion becomes greater. If other factors are equal, the loss of soil on a 12 percent slope under continuous cultivation is about 3 times as great as the loss on a 5 percent slope. Slope also influences soil development and limits farming operations.

Other characteristics observed in the course of the field field study and considered in classifying the soils include the nature of the underlying parent material from which the soil developed and the acidity or alkalinity of the soil as measured by chemical tests. The surface stones or outcrops that may interfere with cultivation, the amount of soil lost by erosion, and other external features are also noted.

CLASSIFICATION.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified by types, phases, and series.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, stoniness, or natural drainage are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices therefore can be specified more easily than for soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in texture of the surface layer, but that are otherwise similar in kind, thickness, and arrangement of soil

layers, are normally designated as a soil series. In a given area, however, a soil series may be represented by only one soil type. Each series is named for a place near which it was first mapped. Thus, Merrimac is the name of a deep, porous, well-drained, acid soil that occurs on deposits of water-laid gravel and sand in Rockingham County. This soil was named for the Merrimack River (originally spelled Merrimac).

A soil complex consists of two or more kinds of soil that occur in such small areas and are so intricately associated that they cannot be shown separately on the soil map. The Shapleigh-Gloucester sandy loams are examples of soil complexes.

An undifferentiated soil group consists of two or more similar taxonomic units, which do not occur in regular geographic association but are shown as one mapping unit. Such mapping units are named in terms of their constituent taxonomic units and connected by "and." In Rockingham County the mapping unit Leicester and Ridgebury fine sandy loams, 0 to 3 percent slopes, is an example of an undifferentiated soil group.

Miscellaneous land types.—Areas that have little true soil are not classified by types and series. Instead, they are identified by descriptive names, as Coastal beach and dune sand, and Urban and made land.

General Soil Areas

The colored map in the back of this report shows general soil areas in the county. Each of the general areas, or soil associations, consists of several different soils in a pattern that is somewhat similar from place to place. Within one general area the pattern of soils, of course, is not strictly uniform, but each soil tends to be located in its own kind of place—on the hilltops, on the slopes, in the small valleys, in the large valleys, and so on.

Association 1

Shallow to deep soils mainly on olive and brownish glacial till: Paxton, Brookfield, Brimfield

This association occupies two areas in the central and northwestern parts of the county. The soils have formed on loamy glacial till derived largely from weathered brown mica schist. Part of the till is olive colored.

The Paxton soils have gently sloping to sloping relief. Surface runoff is medium, but internal drainage is restricted by the compact layer, or pan, that generally occurs at a depth of about 24 inches. The Paxton soils are well suited to the crops generally grown on dairy farms. They are the best agricultural soils of any in the association.

The Brookfield soils are generally rolling to hilly. Their parent material is loose to friable. These soils are not used extensively for agriculture.

The Brimfield soils are shallow over bedrock, and the bedrock outcrops in many places. They are generally well drained, but they are somewhat droughty in places because they are shallow. In this county the Brimfield soils have not been mapped separately from the Brookfield soils.

Association 2

Shallow to deep soils on olive-colored glacial till: Paxton, Charlton, Hollis

This association occurs mainly in the northwestern part of the county, but one area is in the west-central part. The soils have formed on loamy till derived largely from schist.

The Paxton soils are gently sloping to sloping. Surface runoff is medium to rapid. Internal drainage is restricted by the compact layer, or pan, that occurs in most places at a depth of about 24 inches. The Paxton soils are well suited to the crops commonly grown on dairy farms.

The Charlton soils are level to steep and are well drained. Their parent material is generally slightly compact but, in places it is firm and may have a weak platy structure. Crop yields are fair to good on these soils. In this association the Charlton and Paxton soils are the most desirable for agriculture.

The Hollis soils are shallow over bedrock, and the bedrock outcrops in many places. They are level to steep. These soils are well drained but are somewhat droughty in places because they are shallow. In this county the Hollis soils are not mapped separately. They are intermingled with the Charlton, and the soils are mapped as Hollis-Charlton complexes.

Association 3

Deep soils on gray glacial till or on glacial outwash: Gloucester, Merrimac, Sudbury

This is the largest association in the county. It extends from the northern and western boundaries of the county to the Massachusetts line on the southeast. The Gloucester soils have developed on sandy, loose till derived largely from granite, and the Merrimac and Sudbury soils have developed from glacial outwash derived largely from granite, gneiss, and schist. The soils are droughty and are low in fertility.

The Gloucester soils are predominantly gently rolling to rolling. They are well drained.

The Merrimac soils are nearly level to gently sloping or undulating. They are well drained to excessively drained.

The Sudbury soils are nearly level to gently sloping and are moderately well drained. They are similar to the Merrimac soils, with which they are associated, but they are mottled at a depth of approximately 15 inches. The Sudbury soils remain wet longer in spring than the other soils of the association. The kinds of crops that can be grown on them are limited.

Association 4

Well drained soils on shallow glacial till or on deep glacial outwash and poorly drained soils on marine and lake-laid silts and clays: Hollis, Merrimac, Scantic

This association is in the northeastern part of the county. It is mainly in one large area that extends from the northern boundary of the county to the coast. The Hollis soils have developed on glacial till derived

mainly from mica schist or phyllite; the Merrimac soils have developed on glacial outwash derived mainly from granite, gneiss, and schist; and the Scantic soils have developed from mildly alkaline to slightly acid glaciolacustrine and marine silts and clays.

The Hollis soils are level to steep. They are well drained; surface runoff and internal drainage are medium to rapid. These soils are shallow and outcrops are common. They are somewhat droughty in places, and yields are low in dry years.

The Merrimac soils are generally nearly level to gently sloping. Like the Hollis soils they are well drained. On the Merrimac soils yields are normally low.

The Scantic soils are level to gently sloping and are poorly drained. Hay will produce fairly good yields in areas that are drained. Sedges, however, tend to replace the more desirable plants.

Association 5

Gently rolling or rolling, well drained soils and nearly level, very poorly drained soils on glacial till: Gloucester, Shapleigh, Whitman

This association is in the southern part of the county. The soils have developed from glacial till derived largely from granite and gneiss.

The Gloucester soils are predominantly gently rolling to rolling, but some areas are level and some are hilly. The soils are generally well drained, but they are somewhat droughty in places. Normally, yields are low on these soils, but the soils can be used for early vegetables because they warm early in spring.

The Shapleigh soils are level to steep. They are generally well drained but are somewhat droughty in places because they are shallow. As a rule crop yields on these soils are fair, but they are poor in dry seasons.

The Whitman soils are level to nearly level. They are very poorly drained. Because of their poor drainage and many stones, they are not good soils for farming.

Association 6

Nearly level or gently sloping, well drained soils on glacial outwash and moderately well drained marine and lake-laid silts and clays: Merrimac, Buxton

This association is in the northeastern corner of the county. It occurs in only one area. The Merrimac soils have developed on glacial outwash derived largely from granite, gneiss, and schist. The Buxton soils have developed on neutral to medium acid marine and glaciolacustrine silts and clays.

The Merrimac soils are level to moderately steep. Their drainage ranges from good to excessive, and the soils are somewhat droughty. Crops grown on them produce low yields.

The Buxton soils are level to gently sloping. They are moderately well drained and are mottled at depths below 12 to 18 inches. These soils can be used for hay and pasture if mixtures are seeded that will tolerate moist conditions. The soils must be drained if they are to be used for row crops.

Association 7

Gently sloping or sloping soils on glacial till, surrounded by very poorly drained soils on lake-laid silts and clays: Paxton, Sutton, Biddeford

This association is in the eastern part of the county. It occupies only one fairly small area. The Paxton and Sutton soils have formed on loamy till derived largely from schist. The Biddeford soils have developed on neutral to moderately acid marine and glaciolacustrine silts and clays.

The Paxton soils are gently sloping to sloping. They are well drained; surface runoff is medium, but internal drainage is restricted by the compact layer, or pan, that occurs at a depth of about 24 inches. These soils are well suited to the crops commonly grown on dairy farms.

The Sutton soils are level to gently sloping and are moderately well drained. They are mottled at depths below 10 to 18 inches, normally at a depth below 15 inches. Crops on these soils produce good yields.

The Biddeford soils are level to very gently sloping and are very poorly drained . They surround the areas of soils derived from till and thus form part of a complex soil pattern. Unless these soils are drained, they are suitable only for pasture or for growing hay of poor quality. The pastures provide good grazing in dry seasons.

Association 8

Well drained soils on shallow glacial till or deep glacial outwash and moderately well drained soils on marine and lake-laid silts and clays: Hollis, Warwick, Buxton

This association occurs in the northeastern part of the county along the coast. It occupies one area that is rather small. The Hollis soils have developed on glacial till. The Warwick soils have developed on glacial outwash that consisted mainly of schist and phyllite. The glacial outwash also contained a small amount of siliceous limestone that makes the soils slightly acid at a depth of about 30 inches. The Buxton soils have developed on neutral to medium acid marine and glaciolacustrine silts and clays.

The Hollis soils are level to steep. They are shallow and outcrops are common. These soils are generally well drained but are so droughty in places that yields are poor in dry seasons.

The Warwick soils are level to sloping. They are well drained. Crops on these soils produce fair to good yields.

The Buxton soils are level to gently sloping. They are moderately well drained and are mottled at depths below 12 to 18 inches. Hay and pasture plants grow well on these soils, but mixtures must be seeded that will tolerate moist conditions. Drainage is needed if row crops are to be grown.

Use and Management

This section has four main parts. The first explains how soils are classified according to their capability,

the second discusses the management groups for this county, the third has a table of estimated yields to be obtained under two levels of management, and the fourth discusses general management of the soils.

Capability Grouping of Soils

Capability grouping is a system of classification used to show the relative suitability of soils for crops, grazing, forestry, and wildlife. It is a practical grouping based on the needs and limitations of the soils, on the risks of damage to them, and also on their response to management. There are three levels above the soil mapping unit in this grouping. These are the capability unit, subclass, and class.

The capability unit is the lowest level of capability grouping. A capability unit is made up of soils similar in kind of management they need, in risk of damage, and in general suitability for use. In this report the soil mapping units are arranged in management groups that usually include more than one capability unit and are synonymous with the next broader grouping, the subclass. The subclass is used to indicate the dominant kind of limitation. The letter symbol "e" indicates that the main limiting factor is risk of erosion if the plant cover is not maintained; "w" means excess water that retards plant growth or interferes with cultivation; and "s" shows that the soils are stony, shallow, droughty, or unusually low in fertility.

The broadest grouping, the land class, is identified by Roman numerals. All the soils in one class have limitations and management problems of about the same degree, but of different kinds, as shown by the subclass. All of the land classes except class I may have one or more subclasses.

In classes I, II, and III are soils that are suitable for annual or periodic cultivation of annual or short-lived crops.

Class I soils are those that have the widest range of use and the least risk of damage. They are level, or nearly level, productive, well drained, and easy to work. They can be cultivated with almost no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly, but do not have quite so wide a range of suitability as class I soils. Some class II soils are gently sloping; consequently, they need moderate care to prevent erosion. Other soils in class II may be slightly droughty, or slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use. These need even more careful management.

In class IV are soils that should be cultivated only occasionally or only under very careful management.

In classes V, VI, and VII are soils that normally should not be cultivated for annual or short-lived crops but that can be used for pasture or range, as woodland, as or refuges for wildlife.

Class V soils (none in Rockingham County) are nearly level and gently sloping but are droughty, wet, low in fertility, or otherwise unsuitable for cultivation.

Class VI soils are not suitable for crops because they are stony, steep, droughty, or otherwise limited, but they give fair yields of forage or forest products. Many soils in class VI can be set out to fruit trees or forest trees.

Class VII soils are best used for forest products. Selected areas may provide a limited amount of forage. The soils have characteristics that limit them severely for these uses.

In class VIII are soils that have practically no agricultural use. Some of them are important parts of watersheds or have value as wildlife habitats or for scenery.

Capability Classes, Subclasses, and Management Groups

Class I.—Soils that have few or no outstanding limitations for use.
- Management group 1. Deep, nearly level, nonstony, well-drained soils.

Class II.—Soils that have moderate limitations if cultivated.
- IIe: Gently sloping soils.
  - Management group 2. Deep, nonstony, well-drained soils.
- IIw: Soils that are seasonally wet or are subject to occasional overflow.
  - Management group 3. Soils in nearly level, gently sloping, or depressed areas.
- IIs: Soils that are limited by shallowness or unfavorable texture.
  - Management group 4. Shallow or droughty soils.

Class III.—Soils that have severe limitations if cultivated.
- IIIe: Soils in gently sloping or moderately sloping areas that are subject to erosion.
  - Management group 5. Deep, well-drained, nonstony soils; some are eroded.
- IIIs: Nearly level or gently sloping soils underlain by sand or gravel.
  - Management group 6. Sandy soils.

Class IV.—Soils suitable for limited or occasional cultivation under careful management.
- IVe: Strongly sloping soils.
  - Management group 7. Deep, well-drained, nonstony soils; some are severely eroded.
- IVw: Nearly level or gently sloping soils that have a high water table.
  - Management group 8. Silty or loamy, wet soils.
- IVs: Gently sloping to strongly sloping soils that are shallow or have unfavorable texture.
  - Management group 9. Sandy and loamy soils underlain by bedrock or gravel.

Class VI.—Soils suitable for pasture or trees but not suitable for cultivation except under unusually careful management.
- VIe: Strongly sloping or steep soils.
  - Management group 10. Well-drained, nonstony soils; some are severely eroded.

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VIw: Nearly level and gently sloping soils that are wet to the surface most of the year.
Management group 11. Silty or loamy soils that have a high water table much of the year.
VIs: Nearly level to strongly sloping soils that are rocky or stony.
Management group 12. Rocky or stony soils.

Class VII.—Soils not suitable for cultivation and severely limited for pasture or trees.
VIIw: Nearly level, very wet areas.
Management group 13. Mucks and peats.
VIIs: Gently sloping to steep soils that are sandy, very rocky, or very stony.
Management group 14. Sandy, very rocky, or very stony soils.

Class VIII.—Soils not suitable for producing vegetation in commercial quantities.
VIIIw: Marsh areas.
Management group 15. Fresh water marsh and tidal marsh.
VIIIs: Sandy areas.
Management group 16. Coastal beach and dune sand.

Management Groups

In the following pages management is discussed for the soils of Rockingham County in terms of the strong points and deficiencies of the soils. The soils have been divided into 16 management groups. For each group is given a description of the important characteristics common to the soils of the group and a discussion of the use and management needs of the soils. Much of the information in the section was taken from New Hampshire Agricultural Experiment Station Bulletin No. 424 (*5*).

MANAGEMENT GROUP 1: DEEP, NEARLY LEVEL, NONSTONY, WELL-DRAINED SOILS

These deep, well-drained soils are in capability class I. They retain enough moisture for plants to grow well, but excess water seeps away readily. The following soils are in this management group:

Brookfield sandy loam, 0 to 3 percent slopes.
Charlton loam, 0 to 3 percent slopes.
Gloucester sandy loam, 0 to 3 percent slopes.
Melrose fine sandy loam, 0 to 3 percent slopes.
Merrimac fine sandy loam, 0 to 3 percent slopes.
Ondawa fine sandy loam, 0 to 3 percent slopes.
Paxton loam, 0 to 3 percent slopes.
Warwick gravelly loam, 0 to 3 percent slopes.

These soils are well suited to corn, truck crops, small grains, and all of the commonly grown grasses and legumes. Poor air drainage limits their use for orchards. Good management practices include the use of balanced crop rotations. The soils also need manure.

MANAGEMENT GROUP 2: DEEP, NONSTONY, WELL-DRAINED SOILS

These deep, gently sloping soils are in capability subclass IIe. They are subject to erosion. The soils retain moisture well, but runoff may be excessive on the stronger slopes. The following soils are in this management group:

Brookfield sandy loam, 3 to 8 percent slopes.
Charlton loam, 3 to 8 percent slopes.
Gloucester sandy loam, 3 to 8 percent slopes.
Melrose fine sandy loam, 3 to 8 percent slopes.
Merrimac fine sandy loam, 3 to 8 percent slopes.
Paxton loam, 3 to 8 percent slopes.
Warwick gravelly loam, 3 to 8 percent slopes.

These soils are well suited to corn, truck crops, fruit trees, small grains, and all of the grasses and legumes grown locally. Because of the gently sloping relief, they need simple practices to control erosion, as tilling on the contour, stripcropping, and seeding winter cover crops. Balanced crop rotations are also needed.

MANAGEMENT GROUP 3: SOILS IN NEARLY LEVEL, GENTLY SLOPING, OR DEPRESSED AREAS

The soils of this group are in capability subclass IIw. They are wet in spring and fall and after heavy rains. The areas in depressions, at the bases of slopes, and on the lower slopes generally receive runoff from the higher lying soils, and sometimes the soils become saturated. Then, the growth of plants is retarded because air cannot circulate through the soil. The following soils are in this management group:

Acton and Scituate sandy loams, 0 to 3 percent slopes.
Acton and Scituate sandy loams, 0 to 8 percent slopes.
Acton and Scituate sandy loams, 3 to 8 percent slopes.
Buxton silt loam, 0 to 3 percent slopes.
Buxton silt loam, 3 to 8 percent slopes.
Buxton silt loam, 3 to 8 percent slopes, severely eroded.
Elmwood fine sandy loam, 0 to 3 percent slopes.
Elmwood fine sandy loam, 3 to 8 percent slopes.
Gloucester and Scituate sandy loams, 0 to 3 percent slopes.
Gloucester and Scituate sandy loams, 3 to 8 percent slopes.
Podunk fine sandy loam, 0 to 3 percent slopes.
Sudbury fine sandy loam, 0 to 3 percent slopes.
Sudbury fine sandy loam, 0 to 8 percent slopes.
Sudbury fine sandy loam, 3 to 8 percent slopes.
Sutton and Woodbridge loams, 0 to 3 percent slopes.
Sutton and Woodbridge loams, 0 to 8 percent slopes.
Sutton and Woodbridge loams, 3 to 8 percent slopes.

These soils are well suited to moisture-tolerant small grains, grasses, and legumes, but they are only fairly well suited to cultivated crops. They are poorly suited to alfalfa, winter vetch, and fruit trees. Artificial drainage would increase the number of crops that can be grown. Nevertheless, because many of the areas are small and occur within larger areas of better drained soils, the cost of drainage may be high.

MANAGEMENT GROUP 4: SHALLOW OR DROUGHTY SOILS

These soils are in capability subclass IIs. The sandy soils are droughty, and the shallow soils dry out quickly when the weather is dry. Depth to bedrock varies considerably; therefore, in some fields both deep and shallow soils occur. As a result, some areas within a field may be much less droughty than others. The soils on sloping areas erode readily if they are cropped intensively. The following soils are in this management group:

Brimfield-Brookfield sandy loams, 3 to 8 percent slopes.
Hollis-Charlton loams, 0 to 3 percent slopes.
Hollis-Charlton loams, 3 to 8 percent slopes.
Merrimac sandy loam, 0 to 3 percent slopes.
Merrimac fine sandy loam and sandy loam, 0 to 3 percent slopes.
Shapleigh-Gloucester sandy loams, 0 to 8 percent slopes.

These soils are only fairly well suited to the locally grown row crops, small grains, grasses, and legumes. The level relief and lack of moisture are not favorable for fruit trees; as a rule the trees do not grow well on the shallow soils, although their roots are concentrated in the deeper spots.

The soils should not be cropped intensively. They need to have soil-building crops in the rotation that will add organic matter to the soil. Stripcropping is desirable to protect the more sloping soils from erosion. Supplemental irrigation is needed but will not be practical in all areas.

MANAGEMENT GROUP 5: DEEP, WELL-DRAINED, NONSTONY SOILS; SOME OF THEM ERODED

These soils are in capability subclass IIIe. They retain moisture well, but runoff is excessive on the stronger slopes. Erosion is a hazard. The following soils are in this management group:

Brookfield sandy loam, 3 to 15 percent slopes.
Brookfield sandy loam, 8 to 15 percent slopes.
Charlton loam, 3 to 15 percent slopes.
Charlton loam, 8 to 15 percent slopes.
Gloucester sandy loam, 3 to 15 percent slopes.
Gloucester sandy loam, 8 to 15 percent slopes.
Gloucester and Scituate sandy loams, 3 to 15 percent slopes.
Gloucester and Scituate sandy loams, 8 to 15 percent slopes.
Melrose fine sandy loam, 8 to 15 percent slopes.
Merrimac fine sandy loam, 8 to 15 percent slopes.
Paxton loam, 3 to 15 percent slopes.
Paxton loam, 8 to 15 percent slopes.
Suffield silt loam, 8 to 15 percent slopes.
Suffield silt loam, 8 to 15 percent slopes, severely eroded.
Warwick gravelly loam, 8 to 15 percent slopes.
Warwick gravelly loam, 3 to 15 percent slopes.

These soils are well suited to corn, truck crops, fruit trees, small grains, and all of the grasses and legumes grown locally. They need practices to control erosion, as plowing on the contour, and terracing or stripcropping. The soils require longer rotations than soils that are less sloping, and hay or other sod crops should be grown more frequently.

MANAGEMENT GROUP 6: SANDY SOILS

These sandy soils are in capability subclass IIIs. They are droughty, but the sandy loams are less droughty than the loamy sands. Water moves rapidly through all of the soils, however, and crops are damaged in dry weather. The soils on the stronger slopes are subject to erosion. The following soils are in this management group:

Barnstead fine sandy loam and sandy loam, 3 to 8 percent slopes.
Hinckley loamy sand, 0 to 3 percent slopes.
Hinckley loamy sand, 3 to 8 percent slopes.
Jaffrey loamy sand, 0 to 3 percent slopes.
Jaffrey loamy sand, 3 to 8 percent slopes.
Merrimac sandy loam, 3 to 8 percent slopes.
Merrimac fine sandy loam and sandy loam, 3 to 8 percent slopes.
Windsor loamy sand, 0 to 3 percent slopes.
Windsor loamy sand, 3 to 8 percent slopes.

The loamy sands of this group are fairly well suited to most of the small grains, grasses, and legumes grown locally, but they are poorly suited to fruit trees and row crops. The sandy loams are fairly well suited to all of the crops grown locally.

These soils should not be cropped intensively. They need soil-building crops in the rotation, and stripcropping is desirable. Supplemental irrigation is needed but will not be practical for all areas.

MANAGEMENT GROUP 7: DEEP, WELL-DRAINED, NONSTONY SOILS; SOME OF THEM SEVERELY ERODED

These soils are in capability subclass IVe. They are subject to erosion. The soils retain moisture well, but runoff is rapid on the strong slopes. The following soils are in this management group:

Brookfield sandy loam, 15 to 25 percent slopes.
Charlton loam, 15 to 25 percent slopes.
Gloucester sandy loam, 15 to 25 percent slopes.
Gloucester and Scituate sandy loams, 15 to 25 percent slopes.
Merrimac fine sandy loam, 15 to 25 percent slopes.
Paxton loam, 15 to 25 percent slopes.
Suffield silt loam, 15 to 25 percent slopes.
Suffield silt loam, 15 to 25 percent slopes, severely eroded.

These soils are suited to the grasses and legumes grown locally. They can be cultivated to a limited extent if they are managed carefully, but they are best kept in sod crops most of the time.

MANAGEMENT GROUP 8: SILTY OR LOAMY, WET SOILS

These poorly drained, level to gently sloping soils are in capability subclass IVw. Throughout most of the growing season they have a high water table that restricts the growth of plants. The following soils are in this management group:

Buxton and Scantic silt loams, 0 to 3 percent slopes.
Leicester and Ridgebury fine sandy loams, 0 to 3 percent slopes.
Leicester and Ridgebury fine sandy loams, 3 to 8 percent slopes.
Rumney and Saco fine sandy loams, 0 to 3 percent slopes.
Scantic silt loam, 0 to 3 percent slopes.
Scantic silt loam, 3 to 8 percent slopes.
Swanton fine sandy loam, 0 to 3 percent slopes.
Swanton fine sandy loam, 3 to 8 percent slopes.
Walpole fine sandy loam, 0 to 3 percent slopes.
Walpole fine sandy loam, 3 to 8 percent slopes.

Poor drainage causes these soils to be unsuited to most crops. They are fairly well suited to winter rye, bromegrass, redtop, birdsfoot trefoil, alsike clover, and Ladino clover, and are well suited to reed canarygrass. Artificial drainage will increase the number of crops that can be grown, but because of the cost, it may not be justified.

MANAGEMENT GROUP 9: SANDY AND LOAMY SOILS UNDERLAIN BY BEDROCK OR GRAVEL

These sloping soils are in subclass IVs. Some of them are shallow and most of them are sandy. The shallow soils are droughty during dry weather. Some areas may be more droughty than others, however, because the depth of the soil may vary considerably within the same field. The sandy soils overlie beds of gravel. Water filters through them rapidly, and they are droughty after fairly short periods of dry weather. Runoff is rapid on some of the more sloping areas, and erosion is a hazard. The following soils are in this management group:

Barnstead fine sandy loam and sandy loam, 8 to 25 percent slopes.
Brimfield-Brookfield sandy loams, 8 to 15 percent slopes.
Hollis-Charlton loams, 8 to 15 percent slopes.

Merrimac fine sandy loam and sandy loam, 8 to 25 percent slopes.
Merrimac sandy loam, 8 to 15 percent slopes.
Shapleigh-Gloucester sandy loams, 8 to 15 percent slopes.

These soils are only fairly well suited to row crops, small grains, grasses, and the legumes grown locally. They should be kept in sod crops most of the time. Under careful management they can be cropped to a limited extent, but measures must be taken to protect them from erosion.

MANAGEMENT GROUP 10: WELL-DRAINED, NONSTONY SOILS; SOME OF THEM SEVERELY ERODED

These soils are in capability subclass VIe. Because of their strong slopes, erosion is a hazard. The following soils are in this management group:

Charlton loam, 25 to 35 percent slopes.
Hollis-Charlton loams, 15 to 25 percent slopes.
Shapleigh-Gloucester sandy loams, 15 to 35 percent slopes.
Suffield silt loam, 25 to 35 percent slopes.

These soils are too steep for cultivated crops. Under careful management they are suitable for pasture or forests. The pastures need lime and fertilizer and must not be overgrazed.

MANAGEMENT GROUP 11: SILTY OR LOAMY SOILS THAT HAVE A HIGH WATER TABLE MUCH OF THE YEAR

These soils are in capability subclass VIw. They are generally nearly level, but some areas have mild slopes. The soils are very poorly drained and are saturated most of the year. They have little value for agriculture unless they are drained. The following soils are in this management group:

Biddeford silty clay loam, 0 to 3 percent slopes.
Rumney and Saco silt loams, 0 to 3 percent slopes.
Scantic silt loam and Biddeford silty clay loam, 0 to 3 percent slopes.
Scarboro fine sandy loam, 0 to 3 percent slopes.
Walpole and Scarboro fine sandy loams, 0 to 5 percent slopes.
Whately fine sandy loam, 0 to 3 percent slopes.
Whitman fine sandy loam, 0 to 3 percent slopes.
Whitman fine sandy loam, 3 to 8 percent slopes.

These soils are fairly well suited to reed canarygrass, but they are poorly suited to all of the other crops grown locally. Artificial drainage would increase the number of crops that can be grown, but it may not be practical.

MANAGEMENT GROUP 12: ROCKY OR STONY SOILS

These nearly level to strongly sloping soils are in capability subclass VIs. They occur on uplands. Their drainage ranges from good to very poor. The following soils are in this management group:

Acton and Scituate stony sandy loams, 0 to 8 percent slopes.
Acton and Scituate stony sandy loams, 0 to 3 percent slopes.
Acton and Scituate stony sandy loams, 3 to 8 percent slopes.
Brimfield-Brookfield rocky sandy loams, 3 to 15 percent slopes.
Brimfield-Brookfield rocky sandy loams, 3 to 8 percent slopes.
Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes.
Brookfield stony sandy loam, 0 to 15 percent slopes.
Brookfield stony sandy loam, 0 to 8 percent slopes.
Brookfield stony sandy loam, 8 to 15 percent slopes.
Brookfield stony sandy loam, 15 to 25 percent slopes.
Charlton stony loam, 0 to 15 percent slopes.
Charlton stony loam, 0 to 8 percent slopes.
Charlton stony loam, 8 to 15 percent slopes.
Charlton stony loam, 15 to 25 percent slopes.
Gloucester stony sandy loam, 0 to 15 percent slopes.
Gloucester stony sandy loam, 0 to 8 percent slopes.
Gloucester stony sandy loam, 8 to 15 percent slopes.
Gloucester stony sandy loam, 15 to 25 percent slopes.
Gloucester and Scituate stony sandy loams, 0 to 15 percent slopes.
Gloucester and Scituate stony sandy loams, 3 to 8 percent slopes.
Gloucester and Scituate stony sandy loams, 8 to 15 percent slopes.
Gloucester and Scituate stony sandy loams, 15 to 25 percent slopes.
Hollis-Charlton rocky loams, 3 to 15 percent slopes.
Hollis-Charlton rocky loams, 3 to 8 percent slopes.
Hollis-Charlton rocky loams, 8 to 15 percent slopes.
Leicester, Ridgebury, and Whitman stony fine sandy loams, 0 to 3 percent slopes.
Leicester, Ridgebury, and Whitman stony fine sandy loams, 3 to 8 percent slopes.
Paxton stony loam, 0 to 15 percent slopes.
Paxton stony loam, 3 to 8 percent slopes.
Paxton stony loam, 8 to 15 percent slopes.
Paxton stony loam, 15 to 25 percent slopes.
Shapleigh-Gloucester rocky sandy loams, 3 to 15 percent slopes.
Sutton and Woodbridge stony loams, 0 to 8 percent slopes.

These soils can be used for permanent pasture or trees. They can be used for the same kind of crops as are grown on similar nonstony soils, if the stones are removed. The large numbers of stones are the principal limiting factor in managing the soils. The stones are generally so numerous that farm machinery cannot be used. Their removal depends on whether the gain would justify the cost.

MANAGEMENT GROUP 13: MUCKS AND PEATS

These organic soils are in capability subclass VIIw. They are wet soils. They are saturated throughout the year. They are made up of the remains of plants that have accumulated in marshy areas or on the sites of former ponds. The organic material is acid, light in weight, spongy, and porous and holds several times its own weight in water. The following soils are in this group:

Balch and Littlefield peats.
Balch and Littlefield peats, shallow.
Waterboro muck.
Waterboro muck, shallow.

These soils have limited agricultural use because they are wet, and crops are generally subject to frost. Some muck areas are used for wild hay, but the value of the crop is probably not worth the difficulty in harvesting it. One of the best uses of these areas is for wildlife refuges.

MANAGEMENT GROUP 14: SANDY, VERY ROCKY, OR VERY STONY SOILS

These soils are in capability subclass VIIs because they are shallow or very stony, have many outcrops, or are very steep and coarse textured. The following soils are in this management group:

Brimfield-Brookfield rocky sandy loams, 15 to 25 percent slopes.
Brimfield-Brookfield very rocky very stony sandy loams, 3 to 15 percent slopes.
Brimfield-Brookfield very rocky very stony sandy loams, 15 to 25 percent slopes.
Brimfield-Brookfield very rocky very stony sandy loams, 25 to 35 percent slopes.
Gloucester very stony sandy loam, 15 to 25 percent slopes.
Gloucester very stony sandy loam, 3 to 15 percent slopes.
Hinckley loamy sand, 8 to 35 percent slopes.

Hinckley stony loamy sand, 3 to 25 percent slopes.
Hollis-Charlton rocky loams, 15 to 25 percent slopes.
Hollis-Charlton very rocky very stony loams, 3 to 15 percent slopes.
Hollis-Charlton very rocky very stony loams, 15 to 25 percent slopes.
Hollis-Charlton very rocky very stony loams, 25 to 35 percent slopes.
Jaffrey loamy sand, 8 to 35 percent slopes.
Merrimac sandy loam, 15 to 25 percent slopes.
Shapleigh-Gloucester rocky sandy loams, 15 to 35 percent slopes.
Shapleigh-Gloucester very rocky very stony sandy loams, 3 to 15 percent slopes.
Shapleigh-Gloucester very rocky very stony sandy loams, 15 to 35 percent slopes.
Windsor loamy sand, 8 to 25 percent slopes.

These soils are best used for growing trees, for wildlife refuges, or for recreational purposes. The stones and steep slopes hinder logging operations. The many bedrock outcrops and the stones throughout the soil reduce the rate of tree growth. The nonstony loamy sands of this group have little value for agriculture because they are steep and droughty, and plant nutrients leach out readily.

MANAGEMENT GROUP 15: FRESH WATER MARSH AND TIDAL MARSH

These soils are in capability subclass VIIIw because they are extremely wet. They are too wet to be of any agricultural value. The following soils are in this management group:

Fresh water marsh. Tidal Marsh.

Tidal marsh occurs in low areas along the coast and is covered with water at high tide. Fresh water marsh occurs around the edges of fresh water ponds and lakes. From 1 to 2 feet of water covers the areas all or part of the year. Both types of marsh are valuable, principally for wildlife refuges and for recreation.

MANAGEMENT GROUP 16: COASTAL BEACH AND DUNE SAND

The only mapping unit in this management group is Coastal beach and dune sand. It is in capability subclass VIIIs.

Coastal beach occurs along the coast from Maine to Massachusetts. The sand dunes lie next to the beaches. The coarse, sandy soils have no particular value for agriculture. Wind action constantly shifts the dune sands and makes them a hazard to adjacent agricultural areas by covering the more fertile soils. These areas are important for recreational purposes.

Estimated Yields

In table 1 are given the estimated average acre yields of the principal crops grown on the soils of Rockingham County under two levels of management. The yields indicated in columns A were obtained with farming practices commonly used in 1954. These practices included the use of a fairly long rotation, as corn or potatoes for the first year, a small grain the second year, and hay for 2 to 4 years. Under these practices corn commonly receives an application of manure and superphosphate; potatoes, about 500 pounds of a complete fertilizer; and hay crops, 1 to 2 tons of lime when the crop is reseeded.

The estimates in columns B indicate average yields that may be obtained if more intensive management practices are used. These practices include using measures to control erosion and plowing under green-manure crops to increase the organic matter in the soil. They also include the use of more frequent applications of manure and superphosphate or other complete fertilizer for corn and potatoes; 1½ to 2 tons of lime at seeding time and a topdressing of 400 to 600 pounds an acre of a complete fertilizer for grasses grown for hay; 500 to 800 pounds of a complete fertilizer for mixed legumes and grasses grown for hay; and a fertilizer high in phosphorus and potassium for legumes grown alone. The pastures are improved by removing the brush, turning over the sod, adding fertilizer and lime, and seeding with Ladino clover or other legumes.

The estimates in table 1 are based primarily on interviews with members of the staff of the agricultural experiment station who were in a position to observe the soils and crop yields in the county. These figures are as accurate as can be expected without detailed and lengthy research and will furnish some idea of what yields can be expected from the different soils under various types of management.

General Management

In Rockingham County poultry raising and dairying are the most important industries, but fruit trees and market vegetables are important sources of income. In the following pages are discussions of the general management practices used on the poultry farms, dairy farms, orchards, and vegetable farms in this county. In addition there is a discussion of water control.

Poultry farms.—The poultry industry has expanded rapidly during the past few years. Some of the larger poultry farms are located on the droughty terrace soils not well suited to dairying. Others are in the uplands. The large poultry farms are highly specialized. As a rule, the feed is not grown on the farm but is purchased from commercial feed companies.

The areas that have the best soils for growing grass are usually chosen as range. The range generally is not rotated for several years. A good sod is maintained by spacing the shelters far enough apart so that the birds will not be crowded closely together and also by regulating the number of birds allowed on an area. The sod consists mainly of grass. The grass is clipped, lime is applied, and fertilizer is used as a topdressing. As a rule, the poultry manure is not used on the farm but is sold or given to a nearby dairy or to a vegetable farmer.

Dairy farms.—On the dairy farms in the county, large acreages are used for hay and pasture. The permanent pastures are grazed during part of the season. In addition, rotational and supplementary pastures provide forage.

Long rotations are generally used on the dairy farms. The most common rotation consists of growing corn for silage for 2 years and growing rye in the winter as a cover crop. The areas are then used for hay and pasture for 2 to 6 years.

TABLE 1.—*Estimated average acre yields of principal crops under two levels of management*

[Yields in columns A are those obtained under common management; yields in columns B are those to be expected under improved management Dashes indicate crop is not grown at the management level indicated or the soil is unsuited to its production]

Soil	Corn for grain		Corn for silage		Mixed hay (timothy and clover)		Alfalfa hay		Oats		Potatoes		Permanent pasture		Relative suitability for apples
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
	Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Acres per animal unit*[1]	*Acres per animal unit*[1]	
Acton and Scituate sandy loams, 3 to 8 percent slopes.		50	5	8	1½	3	----	----	30	40	-----	-----	3	1	Poor.
Acton and Scituate sandy loams, 0 to 3 percent slopes.	35	50	5	8	1½	3	----	----	30	40	-----	-----	3	1	Poor.
Acton and Scituate sandy loams, 0 to 8 percent slopes.	35	50	5	8	1½	3	----	----	30	40	-----	-----	3	1	Poor.
Acton and Scituate stony sandy loams, 3 to 8 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	3	1	----------
Acton and Scituate stony sandy loams, 0 to 3 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	3	1	----------
Acton and Scituate stony sandy loams, 0 to 8 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	3	1	----------
Barnstead fine sandy loam and sandy loam, 3 to 8 percent slopes.	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Barnstead fine sandy loam and sandy loam, 8 to 25 percent slopes.	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Biddeford silty clay loam, 0 to 3 percent slopes	----	----	----	----	1	2	----	----	----	----	-----	-----	------	------	----------
Brimfield-Brookfield sandy loams, 3 to 8 percent slopes.	30	45	6	10	1	2	1	2	25	35	-----	-----	6	3	Poor.
Brimfield-Brookfield sandy loams, 8 to 15 percent slopes.	30	45	6	10	1	2	1	2	25	35	-----	-----	6	3	Poor.
Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	7	4	----------
Brimfield-Brookfield rocky sandy loams, 3 to 8 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	7	4	----------
Brimfield-Brookfield rocky sandy loams, 15 to 25 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	------	------	----------
Brimfield-Brookfield rocky sandy loams, 3 to 15 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	------	------	----------
Brimfield-Brookfield very rocky very stony sandy loams, 3 to 15 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	------	------	Poor.
Brimfield-Brookfield very rocky very stony sandy loams, 15 to 25 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	------	------	Poor.
Brimfield-Brookfield very rocky very stony sandy loams, 25 to 35 percent slopes.	----	----	----	----	----	----	----	----	----	----	-----	-----	------	------	Poor.
Brookfield sandy loam, 3 to 8 percent slopes	50	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Brookfield sandy loam, 3 to 15 percent slopes	50	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Brookfield sandy loam, 0 to 3 percent slopes	55	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Brookfield sandy loam, 8 to 15 percent slopes	50	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Brookfield sandy loam, 15 to 25 percent slopes	----	----	----	----	1½	2½	2	3	----	----	-----	-----	5	3	----------
Brookfield stony sandy loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	5	3	----------
Brookfield stony sandy loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	5	3	----------
Brookfield stony sandy loam, 15 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	5	3	----------
Brookfield stony sandy loam, 0 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	5	3	----------
Buxton silt loam, 3 to 8 percent slopes	35	50	5	8	1½	3	----	----	30	40	-----	-----	3	1	Poor.
Buxton silt loam, 0 to 3 percent slopes	35	50	5	8	1½	3	----	----	30	40	-----	-----	3	1	Poor.
Buxton silt loam, 3 to 8 percent slopes, severely eroded.	30	45	4	7	1	2½	----	----	25	35	-----	-----	2	1	Poor.
Buxton and Scantic silt loams, 0 to 3 percent slopes	----	----	----	----	1	2	----	----	----	----	-----	-----	4	2	----------
Charlton loam, 8 to 15 percent slopes	60	80	12	18	2	4	2½	4	45	60	350	500	3	1	Good.
Charlton loam, 3 to 15 percent slopes	60	80	12	18	2	4	2½	4	45	60	350	500	3	1	Good.
Charlton loam, 3 to 8 per cent slopes	60	80	12	18	2	4	2½	4	45	60	350	500	3	1	Good.
Charlton loam, 0 to 3 percent slopes	60	80	12	18	2	4	2½	4	45	60	350	500	3	1	Good.
Charlton loam, 15 to 25 percent slopes	----	----	----	----	2	4	2½	4	----	----	-----	-----	3	1	----------
Charlton loam, 25 to 35 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	4	2	----------
Charlton stony loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	3	1	----------
Charlton stony loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	3	1	----------
Charlton stony loam, 15 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	3	1	----------
Charlton stony loam, 0 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	-----	-----	3	1	----------
Elmwood fine sandy loam, 3 to 8 percent slopes	35	40	5	8	1½	3	----	----	30	40	-----	-----	3	1	Poor.
Elmwood fine sandy loam, 0 to 3 percent slopes	35	40	5	8	1½	3	----	----	30	40	-----	-----	3	1	Poor.

See footnotes at end of table.

TABLE 1.—*Estimated average acre yields of principal crops under two levels of management*—Continued

Soil	Corn for grain		Corn for silage		Mixed hay (timothy and clover)		Alfalfa hay		Oats		Potatoes		Permanent pasture		Relative suitability for apples
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
	Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Acres per animal unit*[1]	*Acres per animal unit*[1]	
Gloucester sandy loam, 8 to 15 percent slopes	50	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Gloucester sandy loam, 0 to 3 percent slopes	50	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Gloucester sandy loam, 3 to 8 percent slopes	50	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Gloucester sandy loam, 15 to 25 percent slopes	----	----	----	----	1½	2½	2	3	----	----	----	----	5	3	----------
Gloucester sandy loam, 3 to 15 percent slopes	50	70	6	12	1½	2½	2	3	35	45	250	400	5	3	Moderate.
Gloucester stony sandy loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	5	3	----------
Gloucester stony sandy loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	5	3	----------
Gloucester stony sandy loam, 15 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	5	3	----------
Gloucester stony sandy loam, 0 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	5	3	----------
Gloucester very stony sandy loam, 15 to 25 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Gloucester very stony sandy loam, 3 to 15 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Gloucester and Scituate sandy loams, 3 to 8 percent slopes.	50	70	6	12	1½	2½	----	----	----	----	----	----	3	1	Poor.
Gloucester and Scituate sandy loams, 0 to 3 percent slopes.	50	70	6	12	1½	2½	----	----	----	----	----	----	3	1	Poor.
Gloucester and Scituate sandy loams, 8 to 15 percent slopes.	50	70	6	12	1½	2½	----	----	----	----	----	----	3	1	Poor.
Gloucester and Scituate sandy loams, 15 to 25 percent slopes.	----	----	----	----	1½	2½	----	----	----	----	----	----	3	1	Poor.
Gloucester and Scituate sandy loams, 3 to 15 percent slopes.	50	70	6	12	1½	2½	----	----	----	----	----	----	3	1	Poor.
Gloucester and Scituate stony sandy loams, 3 to 8 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	3	1	----------
Gloucester and Scituate stony sandy loams, 8 to 15 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	3	1	----------
Gloucester and Scituate stony sandy loams, 15 to 25 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	3	1	----------
Gloucester and Scituate stony sandy loams, 0 to 15 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	3	1	----------
Hinckley loamy sand, 8 to 35 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Hinckley loamy sand, 0 to 3 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	5	Poor.
Hinckley loamy sand, 3 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	5	Poor.
Hinckley stony loamy sand, 3 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Hollis-Charlton loams, 8 to 15 percent slopes	35	50	7	12	1	2	1	2	30	40	----	----	5	2	Poor.
Hollis-Charlton loams, 0 to 3 percent slopes	35	50	7	12	1	2	1	2	30	40	----	----	5	2	Poor.
Hollis-Charlton loams, 3 to 8 percent slopes	35	50	7	12	1	2	1	2	30	40	----	----	5	2	Poor.
Hollis-Charlton loams, 15 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	5	2	----------
Hollis-Charlton rocky loams, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	6	3	----------
Hollis-Charlton rocky loams, 3 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	6	3	----------
Hollis-Charlton rocky loams, 15 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Hollis-Charlton rocky loams, 3 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Hollis-Charlton very rocky very stony loams, 3 to 15 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Hollis-Charlton very rocky very stony loams, 15 to 25 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Hollis-Charlton very rocky very stony loams, 25 to 35 percent slopes.	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Jaffrey loamy sand, 0 to 3 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	5	Poor.
Jaffrey loamy sand, 8 to 35 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	------	----------
Jaffrey loamy sand, 3 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	------	5	Poor.
Leicester and Ridgebury fine sandy loams, 3 to 8 percent slopes.	----	----	----	----	1	2	----	----	----	----	----	----	4	2	----------
Leicester and Ridgebury fine sandy loams, 0 to 3 percent slopes.	----	----	----	----	1	2	----	----	----	----	----	----	4	2	----------
Leicester, Ridgebury, and Whitman stony fine sandy loams, 3 to 8 percent slopes.	----	----	----	----	1	2	----	----	----	----	----	----	------	------	----------
Leicester, Ridgebury, and Whitman stony fine sandy loams, 0 to 3 percent slopes.	----	----	----	----	1	2	----	----	----	----	----	----	------	------	----------
Melrose fine sandy loam, 3 to 8 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	40	5	3	Moderate.
Melrose fine sandy loam, 0 to 3 percent slopes	40	60	6	12	1½	2½	1½	2¼	35	45	250	400	5	3	Moderate.
Melrose fine sandy loam, 8 to 15 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Merrimac fine sandy loam, 3 to 8 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Merrimac fine sandy loam, 0 to 3 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.

See footnotes at end of table.

TABLE 1.—*Estimated average acre yields of principal crops under two levels of management*—Continued

Soil	Corn for grain		Corn for silage		Mixed hay (timothy and clover)		Alfalfa hay		Oats		Potatoes		Permanent pasture		Relative suitability for apples
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
	Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Acres per animal unit*[1]	*Acres per animal unit*[1]	
Merrimac fine sandy loam, 8 to 15 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Merrimac fine sandy loam, 15 to 25 percent slopes					1½	2¼	1¼	2¼					5	3	Moderate.
Merrimac sandy loam, 3 to 8 percent slopes	30	45	6	10	1	2	1	2	25	35	200	350	6	3	Poor.
Merrimac sandy loam, 0 to 3 percent slopes	30	45	6	10	1	2	1	2	25	35	200	350	6	3	Poor.
Merrimac sandy loam, 8 to 15 percent slopes	30	45	6	10	1	2	1	2	25	35	200	350	6	3	Poor.
Merrimac sandy loam, 15 to 25 percent slopes					1	2	1	2					6	3	
Merrimac fine sandy loam and sandy loam, 0 to 3 percent slopes.	30	45	6	10	1	2	1	2	25	35	200	350	6	3	Poor.
Merrimac fine sandy loam and sandy loam, 3 to 8 percent slopes.	30	45	6	10	1	2	1	2	25	35	200	350	6	3	Poor.
Merrimac fine sandy loam and sandy loam, 8 to 25 percent slopes.													6	3	
Ondawa fine sandy loam, 0 to 3 percent slopes[2]	60	80	10	15	2	4	2½	4	45	60	300	450	3	1	
Paxton loam, 3 to 8 percent slopes	60	80	10	15	2½	4½	2½	4	40	55	350	500	3	1	Good.
Paxton loam, 0 to 3 percent slopes	60	80	10	15	2½	4½	2½	4	40	55	350	500	3	1	Good.
Paxton loam, 3 to 15 percent slopes	60	80	10	15	2½	4½	2½	4	40	55	350	500	3	1	Good.
Paxton loam, 8 to 15 percent slopes	60	80	10	15	2½	4½	2½	4	40	55	350	500	3	1	Good.
Paxton loam, 15 to 25 percent slopes					2½	4½	2½	4					3	1	
Paxton stony loam, 8 to 15 percent slopes													3	1	
Paxton stony loam, 0 to 15 percent slopes													3	1	
Paxton stony loam, 3 to 8 percent slopes													3	1	
Paxton stony loam, 15 to 25 percent slopes													3	1	
Podunk fine sandy loam, 0 to 3 percent slopes	35	50	5	8	1½	3			30	40			3	1	Poor.
Rumney and Saco fine sandy loams, 0 to 3 percent slopes.					1	2							4	2	
Rumney and Saco silt loams, 0 to 3 percent slopes					1	2							4	2	
Scantic silt loam, 0 to 3 percent slopes					1	2							4	2	
Scantic silt loam, 3 to 8 percent slopes															
Scantic silt loam and Biddeford silty clay loam, 0 to 3 percent slopes.					1	2									
Scarboro fine sandy loam, 0 to 3 percent slopes					1	2									
Shapleigh-Gloucester sandy loams, 8 to 15 percent slopes.	30	40	6	10	1	2	1	2	25	35			6	3	Poor.
Shapleigh-Gloucester sandy loams, 0 to 8 percent slopes.	30	40	6	10	1	2	1	2	25	35			6	3	Poor.
Shapleigh-Gloucester sandy loams, 15 to 35 percent slopes.					1	2	1	2	25	35			6	3	Poor.
Shapleigh-Gloucester rocky sandy loams, 3 to 15 percent slopes.													7	4	
Shapleigh-Gloucester rocky sandy loams, 15 to 35 percent slopes.															
Shapleigh-Gloucester very rocky very stony sandy loams, 3 to 15 percent slopes.															
Shapleigh-Gloucester very rocky very stony sandy loams, 15 to 35 percent slopes.															
Sudbury fine sandy loam, 0 to 3 percent slopes	35	40	5	8	1½	3			30	40			3	1	Poor.
Sudbury fine sandy loam, 3 to 8 percent slopes	35	40	5	8	1½	3			30	40			3	1	Poor.
Sudbury fine sandy loam, 0 to 8 percent slopes	35	40	5	8	1½	3			30	40			3	1	Poor.
Suffield silt loam, 8 to 15 percent slopes	50	70	8	14	3	4½	2	3	45	60	250	350	3	1	Good.
Suffield silt loam, 8 to 15 percent slopes, severely eroded.	45	65	7	13	2½	4	1½	2½	40	55	200	300	4	2	Good.
Suffield silt loam, 15 to 25 percent slopes					3	4½	2	3					3	1	
Suffield silt loam, 15 to 25 percent slopes, severely eroded.					2½	4	1½	2½					4	2	
Suffield silt loam, 25 to 35 percent slopes													4	2	
Sutton and Woodbridge loams, 3 to 8 percent slopes	40	55	6	9	2	3½			35	45			3	1	Poor.
Sutton and Woodbridge loams, 0 to 3 percent slopes	40	55	6	9	2	3½			35	45			3	1	Poor.
Sutton and Woodbridge loams, 0 to 8 percent slopes	40	55	6	9	2	3½			35	45			3	1	Poor.
Sutton and Woodbridge stony loams, 0 to 8 percent slopes.													3	1	
Swanton fine sandy loam, 0 to 3 percent slopes					1	2							4	2	
Swanton fine sandy loam, 3 to 8 percent slopes					1	2							4	2	
Walpole fine sandy loam, 0 to 3 percent slopes					1	2							4	2	
Walpole fine sandy loam, 3 to 8 percent slopes					1	2							4	2	

See footnotes at end of table.

TABLE 1.—*Estimated average acre yields of principal crops under two levels of management*—Continued

Soil	Corn for grain		Corn for silage		Mixed hay (timothy and clover)		Alfalfa hay		Oats		Potatoes		Permanent pasture		Relative suitability for apples
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
	Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Acres per animal unit*[1]	*Acres per animal unit*[1]	
Walpole and Scarboro fine sandy loams, 0 to 5 percent slopes.	----	----	----	----	1	2	----	----	----	----	----	----	----	----	----
Warwick gravelly loam, 3 to 8 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Warwick gravelly loam, 0 to 3 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Warwick gravelly loam, 8 to 15 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Warwick gravelly loam, 3 to 15 percent slopes	40	60	6	12	1½	2½	1¼	2¼	35	45	250	400	5	3	Moderate.
Whately fine sandy loam, 0 to 3 percent slopes	----	----	----	----	1	2	----	----	----	----	----	----	----	----	----
Whitman fine sandy loam, 0 to 3 percent slopes	----	----	----	----	1	2	----	----	----	----	----	----	----	----	----
Whitman fine sandy loam, 3 to 8 percent slopes	----	----	----	----	1	2	----	----	----	----	----	----	----	----	----
Windsor loamy sand, 3 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	5	Poor.
Windsor loamy sand, 0 to 3 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	5	Poor.
Windsor loamy sand, 8 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	5	Poor.

[1] An animal unit is equivalent to 1 cow, steer, or horse; 5 hogs; 7 sheep; or 7 goats.

[2] On experimental plots, Hungarian millet and soybeans increased 44 percent with irrigation.

The rotations vary in length on the different soils. On the droughty Merrimac, Gloucester, and Windsor soils, the areas are plowed up and planted to corn more frequently than on the finer textured Paxton, Charlton, and Suffield soils. On the smaller and less intensively managed dairy farms, the rotation may be as long as 9 or 10 years. Such long rotations are not desirable, however, because the quality of the forage decreases considerably and the yield becomes lower than when a shorter rotation is used.

Commercial fertilizer, lime, and manure are used on many of the dairy farms. Manure is used under corn grown for silage, for establishing new seedings, and as a topdressing on fields used for hay. Many farmers also use manure from the nearby poultry farms to fertilize the fields. The poultry manure is applied at about half the rate of cow manure.

Orchards.—Apples are grown extensively in this county. The trees are set out in sod and mulched with hay. About 100 pounds of hay is used as a mulch around the base of the tree when it is set out, and more is added at intervals so that enough mulch is always present to prevent grass from growing. Generally between 200 and 300 pounds of hay per tree is placed around the base of the tree at any one time, or approximately 2 tons per acre each year. The mulch covers an area slightly greater than the spread of the branches. None is applied closer than 2 or 3 feet from the trunk of the tree. If it is placed closer, mice may damage the tree. The grass between the trees is mowed and supplies part of the mulch.

Between ⅛ and ¼ pound of ammonium nitrate, or its equivalent, is applied for each year of age of the tree. The application ranges up to 5 pounds per tree. Tests indicate that if the mulch is used continuously for 5 to 10 years, less nitrogen is needed.

On all kinds of soils poultry manure is suitable as a fertilizer for apple trees. It is especially desirable for trees growing on the Gloucester sandy loams, on which many of the smaller orchards are located. A combination of raising poultry and growing apple trees is efficient because the labor demands of these two types of farming do not overlap.

In this county the soils are commonly deficient in magnesium for apple trees, especially where the soils are acid. This is evidenced by the presence of leaf scorch. A temporary remedy is to spray the orchards with a solution of magnesium sulfate. The condition can be corrected permanently by applying magnesium-bearing limestone, but this is not effective until several years after it is applied. If the soils are deficient in boron, borax should be applied at the rate of one-half pound per tree every 3 years.

Vegetable farms.—Vegetables are grown for market mainly in the eastern part of the county along U. S. Highway No. 1 and in the southern part near the Massachusetts State line. They are grown mainly on level to nearly level areas of Merrimac soils. The principal vegetable crops are snap beans, cabbage, carrots, sweet corn, cucumbers, squash, and tomatoes.

A vegetable crop is grown each year, but rye is commonly grown as a cover crop during the winter to reduce erosion and leaching and to provide organic matter. The rye is plowed under early in spring, and a ton or more per acre of a complete fertilizer is added before the vegetables are planted. On many of the farms, the poultry manure produced on the nearby large poultry farms is used in addition to commercial fertilizers.

Water control

Control of water on and in the soils involves three things—control of runoff and erosion; improvement of drainage; and protection from overflow. In Rockingham County, the control of runoff and erosion is the most important of these three, but drainage also needs to be improved on many of the soils. Little damage occurs as the result of overflow. The following is a discussion of runoff and erosion, and of drainage. The problem of overflow has not been discussed because its relation to the soils is minor in this counnty.

Runoff and erosion.—To control runoff, crops must be selected carefully and suitable rotations must be used. In addition, such practices as tilling on the contour, stripcropping, terracing, and planting winter cover crops will be needed on sloping soils used for cultivated crops, and woodland must be managed with care. In this county the soils that have been used for cultivated crops are water eroded to some extent, and some of the light, sandy soils are slightly to moderately eroded as the result of wind.

Gullies are not common, but some occur, not only in the severely eroded soils but also in the soils that are considered only slightly to moderately eroded. Gullying has been checked in many places by changing from cultivated crops to hay or pasture or by replanting to trees.

The most active erosion occurs on soils planted to clean-tilled crops, as corn, potatoes, and market vegetables. Some erosion takes place when the soils used for hay are plowed and planted to a cultivated crop before being reseeded to hay. Some also takes place in pastures that have been overgrazed.

Soils that have slopes of 0 to 3 percent can be used for cultivated crops if ordinary good management is used. Special management will be needed, however, if soils receive runoff from adjacent, higher lying areas.

For soils that have slopes of 3 to 15 percent, the following are suggested for controlling runoff: (1) Using a crop rotation in which the soils are in sod at least 3 years out of 5; (2) maintaining a cover of grass and legumes that is fertilized adequately; (3) tilling on the contour or stripcropping; (4) using diversion ditches to decrease the size of the runoff area in a field or to intercept water that would normally run onto the soils from higher lying areas; and (5) growing a winter cover crop on all of the soils to be used for row crops.

The soils that have slopes of 15 to 30 percent should be kept in hay or pasture most of the time. The light-textured soils that are poorly suited to grass are best planted to trees. Most of the soils that have slopes greater than 30 percent should be left in forest.

Drainage.—In this county there are large areas of moderately well drained, poorly drained, and very poorly drained soils that could be improved by artificial drainage. Artificial drainage is generally provided by using open ditches or interceptor ditches, by installing tile drains, or by bedding or grading. Before deciding to drain an area, the general suitability of the soils for crops must be considered and also the cost of installing drainage in view of the expected returns from improved yields.

The drainage of the coarser textured soils, as the Walpole and Scarboro, can be improved by open ditches, interceptor ditches, or by tile. That of the fine-textured soils, as the Scantic and Biddeford, can be improved by bedding or grading the soils to remove surface water. When the soils are bedded, they are shaped into a series of elevated beds that are separated by shallow ditches.

Because of differences in the depth of clay, some areas of Swanton and Whately soils differ from others in the type of artificial drainage needed. Where the clay is at depths greater than 2½ feet, drainage by means of open ditches ordinarily can be used. Where the clay is nearer the surface, bedding the soils is generally more satisfactory. Tile drainage is feasible if the tile is backfilled with pervious material to an elevation higher than that of the clay.

Some areas of Whitman, Scarboro, and Biddeford soils could be drained, but because of the lack of readily available outlets, the cost would not be justified.

Forests[2]

About 75 percent of Rockingham County is covered by forests. The most extensive forested areas are in the northern and western parts of the county. The forests are mainly on poorly drained or stony to very stony, well drained soils of the uplands and on the moderately coarse textured soils of the terraces.

During colonial days, the white pine from this county was used extensively for building ships. Only the best timber was used at first, but as the select trees decreased in number, the ones of poorer quality were cut.

The present stand consists of a mixture of white pines and hardwoods. On the coarse-textured soils, the stands of white pine are mixed with pitch pine, gray birch, red maple, pin cherry, and white oak. On the fine-textured soils are paper birch, black birch, and gray birch, white ash, red oak, and sugar maple.

Mixed stands of hardwoods and pines are desirable because the pine in these stands is of higher quality than that from pure stands. Also, diseases and insects can be controlled more easily if the stand consists of mixed species and of trees of different ages. Poorly formed and mature cull trees should be removed. If the areas are understocked with desirable species, more desirable trees can be planted to replace the culls. It is best, however, to allow the trees of the desirable species to reseed themselves. If trees are planted, red pine will grow best on coarse-textured, dry soils and white pine, on the slightly finer textured soils. Among the hardwoods, maple, ash, and oak grow better on the finer textured soils where there is more available moisture than elsewhere. Good stands of hardwoods generally will develop from existing seedlings or sprouts.

Most of the timber from the forests is used locally. A number of portable sawmills operate in the county, and there are several permanent mills. Some of the forested areas are used by towns and cities as recrea-

[2] Information for this section was supplied by Lewis C. Swain, Professor of Forestry, University of New Hampshire.

tional areas. There are no national forests in the county, but a few areas are owned by the State.

Apparently fires have caused considerable damage to the forests in the county in the past. This is evidenced by the presence of pin cherry, aspen, gray birch, paper birch, and scrub oak in areas that have been burned over. A State forester now administers the fire-prevention activities. State and Federal agencies cooperate in fighting insects and disease.

Engineering Applications[3]

This soil survey report for Rockingham County, N. H., contains information that can be used by engineers to—

(1) Make soil and land-use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
(2) Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
(3) Make reconnaissance surveys of soil and ground conditions that will aid in selecting highway and airport locations and in planning detailed soil surveys for the intended locations.
(4) Locate sand and gravel for use in structures.
(5) Correlate pavement performance with types of soil and thus develop information that will be useful in designing and maintaining the pavements.
(6) Determine the suitability of soil units for cross-country movements of vehicles and construction equipment.
(7) Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making soil maps and reports that can be used readily by engineers.

The mapping and the descriptive report are somewhat generalized, however, and should be used only in planning more detailed field surveys that will, in turn, be used to determine the in-place condition of the soil at the site of the proposed engineering construction.

Soil Science Terminology

Some of the terms used by the agricultural soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, sand, aggregate, and granular—have special meanings in soil science. These terms are defined as follows:

Soil: The natural medium for the growth of land plants on the surface of the earth; composed of organic and mineral materials.

Clay: A soil separate or size group of mineral particles less than 0.002 mm. in diameter. Clay as a textural class includes soil material containing 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Silt: A soil separate having diameters ranging from 0.05 mm. to 0.002 mm. As a textural class silt includes soil material that contains 80 percent or more silt and less than 12 percent clay.

Sand: A soil separate ranging in diameter from 2.0 mm. to 0.05 mm. As a textural class sand includes soil material that contains 85 percent or more sand and not more than 10 percent clay.

Topsoil: Presumably fertile soil material used to topdress roadbanks, gardens, and lawns.

Aggregate: A cluster of primary soil particles held together by internal forces to form a clod or fragment.

Granular structure: Individual grains grouped into spherical aggregates with indistinct sides. Highly porous granules are commonly called crumbs.

Soil Test Data and Engineering Classifications

To be able to make the best use of the soil maps and the soil survey reports, the engineer should know the physical properties of the soil materials and the in-place condition of the soil. After testing soil materials and observing the behavior of soils when used in engineering structures and foundations, the engineer can develop design recommendations for the soil units delineated on the maps.

Soil test data

Samples of the principal soil types of each of four extensive soil series were tested in accordance with standard procedures (*1*) to help evaluate the soils for engineering purposes. The test data are given in table 2. Although each soil series was sampled in three localities, and the test data show some variations in physical test characteristics, they probably do not show the maximum variations of the B and C horizons of each of the soil series. All samples were obtained at depths of less than 4 feet. The test data, therefore, may not be a suitable basis for estimating the characteristics of soil materials that occur in deep cuts in areas of rolling or hilly topography.

The engineering soil classifications in table 2 are based on data obtained by mechanical analyses and by tests made to determine liquid limits and plastic limits. Mechanical analyses were made by combined sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used as a basis for naming soil textural classes.

The liquid-limit and plastic-limit tests measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a semisolid or plastic state. As the moisture content is further increased, the material changes from the plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a solid to

[3] This section was prepared cooperatively by the Soil Conservation Service and the Division of Physical Research, Bureau of Public Roads. Test data in table 2 were obtained in the Soils Laboratory, Bureau of Public Roads.

TABLE 2.—*Engineering test data*[1] *for soil samples taken from 11 soil profiles,*

Soil and location	Parent material	Bureau of Public Roads report No.	Depth	Horizon	Moisture-density		Mechanical analysis[2]				
							Discarded in field sampling		Percentage passing sieve[3]		
					Maximum dry density	Optimum moisture	Larger than 3 inches	From 1 to 3 inches	3-in.	2-in.	1 to ½-in.
			Inches		*Lb. per cu. ft.*	*Percent*	*Percent*	*Percent*			
Charlton loam:											
2 miles NNE. of Epping	Glacial till over schistose rock.	S30954	1 to 8	B_{21}	94	22	10	5	90		
		S30955	8 to 18	B_{22}	104	18	10	5	90		
		S30956	28 to 38	C	116	13	10	5	90		
1,000 yards NW. of northern tip of Lucas Pond (modal profile).	Glacial till	S30951	0 to 7	A_1	93	23	10	5	90		
		S30952	13 to 24	B_{22}	112	14	10	5	90		
		S30953	24+	C	118	12	10	5	90		
Strafford Co., 0.5 mile NW. of route 9 on University of N.H. plots.	Glacial till	S30957	0 to 9	A_p	103	17	10	5	90		
		S30958	15 to 25	B_{22}	116	12	10	5	90		
		S30959	28 to 40	B_{2m}	125	10	10	5	90		
Gloucester sandy loam:											
Northern slope of Mount Misery (modal profile).	Glacial till from granitic materials.	S30960	0 to 3½	A_1	96	19	15	10	85		
		S30961	6 to 17	B_{22}	115	12	15	10	85		
		S30962	21+	C	115	9	15	10	85		
0.9 mile N. of Deerfield	Same	S30963	0 to 5	A_1	86	25	15	10	85		
		S30964	9 to 20	B_{22}	120	10	15	10	85		
		S30965	20+	C	126	8	15	10	85		
Gloucester stony sandy loam:											
0.75 mile NW. of Nottingham Square.	Same	S30966	0 to 2	A_1	88	23	25	5	75		
		S30967	8 to 20	B_{22}	119	11	25	5	75		
		S30968	26+	C	121	9	25	5	75		
Merrimac sandy loam:											
1.5 miles NE. of South Deerfield.	Glacial outwash and terrace material predominantly granitic.	S30972	0 to 2½	A_1	97	20					100
		S30973	6 to 24	B_{22}	114	13					100
		S30974	24+	C	111	14				100	97
1 mile NE. of Auburn (modal profile).	Same	S30969	0 to 5	A_1	93	21					100
		S30970	9 to 14	B_{22}	121	11					
		S30971	27+	C	105	12					
Gravel pit NW. corner of Beaver Pond.	Same	S30975	0 to 3	A_1	91	21					
		S30976	8 to 15	B_{22}	118	10					100
		S30977	23+	D	115	12				100	94
Paxton loam:											
0.4 mile N. of Suncook Pond	Glacial till from mica schist.	S30981	0 to 3	A_1	98	19	5	10	95		
		S30982	3 to 8	B_{21}	109	16	5	10	95		
		S30983	27+	C	121	9	5	10	95		
1.05 miles N. of Northwood Ridge.	Same	S30984	0 to 7	A_p	95	21	5	10	95		
		S30985	14 to 22	B_{22}	113	15	5	10	95		
		S30986	22+	C	122	12	5	10	95		
0.65 mile S. of SE. corner of Epsom (modal profile).	Same	S30978	0 to 9	A_p	110	15	10	5	90		
		S30979	9 to 15	B_2	118	12	10	5	90		
		S30980	21+	C_2	125	10	10	5	90		

[1] Tests performed by Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (A.A.S.H.O.).

[2] Mechanical analyses based on the soil samples received by the Bureau of Public Roads Laboratory; analyses made according to the American Association of State Highway Officials Designation: T 88. Results by this procedure frequently differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the A.A.S.H.O. 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 in the soil sample, including that coarser than 2 mm. in diameter. In

Rockingham County, and 1 soil profile, Strafford County, N. H.

Mechanical analysis[2]—Continued												Liquid limit	Plasticity index	Classification	
Percentage passing sieve[3]—Continued								Percentage smaller than[3]						A.A.S.H.O.[4]	Unified[5]
1-in.	¾-in.	⅜-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
79	76	70	65	59	53	50	41	36	19	8	5	NP[6]	NP	A-4(3)	GM-SM.
79	76	71	66	61	54	51	41	34	19	7	4	NP	NP	A-4(2)	SM.
82	76	70	64	56	45	41	29	24	14	7	4	NP	NP	A-2-4(0)	SM.
80	78	76	73	71	60	57	38	32	21	11	7	43	5	A-5(1)	SM.
67	66	61	58	54	48	43	26	21	14	7	4	NP	NP	A-2-4(0)	GM.
74	71	66	62	58	49	43	26	20	12	7	4	NP	NP	A-2-4(0)	SM.
85	84	81	78	75	65	56	38	29	25	11	5	NP	NP	A-4(2)	SM.
77	77	74	72	70	59	50	29	23	14	7	5	NP	NP	A-2-4(0)	SM.
76	75	71	67	63	49	43	28	22	14	9	5	NP	NP	A-2-4(0)	SM.
75	75	74	73	70	57	48	28	23	14	8	5	NP	NP	A-2-4(0)	SM.
71	70	70	69	66	52	44	22	22	15	9	7	NP	NP	A-2-4(0)	SM.
75	75	74	73	67	37	22	4	3	2	2	2	NP	NP	A-1-b(0)	SP-SM.
75	72	69	67	65	54	47	29	23	13	7	4	NP	NP	A-2-4(0)	SM.
72	70	65	61	56	44	38	21	17	11	6	3	NP	NP	A-2-4(0)	SM.
73	71	68	65	60	46	38	20	15	10	5	3	NP	NP	A-2-4(0)	SM.
70	70	69	69	68	54	43	24	20	11	6	5	NP	NP	A-2-4(0)	SM.
64	59	53	47	41	29	23	11	9	5	3	1	NP	NP	A-1-b(0)	SM.
62	60	56	52	48	36	29	13	10	6	3	2	NP	NP	A-1-b(0)	SM.
98	94	88	84	80	58	39	17	14	8	5	4	NP	NP	A-2-4(0)	SM.
97	93	86	78	69	42	26	11	10	7	5	4	NP	NP	A-1-b(0)	SW-SM.
96	94	87	79	70	41	21	3	2	2	2	1	NP	NP	A-1-b(0)	SP.
97	93	89	86	81	49	37	24	19	12	7	5	NP	NP	A-1-b(0)	SM.
100	93	79	67	54	22	13	5	4	3	3	2	NP	NP	A-1-b(0)	SW-SM.
100	99	97	96	93	41	19	5	4	4	3	3	NP	NP	A-1-b(0)	SP-SM.
------	100	99	98	97	85	73	39	31	18	10	7	NP	NP	A-4(1)	SM.
99	98	96	93	90	76	65	26	21	14	8	6	NP	NP	A-2-4(0)	SM.
88	82	72	59	43	9	5	2	2	1	1	0	NP	NP	A-1-a(0)	SP.
85	85	84	82	80	65	56	34	29	20	12	8	NP	NP	A-4(0)	SM.
74	70	63	59	55	44	37	23	19	12	7	5	NP	NP	A-1-b(0)	GM-SM.
85	85	83	82	81	74	67	37	27	16	8	5	NP	NP	A-4(1)	SM.
85	82	81	78	75	64	58	41	34	23	14	10	41	8	A-5(2)	SM.
84	82	80	78	75	66	60	43	38	28	19	13	27	6	A-4(2)	SM-SC.
84	84	82	81	77	66	60	44	36	26	17	13	22	5	A-4(2)	SM-SC.
71	69	67	66	63	53	47	30	25	17	11	8	NP	NP	A-2-4(0)	SM.
84	83	81	78	75	63	55	36	30	21	13	10	22	3	A-4(1)	SM.
80	80	78	76	74	61	53	32	25	18	11	8	NP	NP	A-2-4(0)	SM.

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 used in this table are not suitable for use in naming textural classes for soils.

[3] Based on total material. Laboratory test data corrected for amount discarded in field sampling.

[4] Based on the Classification of Soils and Soil-Aggregate Mixtures for Highway Purposes, A.A.S.H.O. Designation: M 145-49.

[5] Based on the Unified Soil Classification System, Tech. Memo. 3-357, v. 1, Waterways Experiment Station, Corps of Engineers, March 1953.

[6] NP = Nonplastic.

TABLE 3.—*Classification of soils by American*

General classification	Granular materials (35 percent				
Group classification	A-1		A-3	A-2	
	A-1-a	A-1-b		A-2-4	A-2-5
Sieve analysis: Percent passing—					
No. 10	50 maximum.				
No. 40	30 maximum.	50 maximum.	51 minimum.		
No. 200	15 maximum.	25 maximum.	10 maximum.	35 maximum.	35 maximum.
Characteristics of fraction passing No. 40 sieve—					
Liquid limit			NP[2]	40 maximum.	41 minimum.
Plasticity index	6 maximum.	6 maximum.	NP[2]	10 maximum.	10 maximum.
Group index	0	0	0	0	0
Usual types of significant constituent materials	Stone fragments, gravel, and sand.	Stone fragments, gravel, and sand.	Fine sand.	Silty gravel and sand.	Silty gravel and sand.
General rating as subgrade	Excellent to good.				

[1] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1; ed. 7): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, A.A.S.H.O. Designation: M 145–49.

a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Table 2 also gives compaction (moisture-density) data for the tested soils. If a soil material is compacted at successively higher moisture contents, assuming that the compactive effort remains constant, the density of the compacted material will increase until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed maximum dry density. Moisture-density data are important in earthwork, for as a rule optimum stability is obtained if the soil is compacted to about the maximum dry density, when it is at approximately the optimum moisture content.

Engineering classification systems

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A-1, consisting of gravelly soils of high bearing capacity, to A-7, consisting of clay soils having low strength when wet. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best materials to 20 for the poorest. The group index number is shown in parentheses, following the soil group symbol, in the next to last column of table 2. The principal characteristics according to which soils are classified in this system are shown in table 3.

Some engineers prefer to use the Unified soil classification system (*11*). In this system soil materials are identified as coarse grained (8 classes), fine grained (6 classes), or highly organic. The principal characteristics of the 15 classes of soil are given in table 4. The classification of the tested soils according to the Unified system is given in the last column of table 2.

Soil Engineering Data and Recommendations

Some of the engineering information can be obtained from the soil map and the soil association map. For many details it will be necessary, however, to refer to the text of the report, particularly to the sections entitled Descriptions of Soils, and Geology.

The soil profile descriptions as well as the soil maps should be used in planning detailed surveys at construction sites. These will help the engineer to concentrate on the most suitable soils, indicate sources of sand and gravel, and minimize the number of soil samples needed for laboratory testing.

Soil features affecting highway work

In table 5 the soil materials are described, together with selected characteristics that are significant to engineering. The map symbols and soil names are listed alphabetically in this table.

Table 6 shows the estimated physical properties of the soils in this county. The properties listed have been determined by interpreting information about the soils given elsewhere in the report. The properties listed are

Association of State Highway Officials[1]

or less passing No. 200 sieve)		Silt-clay materials (More than 35 percent passing No. 200 sieve)				
A-2—Continued		A-4	A-5	A-6	A-7	
A-2-6	A-2-7				A-7-5	A-7-6
35 maximum.	35 maximum.	36 minimum.	36 minimum.	36 minimum.	36 minimum.	36 minimum.
40 maixmum. 11 minimum.	41 minimum. 11 minimum.	40 maximum. 10 maximum.	41 minimum. 10 maximum.	40 maximum. 11 minimum.	41 minimum. 11 minimum.[3]	41 minimum. 11 minimum.[3]
4 maximum.	4 maximum.	8 maximum.	12 maximum.	16 maximum.	20 maximum.	20 maximum.
Clayey gravel and sand.	Clayey gravel and sand.	Nonplastic to moderately plastic silty soils.	Highly elastic silts.	Medium plastic clays.	Highly plastic clays.	Highly plastic clays.
Fair to poor.						

[2] NP = Nonplastic.
[3] Plasticity index of A-7-5 subgroup is equal to, or less than, LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

typical of a soil profile representative of the given soil series.

The soil test data in table 2, information taken from the rest of the report, and experience with similar soils in other counties were all used as a basis for preparing table 7. Although some of the soils have not been mapped separately, the engineer can use the tabulated data to determine the approximate engineering characteristics of the undifferentiated soil groups and soil associations shown on the maps.

The engineering soil classifications given in table 2 will not apply to all parts of a mapping unit because the texture (grain size) of glacial and water-deposited materials varies. Also, in establishing the engineering classifications, cobbles and stones, that is, particles larger than 3 inches in diameter, are not considered. Many of the soils derived from glacial till are very stony, and the many large stones interfere with the preparation of the finish, or surface layer, of the earth structure. In some parts of the county, the stones and boulders have been removed from the surface but occur in the subsoil and substratum. In general, the glacial till derived from schist contains fewer stones and cobbles and is finer grained than the till derived from granitic materials.

In this county earthwork should be suspended during the winter so that frozen materials will not be used for fills or for constructing embankments. Work can continue in the shallow soils or in soils that are made up of free-draining sandy and gravelly materials. Proper compaction control is required. The soil series are rated in table 7 according to their suitability for winter grading. For the shallow soils, the rating applies only to the soil material and not to the underlying bedrock.

In table 7 the soils have also been rated as sources of topsoil for embankment slopes, ditches, and cut slopes. Normally, only material from the uppermost layer is used, and the ratings apply only to nonstony soils. Soils that are rated poor or not suitable are too wet, stony, or sandy to be suitable as a source of topsoil.

In addition to the rating as to suitability as a source of topsoil, the soils are also rated in table 7 according to their susceptibility to frost action, and the reduction of stability when wet has also been considered. The ratings are based on the suitability of the sandy and gravelly materials for use as subbase and base courses for pavements. For these estimates (1) sandy-gravelly materials that contain less than 30 percent (by weight) of particles larger than one-fourth inch in size are considered sand, and the materials that contain at least 30 percent of particles larger than one-fourth inch and less than 3 inches in size are considered gravel; (2) a rating of "good" is given to soils that have large amounts of sand and that contain approximately 5 to 10 percent material passing the No. 200 sieve (0.074 mm.), and a similar rating is given soils containing large amounts of gravel not more than 5 percent of which passes the No. 200 sieve; and (3) a rating of "fair" is given to sand that contains approximately 10 to 15 percent passing the No. 200 sieve and to gravel containing approximately 5 to 10 percent passing the No. 200 sieve but which may need to be processed to make the sand or gravel nonsusceptible to frost . The "good" and "fair" deposits of sand or gravel must be extensive.

TABLE 4.—*Characteristics of soil groups in Unified*

Major divisions	Group symbol	Soil description	Value as foundation material[2]	Value as base course directly under bituminous pavement	Value for embankments
Coarse-grained soils (*less than 50 percent passing, No. 200 sieve*):					
Gravels and gravelly soils (*more than half of coarse fraction retained on No. 4 sieve*).	GW	Well-graded gravels and gravel-sand mixtures; little or no fines.	Excellent	Good	Very stable; use in pervious shells of dikes and dams.
	GP	Poorly graded gravels and gravel-sand mixtures; little or no fines.	Good to excellent	Poor to fair	Reasonably stable; use in pervious shells of dikes and dams.
	GM	Silty gravels and gravel-sand-silt mixtures.	Good	Poor to good	Reasonably stable; not particularly suited to shells, but may be used for impervious cores or blankets.
	GC	Clayey gravels and gravel-sand-clay mixtures.	Good	Poor	Fairly stable; may be used for impervious core.
Sands and sandy soils (*more than half of coarse fraction passing No. 4 sieve*).	SW	Well-graded sands and gravelly sands; little or no fines.	Good	Poor	Very stable; may be used in pervious sections; slope protection required.
	SP	Poorly graded sands and gravelly sands; little or no fines.	Fair to good	Poor to not suitable.	Reasonably stable; may be used in dike section having flat slopes.
	SM	Silty sands and sand-silt mixtures.	Fair to good	Same	Fairly stable; not particularly suited to shells, but may be used for impervious cores or dikes.
	SC	Clayey sands and sand-clay mixtures.	Fair to good	Not suitable	Fairly stable; use as impervious core for flood-control structures.
Fine-grained soils (*more than 50 percent passing No. 200 sieve*):					
Silts and clays (*liquid limit of 50 or less*).	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, and clayey silts of slight plasticity.	Fair to poor	Not suitable	Poor stability; may be used for embankments if properly controlled.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, and lean clays.	Fair to poor	Not suitable	Stable; used in impervious cores and blankets.
	OL	Organic silts and organic clays having low plasticity.	Poor	Not suitable	Not suitable for embankments.
Silts and clays (*liquid limit greater than 50*).	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, and elastic silts.	Poor	Not suitable	Poor stability; use in core of hydraulic fill dam; not desirable in rolled fill construction.
	CH	Inorganic clays having high plasticity and fat clays.	Poor to very poor	Not suitable	Fair stability on flat slopes; use in thin cores, blankets, and dike sections of dams.
	OH	Organic clays having medium to high plasticity and organic silts.	Poor to very poor	Not suitable	Not suitable for embankments.
Highly organic soils	Pt	Peat and other highly organic soils.	Not suitable	Not suitable	Not used in embankments,

[1] Based on information in the Unified Soil Classification System, Tech. Memo. No. 3-357, vols. 1, 2, and 3. Waterways Experiment Station, Corps of Engineers, 1953. Ratings and ranges in test values are for guidance only. Design should be based on field survey and test of samples from construction site.

[2] Ratings are for subgrade and subbases for flexible pavement.

soil classification system[1]

Compaction: characteristics and recommended equipment	Approximate range in A.A.S.H.O. maximum dry density[3]	Field (in-place) CBR	Subgrade modulus k	Drainage characteristics	Comparable groups in A.A.S.H.O. classification
	Lb./cu. ft.		*Lb./sq. in./in.*		
Good; use crawler-type tractor, pneumatic-tire roller, or steel-wheel roller.	125–135	60–80	300+	Excellent	A–1.
Same	115–125	25–60	300+	Excellent	A–1.
Good, but needs close control of moisture; use pneumatic-tire or sheepsfoot roller.	120–135	20–80	200–300+	Fair to practically impervious.	A–1 or A–2.
Fair; use pneumatic-tire or sheepsfoot roller	115–130	20–40	200–300	Poor to practically impervious.	A–2.
Good; use crawler-type tractor or pneumatic-tire roller.	110–130	20–40	200–300	Excellent	A–1.
Same	100–120	10–25	200–300	Excellent	A–1 or A–3.
Good, but needs close control of moisture; use pneumatic-tire or sheepsfoot roller.	110–125	10–40	200–300	Fair to practically impervious.	A–1, A–2, or A–4.
Fair; use pneumatic-tire roller or sheepsfoot roller.	105–125	10–20	200–300	Poor to practically impervious.	A–2, A–4, or A–6.
Good to poor; close control of moisture is essential; use pneumatic-tire or sheepsfoot roller.	95–120	5–15	100–200	Fair to poor	A–4, A–5, or A–6.
Fair to good; use pneumatic-tire or sheepsfoot roller.	95–120	5–15	100–200	Practically impervious	A–4, A–6, or A–7.
Fair to poor; use sheepsfoot roller[4]	80–100	4–8	100–200	Poor	A–4, A–5, A–6, or A–7.
Poor to very poor; use sheepsfoot roller[4]	70–95	4–8	100–200	Fair to poor	A–5 or A–7.
Fair to poor; use sheepsfoot roller[4]	75–105	3–5	50–100	Practically impervious	A–7.
Poor to very poor; use sheepsfoot roller[4]	65–100	3–5	50–100	Practically impervious	A–5 or A–7.
dams or subgrades for pavements				Fair to poor	None.

[3] Determined in accordance with test designation: T 99–49, A.A.S.H.O.

[4] Pneumatic-tire rollers may be advisable, particularly when moisture content is higher than optimum.

TABLE 5.—*List of soil mapping units and some characteristics significant to engineering*

Map symbol	Soil name	Selected characteristics significant to engineering			
		Natural drainage	Depth to seasonally high water table	Depth to bedrock	Soil material and type of deposit
			Feet	*Feet*	
Aa Ab Ac	Acton and Scituate sandy loams, 0 to 8 percent slopes. Acton and Scituate sandy loams, 0 to 3 percent slopes. Acton and Scituate sandy loams, 3 to 8 percent slopes.	Moderately good	1–1½	(1)	About 2½ feet of SM or SC (A–2 or A–4) derived from sandy glacial till that contains granitic stones, cobbles, and boulders. Internal drainage somewhat retarded by seasonally high water table. Subsoil layers waterlogged during wet seasons. The Scituate soil is developed on compact glacial till.
Ad Ae Af	Acton and Scituate stony sandy loams, 0 to 8 percent slopes. Acton and Scituate stony sandy loams, 0 to 3 percent slopes. Acton and Scituate stony sandy loams, 3 to 8 percent slopes.	Moderately good	1–1½	(1)	Same as Acton and Scituate sandy loams except content of stones, cobbles, and boulders is greater than 10 percent.
Ba	Balch and Littlefield peats	Very poor	(2)	(1)	3 to 50 feet of peat in upland or terrace depressions.
Bb	Balch and Littlefield peats, shallow	Very poor	(2)	(1)	1½ to 3 feet of peat in upland or terrace depressions.
Bc Bd	Barnstead fine sandy loam and sandy loam, 3 to 8 percent slopes. Barnstead fine sandy loam and sandy loam, 8 to 25 percent slopes.	Good to somewhat excessive	5+	(1)	About 2 feet of SM or SC (A–2 or A–4) over stratified sand and gravel on glacial outwash terraces or plains derived from granite gneiss and mica schist.
Be	Biddeford silty clay loam, 0 to 3 percent slopes.	Very poor	(2)	(1)	CL or CH (A–4, A–6, or A–7) derived from marine or glaciolacustrine sediments. The 6- to 8-inch surface layer has high content of organic matter; there is a muck surface layer, less than 1½ feet thick, in places.
Bf Bg Bh Bk	Brimfield-Brookfield rocky sandy loams, 3 to 15 percent slopes. Brimfield-Brookfield rocky sandy loams, 3 to 8 percent slopes. Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes. Brimfield-Brookfield rocky sandy loams, 15 to 25 percent slopes.	Good to somewhat excessive	(3)	0–2	0 to 2 feet of SM or SC (A–2 or A–4) developed from upland glacial till over mica schist or gneiss bedrock. Stones and boulders on surface and throughout soil. Rock outcrops in many places. Brimfield soil is dominant.
Bn Bo	Brimfield-Brookfield sandy loams, 3 to 8 percent slopes. Brimfield-Brookfield sandy loams, 8 to 15 percent slopes.	Good to somewhat excessive	(3)	1½+	Same as Brimfield-Brookfield rocky sandy loams except there is generally about 1½ feet of micaceous soil over bedrock and fewer stones and boulders. Occasional rock outcrops; deep pockets of Brookfield soils.
Br Bs Bt	Brimfield-Brookfield very rocky very stony sandy loams, 3 to 15 percent slopes. Brimfield-Brookfield very rocky very stony sandy loams, 15 to 25 percent slopes. Brimfield-Brookfield very rocky very stony sandy loams, 25 to 35 percent slopes.	Good to excessive	(3)	0–2	Same as Brimfield-Brookfield rocky sandy loams except that the number of stones and boulders is greater and rock outcrops are more numerous.

See footnotes at end of table.

TABLE 5.—*List of soil mapping units and some characteristics significant to engineering*—Continued

Map symbol	Soil name	Selected characteristics significant to engineering			
		Natural drainage	Depth to seasonally high water table	Depth to bedrock	Soil material and type of deposit
			Feet	*Feet*	
Bu	Brookfield sandy loam, 0 to 3 percent slopes.	Good	3+	(1)	Mainly SM or SC (A–2 or A–4) developed on loose upland glacial till derived principally from mica schist. Stones and boulders are in subsoil and substratum.
Bv	Brookfield sandy loam, 3 to 15 percent slopes.				
Bw	Brookfield sandy loam, 3 to 8 percent slopes.				
Bx	Brookfield sandy loam, 8 to 15 percent slopes.				
By	Brookfield sandy loam, 15 to 25 percent slopes.				
Bz	Brookfield stony sandy loam, 0 to 15 percent slopes.	Good	3+	(1)	Same as Brookfield sandy loams except that stones and boulders of schist and granite are on surface and throughout profile.
Bza	Brookfield stony sandy loam, 0 to 8 percent slopes.				
Bzb	Brookfield stony sandy loam, 8 to 15 percent slopes.				
Bzc	Brookfield stony sandy loam, 15 to 25 percent slopes.				
Bzd	Buxton silt loam, 0 to 3 percent slopes	Moderately good	1–1½	(1)	About 1 foot of ML or CL (A–4 or A–6) over CL or CH (A–6 or A–7). Derived from stratified marine and glaciolacustrine sediments. Level areas are ponded after rains.
Bze	Buxton silt loam, 3 to 8 percent slopes				
Bzf	Buxton silt loam, 3 to 8 percent slopes, severely eroded.				
Bzg	Buxton and Scantic silt loams, 0 to 3 percent slopes.	Moderately good to poor	½–1½	(1)	Same as Buxton silt loams except that the water table is between ½ and 1½ feet of the surface and soils are more plastic or have more organic matter. CH or OH (A–7) occurs in some areas. The Buxton soils predominate in this unit.
Ca	Charlton loam, 0 to 3 percent slopes	Good	3+	(1)	2 to 2½ feet of SM, SC, ML, or CL (A–2, A–4, or A–6) developed from glacial till that is mainly SM or GM (A–1 or A–2) derived principally from mica, schist, and phyllite. Stones and boulders in subsoil and substratum.
Cb	Charlton loam, 3 to 15 percent slopes				
Cc	Charlton loam, 3 to 8 percent slopes				
Cd	Charlton loam, 8 to 15 percent slopes				
Ce	Charlton loam, 15 to 25 percent slopes				
Cf	Charlton loam, 25 to 35 percent slopes				
Cg	Charlton stony loam, 0 to 15 percent slopes.	Good	3+	(1)	Same as Charlton loams except that stones and boulders are on surface and throughout the profile.
Ch	Charlton stony loam, 0 to 8 percent slopes.				
Ck	Charlton stony loam, 8 to 15 percent slopes.				
Cm	Charlton stony loam, 15 to 25 percent slopes.				
Cn	Coastal beach and dune sand	Excessive	(4)	(1)	Loose sand, sand dunes, and beaches along coast.
Ea	Elmwood fine sandy loam, 0 to 3 percent slopes.	Moderately good	1–2	(1)	1½ to 2 feet of SM or SC (A–2 or A–4) sandy deposits overlying marine or glaciolacustrine silty and clayey materials. Perched water table.
Eb	Elmwood fine sandy loam, 3 to 8 percent slopes.				
Fa	Fresh water marsh	Very poor	0	(1)	Areas periodically flooded. Covered dominantly with grasses.

See footnotes at end of table.

TABLE 5.—*List of soil mapping units and some characteristics significant to engineering*—Continued

Map symbol	Soil name	Selected characteristics significant to engineering			
		Natural drainage	Depth to seasonally high water table	Depth to bedrock	Soil material and type of deposit
			Feet	*Feet*	
Ga	Gloucester sandy loam, 0 to 3 percent slopes.	Good	3+	(1)	About 1 foot of SM or SC (A–2 or A–4) over predominantly SM or GM (A–1 or A–2). Developed on upland glacial till derived from granitic gneiss. Some cobbles and stones throughout the profile.
Gb	Gloucester sandy loam, 3 to 8 percent slopes.				
Gc	Gloucester sandy loam, 3 to 15 percent slopes.				
Gd	Gloucester sandy loam, 8 to 15 percent slopes.				
Ge	Gloucester sandy loam, 15 to 25 percent slopes.				
Gf	Gloucester stony sandy loam, 0 to 8 percent slopes.	Good	3+	(1)	Similar to Gloucester sandy loams except that stones and boulders up to 4 feet in diameter are on surface and throughout the profile. Boulders and stones occur at intervals of 5 to 20 feet.
Gg	Gloucester stony sandy loam, 8 to 15 percent slopes.				
Gh	Gloucester stony sandy loam, 0 to 15 percent slopes.				
Gk	Gloucester stony sandy loam, 15 to 25 percent slopes.				
Gm	Gloucester very stony sandy loam, 3 to 15 percent slopes.	Good	3+	(1)	Similar to Gloucester stony sandy loams except that stones and boulders occur at intervals of 2 to 5 feet.
Gn	Gloucester very stony sandy loam, 15 to 25 percent slopes.				
Go	Gloucester and Scituate sandy loams, 0 to 3 percent slopes.	Moderately good to good	1–3+	(1)	Scituate soil consists of about 3 feet of SM or SC (A–2 or A–4) developed on very firm, fine-grained granitic till (SC; A–4). Firm substratum impedes internal drainage; water table perched at depths of 1 to 1½ feet. Gloucester soil similar to Gloucester sandy loams. Stones and boulders occur in subsoil and substratum.
Gp	Gloucester and Scituate sandy loams, 3 to 15 percent slopes.				
Gr	Gloucester and Scituate sandy loams, 3 to 8 percent slopes.				
Gs	Gloucester and Scituate sandy loams, 8 to 15 percent slopes.				
Gt	Gloucester and Scituate sandy loams, 15 to 25 percent slopes.				
Gu	Gloucester and Scituate stony sandy loams, 0 to 15 percent slopes.	Moderately good to good	1–3+	(1)	Similar to Gloucester sandy loams except that stones and boulders are on the surface and throughout the profile.
Gv	Gloucester and Scituate stony sandy loams, 3 to 8 percent slopes.				
Gw	Gloucester and Scituate stony sandy loams, 8 to 15 percent slopes.				
Gx	Gloucester and Scituate stony sandy loams, 15 to 25 percent slopes.				
Ha	Hinckley loamy sand, 0 to 3 percent slopes.	Excessive	5+	(1)	1 to 1½ feet of GM or SM (A–1 or A–2) over stratified sand and gravel. Contains some cobbles developed from glaciofluvial deposits derived largely from granite, gneiss, and schist.
Hb	Hinckley loamy sand, 3 to 8 percent slopes.				
Hc	Hinckley loamy sand, 8 to 35 percent slopes.				
Hd	Hinckley stony loamy sand, 3 to 25 percent slopes.	Excessive	5+	(1)	Similar to the Hinckley loamy sands except that cobbles and stones occur on the surface and throughout the profile.

See footnotes at end of table.

TABLE 5.—*List of soil mapping units and some characteristics significant to engineering*—Continued

Map symbol	Soil name	Selected characteristics significant to engineering			
		Natural drainage	Depth to seasonally high water table	Depth to bedrock	Soil material and type of deposit
			Feet	*Feet*	
He	Hollis-Charlton loams, 0 to 3 percent slopes.	Good to somewhat excessive	(3)	0–1½+	2 feet or less of ML or CL (A–4 or A–6) derived from glacial till over shattered mica schist or phyllite. Consolidated bedrock at depths of 3 to 4 feet. Deep pockets of Charlton soils occur in many places.
Hf	Hollis-Charlton loams, 3 to 8 percent slopes.				
Hg	Hollis-Charlton loams, 8 to 15 percent slopes.				
Hh	Hollis-Charlton loams, 15 to 25 percent slopes.				
Hk	Hollis-Charlton rocky loams, 3 to 15 percent slopes.	Good to somewhat excessive	(3)	0–2	Similar to Hollis-Charlton loams except that in 50 percent or more of soil area is less than 2 feet deep over bedrock; outcrops occur in many places.
Hm	Hollis-Charlton rocky loams, 3 to 8 percent slopes.				
Hn	Hollis-Charlton rocky loams, 8 to 15 percent slopes.				
Ho	Hollis-Charlton rocky loams, 15 to 25 percent slopes.				
Hp	Hollis-Charlton very rocky very stony loams, 3 to 15 percent slopes.	Good to excessive	(3)	0–2	Stones and boulders on surface and in profile; bedrock outcrops more numerous than in Hollis-Charlton rocky loams.
Hr	Hollis-Charlton very rocky very stony loams, 15 to 25 percent slopes.				
Hs	Hollis-Charlton very rocky very stony loams, 25 to 35 percent slopes.				
Ja	Jaffrey loamy sand, 0 to 3 percent slopes.	Good	5+	(1)	About 2 feet of SM (A–2) or GM (A–1 or A–2) over stratified sand and gravel developed from glaciofluvial deposits derived from granite, gneiss, and mica schist.
Jb	Jaffrey loamy sand, 3 to 8 percent slopes.				
Jc	Jaffrey loamy sand, 8 to 35 percent slopes.				
La	Leicester and Ridgebury fine sandy loams, 0 to 3 percent slopes.	Poor	½	(1)	About 2½ feet of SM or SC (A–2 or A–4) developed on glacial till from rocks of granite or schist. Substratum of Leicester soil is loose to firm and that of the Ridgebury soil is compact and platy. Stones occur in subsoil and substratum.
Lb	Leicester and Ridgebury fine sandy loams, 3 to 8 percent slopes.				
Lc	Leicester, Ridgebury, and Whitman stony fine sandy loams, 0 to 3 percent slopes.	Poor to very poor	0–½	(1)	Similar to Leicester and Ridgebury fine sandy loams except that stones are on the surface and in the profile. In places, the water table is at the ground surface.
Ld	Leicester, Ridgebury, and Whitman stony fine sandy loams, 3 to 8 percent slopes.				
Ma	Melrose fine sandy loam, 0 to 3 percent slopes.	Good	3+	(1)	About 2½ to 3½ feet of SM or SC (A–2 or A–4) developed from sandy deposits overlying marine or glaciolacustrine silty and clayey materials ML, MH, or CH (A–6 or A–7). Depth to silt and clay ranges from 2 to 5 feet. Internal drainage retarded by clay strata.
Mb	Melrose fine sandy loam, 3 to 8 percent slopes.				
Mc	Melrose fine sandy loam, 8 to 15 percent slopes.				

See footnotes at end of table.

TABLE 5.—*List of soil mapping units and some characteristics significant to engineering*—Continued

Map symbol	Soil name	Selected characteristics significant to engineering			
		Natural drainage	Depth to seasonally high water table	Depth to bedrock	Soil material and type of deposit
			Feet	*Feet*	
Md	Merrimac fine sandy loam, 0 to 3 percent slopes.	Good	5+	(1)	About 2 feet of GM, SM, or SC (A–1, A–2, or A–4) over stratified sand and gravel on glacial outwash terraces or plains derived from granite, gneiss, or schist.
Me	Merrimac fine sandy loam, 3 to 8 percent slopes.				
Mf	Merrimac fine sandy loam, 8 to 15 percent slopes.				
Mg	Merrimac fine sandy loam, 15 to 25 percent slopes.				
Mh	Merrimac fine sandy loam and sandy loam, 0 to 3 percent slopes.				
Mk	Merrimac fine sandy loam and sandy loam, 3 to 8 percent slopes.				
Mm	Merrimac fine sandy loam and sandy loam, 8 to 25 percent slopes.				
Mn	Merrimac sandy loam, 0 to 3 percent slopes.	Somewhat excessive	5+	(1)	Similar to the Merrimac fine sandy loams except that the surface texture is coarser.
Mo	Merrimac sandy loam, 3 to 8 percent slopes.				
Mp	Merrimac sandy loam, 8 to 15 percent slopes.				
Mr	Merrimac sandy loam, 15 to 25 percent slopes.				
Oa	Ondawa fine sandy loam, 0 to 3 percent slopes.	Good	0	(1)	About 2½ feet of SM or SC (A–2 or A–4) over stratified sand and gravel on flood plains; flooded at times.
Pa	Paxton loam, 0 to 3 percent slopes	Good	1½+	(1)	Mostly SM (A–2 or A–4) deep, compact, platy, upland till derived from mica schist, gneiss, and granite. Stones and boulders have generally been removed from ground surface but are common throughout the profile. Internal drainage restricted by compact platy substratum that occurs at depths of 1½ to 2 feet. On steep slopes water seeps out over this layer.
Pb	Paxton loam, 3 to 15 percent slopes				
Pc	Paxton loam, 3 to 8 percent slopes				
Pd	Paxton loam, 8 to 15 percent slopes				
Pe	Paxton loam, 15 to 25 percent slopes				
Pf	Paxton stony loam, 0 to 15 percent slopes.	Good	1½+	(1)	Has more stones on ground surface than Paxton loams.
Pg	Paxton stony loam, 3 to 8 percent slopes.				
Ph	Paxton stony loam, 8 to 15 percent slopes.				
Pk	Paxton stony loam, 15 to 25 percent slopes.				
Pm	Podunk fine sandy loam, 0 to 3 percent slopes.	Moderately good	0	(1)	About 3 feet of SM or SC (A–2 or A–4) over stratified sand and gravel on alluvial flood plains. Periodically flooded.
Ra	Rumney and Saco fine sandy loams, 0 to 3 percent slopes.	Poor to very poor	0	(1)	1 to 1½ feet of SM (A–2 or A–4) to ML, CL, or MH (A–4, A–6, or A–7) over stratified sand and gravel on flood plains. Derived mainly from granite but contains some gneiss and schist. Subject to frequent flooding. Surface layer of Saco soil has high content of organic matter.
Rb	Rumney and Saco silt loams, 0 to 3 percent slopes.				
Sa	Scantic silt loam, 0 to 3 percent slopes	Poor	½	(1)	ML, CL, or CH (A–4, A–6, or A–7) developed from glaciolacustrine and marine sediments. Very slow permeability. In places the Biddeford soil has a muck layer less than 1½ feet thick on surface.
Sb	Scantic silt loam, 3 to 8 percent slopes				
Sc	Scantic silt loam and Biddeford silty clay loam, 0 to 3 percent slopes.	Poor to very poor	0–½	(1)	

See footnotes at end of table.

TABLE 5.—*List of soil mapping units and some characteristics significant to engineering*—Continued

Map symbol	Soil name	Selected characteristics significant to engineering			
		Natural drainage	Depth to seasonally high water table	Depth to bedrock	Soil material and type of deposit
			Feet	*Feet*	
Sd	Scarboro fine sandy loam, 0 to 3 percent slopes.	Very poor	0	(1)	1 to 2 feet of SM or SC (A–2 or A–4) over loose sand on glacial outwash or stream terraces. In places a muck layer, less than 1½ feet thick, covers surface.
Se	Shapleigh-Gloucester sandy loams, 0 to 8 percent slopes.	Good	(3)	1½+	1 to 2 feet of SM or SC (A–2 or A–4) derived from sandy or gravelly stony glacial till over bedrock dominantly of granite or gneiss. In many places there are deep pockets of Gloucester soil. Occasional rock outcrops.
Sf	Shapleigh-Gloucester sandy loams, 8 to 15 percent slopes.				
Sg	Shapleigh-Gloucester sandy loams, 15 to 35 percent slopes.				
Sh	Shapleigh-Gloucester rocky sandy loams, 3 to 15 percent slopes.	Good to somewhat excessive	(3)	0–2	Similar to Shapleigh-Gloucester sandy loams except that depth to bedrock is somewhat less; in many places numerous stones occur throughout the profile, and there are a greater number of outcrops.
Sk	Shapleigh-Gloucester rocky sandy loams, 15 to 35 percent slopes.				
Sm	Shapleigh-Gloucester very rocky very stony sandy loams, 3 to 15 percent slopes.				
Sn	Shapleigh-Gloucester very rocky very stony sandy loams, 15 to 35 percent slopes.				
So	Sudbury fine sandy loam, 0 to 8 percent slopes.	Moderately good	1–1½	(1)	About 2½ feet of SM, SC, or SP (A–2 or A–3) over stratified sand and gravel on glacial outwash terraces or plains. Derived from granite and schist.
Sp	Sudbury fine sandy loam, 0 to 3 percent slopes.				
Sr	Sudbury fine sandy loam, 3 to 8 percent slopes.				
Ss	Suffield silt loam, 8 to 15 percent slopes	Good	3+	(1)	About 2 feet of ML or CL (A–4, A–6, or A–7) developed on stratified marine and glaciolacustrine deposits of silt and clay. Internal drainage retarded by clay substratum.
St	Suffield silt loam, 8 to 15 percent slopes, severely eroded.				
Su	Suffield silt loam, 15 to 25 percent slopes.				
Sv	Suffield silt loam, 15 to 25 percent slopes, severely eroded.				
Sw	Suffield silt loam, 25 to 35 percent slopes.				
Sy	Sutton and Woodbridge loams, 0 to 8 percent slopes.	Moderately good	1–1½	(1)	About 1½ feet of ML or CL (A–4 or A–6) on upland glacial till derived mainly from mica schist. In Woodbridge soil internal drainage retarded by compact platy substratum. Contains some stones in subsoil and substratum. Seepage occurs over this compact layer.
Sz	Sutton and Woodbridge loams, 0 to 3 percent slopes.				
Sza	Sutton and Woodbridge loams, 3 to 8 percent slopes.				
Szb	Sutton and Woodbridge stony loams, 0 to 8 percent slopes.	Moderately good	1–1½	(1)	Same as Sutton and Woodbridge loams except that stones are on surface.

See footnotes at end of table.

TABLE 5.—*List of soil mapping units and some characteristics significant to engineering*—Continued

Map symbol	Soil name	Selected characteristics significant to engineering			
		Natural drainage	Depth to seasonally high water table	Depth to bedrock	Soil material and type of deposit
			Feet	*Feet*	
Szc	Swanton fine sandy loam, 0 to 3 percent slopes.	Poor	½	(1)	2 to 3 feet of SM or SC (A–2 or A–4) overlying stratified silty or clayey glaciolacustrine or marine sediments. In places seepage occurs at top of clay layer.
Szd	Swanton fine sandy loam, 3 to 8 percent slopes.				
Ta	Tidal marsh	Very poor	0	(1)	2½ to 3 feet of SM (A–2 or A–4) over sand. Flats covered by high tide. Fibrous surface mat.
Wa	Walpole fine sandy loam, 0 to 3 percent slopes.	Poor	½	(1)	1 to 2 feet of SM or SC (A–2 or A–4) over stratified sand and gravel on glacial outwash terraces or plains; principally of granitic or schistose origin.
Wb	Walpole fine sandy loam, 3 to 8 percent slopes.				
Wc	Walpole and Scarboro fine sandy loams, 0 to 5 percent slopes.	Poor to very poor	0–½	(1)	Same as the Walpole and Scarboro fine sandy loams mapped separately.
Wd	Warwick gravelly loam, 0 to 3 percent slopes.	Good	5+	(1)	About 1½ feet of GC or GM (A–1 or A–2) over beds of sand, gravel, and cobbles on glaciofluvial deposits derived from schist and phyllite. Cobbles have slaty cleavage.
We	Warwick gravelly loam, 3 to 15 percent slopes.				
Wf	Warwick gravelly loam, 3 to 8 percent slopes.				
Wg	Warwick gravelly loam, 8 to 15 percent slopes.				
Wh	Waterboro muck	Very poor	0	(1)	3 feet or more of muck overlying glacial till or outwash sand and gravel.
Wk	Waterboro muck, shallow	Very poor	0	(1)	Less than 3 feet of muck overlying glacial till or outwash sand and gravel.
Wm	Whately fine sandy loam, 0 to 3 percent slopes.	Very poor	0	(1)	1½ to 3½ feet of SM or SC (A–2 or A–4) overlying marine or glaciolacustrine silty and clayey deposits. Clay substratum retards internal drainage and causes lateral movement of water.
Wn	Whitman fine sandy loam, 0 to 3 percent slopes.	Very poor	0	(1)	SM or SC (A–2 or A–4) contains many stone fragments; occurs in depressions on glacial till uplands. Has thin surface layer of muck in places.
Wo	Whitman fine sandy loam, 3 to 8 percent slopes.				
Wp	Windsor loamy sand, 0 to 3 percent slopes.	Excessive	5+	(1)	2 to 3½ feet of SM (A–2) over SP (A–3) on low-lying terraces; derived from granite and schist. In places has a clay substratum at depths of 6 to 10 feet. The sand is subject to blowing.
Wr	Windsor loamy sand, 3 to 8 percent slopes.				
Ws	Windsor loamy sand, 8 to 25 percent slopes.				

[1] Undulating character of bedrock prevents any precise estimate of depth.
[2] At surface of soil.
[3] Determined by depth to underlying bedrock.
[4] Depth to water table in dune sand is greater than 5 feet. Coastal beach is under water at high tide.

TABLE 6.—*Estimated physical properties of the soils*

Soil series	Depth from surface (typical profile)	Classification		Permeability	Structure	pH	Shrink-swell potential
		Unified	A.A.S.H.O.				
	Inches			*Inches per hour*			
Acton	0 to 10	SM or SC	A-2 or A-4	0.8 to 2.5	Very fine granular	4.5 to 6.0	Moderate to low.
	10 to 30	SM or SC	A-2 or A-4	.8 to 2.5	Single grain	5.1 to 6.0	Moderate to low.
	30+	SM or SC	A-2 or A-4	.8 to 2.5	Single grain	5.1 to 6.0	Moderate.
Barnstead	0 to 7	SM or SC	A-2 or A-4	2.5 to 5	Granular	4.5 to 5.0	Moderate to low.
	7 to 24	SM or SC	A-2 or A-4	5 to 10	Granular	4.5 to 5.0	Low.
	24+	SP, GP, or GM.	A-1, A-2, or A-3.	10+	Single grain	4.5 to 5.0	Low to none.
Biddeford	0 to 5	CL or MH	A-6 or A-7	.05 to .2	Coarse granular	5.1 to 5.5	High to moderate.
	5 to 12	MH or CH	A-7	.05 to .2	Coarse blocky	5.1 to 5.5	High.
	12+	MH or CH	A-7	(1)	Coarse blocky	5.6 to 6.0	High.
Brimfield	0 to 20	SM or SC	A-2 or A-4	.8 to 2.5	Fine granular	4.5 to 5.0	Low.
Brookfield	0 to 18	SM or SC	A-2 or A-4	.2 to .8	Medium granular	5.1 to 5.5	Low.
	18 to 23	SM	A-2	.8 to 2.5	Medium granular	5.1 to 5.5	Low.
	23+	SM	A-2	.8 to 2.5	Single grain	5.1 to 5.5	Low.
Buxton	0 to 12	ML or CL	A-4 or A-6	.2 to .8	Fine granular	5.1 to 5.5	Moderate.
	12 to 15	CL or CH	A-6 or A-7	.05 to .2	Fine granular	5.1 to 5.5	High.
	15 to 24	CH	A-7	(1)	Blocky	5.6 to 6.0	High.
	24+	ML to CH	A-4 to A-7	(1)	Coarse blocky	6.1 to 7.3	High to moderate.
Charlton	0 to 24	SM	A-2, A-4, or A-5.	.8 to 2.5	Granular	5.1 to 5.5	Moderate to low.
	24+	SM or GM	A-1 or A-2	.8 to 2.5	Platy	5.1 to 5.5	Low.
Elmwood	0 to 20	SM	A-2 or A-4	5 to 10	Single grain	5.1 to 6.0	Moderate to low.
	20+	ML to CH	A-4 to A-7	.05 to .2	Blocky or platy	5.1 to 6.5	High to moderate.
Gloucester	0 to 14	SM	A-2	.8 to 2.5	Fine granular	5.1 to 5.5	Low.
	14 to 30	SM or GM	A-1 or A-2	2.5 to 5	Fine granular	5.1 to 5.5	Low.
	30+	SM or GM	A-1 or A-2	5 to 10	Single grain	5.1 to 5.5	Low.
Hinckley	0 to 15	SM or GM	A-1 or A-2	10+	Fine granular	4.5 to 5.5	Low.
	15+	SP, SM, GP, or GM.	A-1, A-2, or A-3.	10+	Single grain	5.1 to 5.5	Low to none.
Hollis	0 to 17	ML or CL	A-4, A-5, or A-6.	.8 to 2.5	Very fine granular	5.1 to 5.5	Moderate.
	17 to 24	SM or SC	A-2 or A-4	.8 to 2.5	Fine granular	5.1 to 5.5	Low.
Jaffrey	0 to 7	SM	A-2	2.5 to 5	Very fine granular	4.5 to 5.5	Low.
	7 to 24	SM or GM	A-1 or A-2	2.5 to 5	Single grain	5.1 to 5.5	Low.
	24+	SP, SM, GP or GM.	A-1, A-2, or A-3.	10+	Single grain	5.1 to 5.5	Low to none
Leicester	0 to 14	SM or SC	A-2 or A-4	.2 to .8	Fine granular	5.1 to 5.5	Moderate to low.
	14 to 30	SM or SC	A-2 or A-4	.8 to 2.5	Single grain	5.1 to 5.5	Low.
	30+	SM	A-2 or A-4	2.5 to 5	Single grain	5.1 to 5.5	Low.
Melrose	0 to 24	SM or SC	A-2 or A-4	.8 to 2.5	Fine granular	4.5 to 5.5	Moderate to low.
	24 to 30	SM or SP	A-2	5 to 10	Single grain	5.6 to 6.0	Low to none.
	30+	ML to CH	A-4 to A-7	.05 to .2	Coarse blocky	5.6 to 7.3	High.
Merrimac	0 to 9	SM or SC	A-1 or A-2	2.5 to 10	Medium granular	5.1 to 5.5	Low.
	9 to 14	SM	A-1 or A-2	5 to 10	Medium granular	5.1 to 5.5	Low.
	14 to 27	SM, SW, or SP.	A-2 or A-3	10+	Fine granular	4.5 to 5.0	Low to none.
	27+	SP, SM, GW, or GM.	A-1, A-2, or A-3.	10+	Single grain	4.5 to 5.0	Low to none.
Paxton	0 to 15	SM	A-4 or A-5	.8 to 2.5	Medium granular	5.1 to 5.5	Moderate to low.
	15 to 21	SM or SC	A-2 or A-4	.8 to 2.5	Medium granular	4.5 to 5.0	Moderate to low.
	21+	SM or SC	A-2 or A-4	.05 to .2	Platy	4.5 to 5.0	Moderate to low.
Ridgebury	0 to 7	SM or SC	A-2 or A-4	.8 to 2.5	Fine granular	5.1 to 5.5	Moderate to low.
	7 to 24	GM	A-1 or A-2	.8 to 2.5	Fine granular	5.1 to 5.5	Low.
	24 to 40	GM	A-1 or A-2	.2 to .8	Coarse platy	5.1 to 5.5	Low.
Rumney	0 to 7	SM or SC	A-2 or A-4	5 to 10	Fine granular	4.5 to 5.5	Moderate to low.
	7 to 20	SM or SC	A-2 or A-4	5 to 10	Single grain	5.1 to 5.5	Moderate to low.
	20+	SM, SP, or GM.	A-1, A-2, or A-3.	10+	Single grain	5.1 to 5.5	Low to none.
Saco	0 to 10	ML or CL	A-4 or A-6	.05 to .2	Fine granular	5.1 to 5.5	Moderate.
	10+	ML to CH	A-4 to A-7	.05 to .2	Massive	5.6 to 7.3	High to moderate.
Scantic	0 to 7	ML or CL	A-4 or A-6	.2 to .8	Fine granular	5.1 to 5.5	Moderate.
	7 to 20	CL or CH	A-6 or A-7	.05 to .2	Blocky	5.1 to 5.5	High.
	20 to 32	CH	A-7	(1)	Platy or blocky	5.1 to 5.5	High.
	32 to 36	CL or CH	A-6 or A-7	.05 to .2	Blocky	5.6 to 6.0	High.
Scarboro	0 to 12	SM or SC	A-2 or A-4	5 to 10	Fine granular	4.5 to 5.5	Moderate to low.
	12+	SP, SM, GP, or GM.	A-1, A-2, or A-3.	10+	Single grain	5.6 to 6.0	Low to none.
Shapleigh	0 to 24	SM or SC	A-2 or A-4	.8 to 2.5	Granular	4.5 to 6.0	Low.
	24 to 30	SM or SC	A-2 or A-4	.8 to 2.5	Granular	5.1 to 6.0	Low.

See footnote at end of table.

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TABLE 6.—*Estimated physical properties of the soils*—Continued

Soil series	Depth from surface (typical profile)	Classification		Permeability	Structure	pH	Shrink-swell potential
		Unified	A.A.S.H.O.				
	Inches			*Inches per hour*			
Sudbury	0 to 11	SM or SC	A–2 or A–4	2.5 to 5	Fine granular	5.1 to 5.5	Low.
	11 to 20	SM	A–2	5 to 10	Single grain	5.1 to 5.5	Low.
	20 to 30	SM or SP	A–2 or A–3	10+	Single grain	5.1 to 5.5	Low to none.
	30+	SP, SM, GP, or GM.	A–1, A–2, or A–3.	10+	Single grain	5.1 to 5.5	Low to none.
Suffield	0 to 12	ML or CL	A–4 or A–6	.2 to .8	Fine granular	5.1 to 5.5	Moderate.
	12 to 24	CL or CH	A–6 or A–7	.05 to .2	Blocky	5.1 to 6.5	High.
	24+	ML to CH	A–4 to A–7	(1)	Blocky	6.1 to 7.3	High to moderate.
Sutton	0 to 20	SC, ML, or CL.	A–4 or A–6	.8 to 2.5	Fine granular	5.1 to 6.0	Moderate.
	20+	SM or SC	A–2 or A–4	.8 to 2.5	Platy	5.6 to 6.5	Low.
Swanton	0 to 30	SM or SC	A–2 or A–4	5 to 10	Blocky	4.5 to 5.0	Moderate.
	30 to 48	ML to CH	A–4 to A–7	.05 to .2	Platy	5.1 to 6.0	High.
Walpole	0 to 4	SM or SC	A–2 or A–4	5 to 10	Granular	4.5 to 5.0	Moderate to low.
	4 to 24	SM or SC	A–2 or A–4	5 to 10	Granular	5.1 to 5.5	Low to moderate.
	24+	SP, SM, GP, or GM.	A–1, A–2, or A–3.	10+	Single grain	5.1 to 5.5	Low to none.
Warwick	0 to 14	GM or GC	A–1 or A–2	2.5 to 5	Granular	5.1 to 5.5	Low.
	14 to 17	SM or GM	A–1 or A–2	5 to 10	Fine granular	5.1 to 6.0	Low.
	17 to 19	SM or GM	A–1 or A–2	5 to 10	Single grain	5.6 to 6.5	Low.
	19+	SP, SM, GP, or GM.	A–1, A–2, or A–3.	10+	Single grain	5.6 to 6.0	Low to none.
Whately	0 to 18	SM or SC	A–2 or A–4	5 to 10	Granular	4.5 to 5.0	Moderate to low.
	18+	ML to CH	A–4 to A–7	.05 to .2	Platy	5.1 to 6.0	Very high.
Whitman	0 to 8	SM or SC	A–2 or A–4	5 to 10	Granular	4.5 to 5.0	Low.
	8+	SM or SC	A–2 or A–4	5 to 10	Single grain	4.5 to 5.0	Low.
Windsor	0 to 8	SM	A–2	5 to 10	Granular	5.1 to 5.5	Low.
	8 to 20	SM	A–2	5 to 10	Granular	5.1 to 5.5	Low.
	20 to 27	SM	A–2	10+	Single grain	5.1 to 5.5	Low.
	27+	SP or SM	A–3	10+	Single grain	5.1 to 5.5	Low to none.
Woodbridge	0 to 21	ML or CL	A–4 or A–6	.8 to 2.5	Fine granular	4.5 to 5.5	Moderate.
	21+	SM or GM	A–1, A–2, or A–4.	.2 to .8	Platy	5.1 to 6.0	Low.

[1] Less than 0.05.

Sandy or gravelly soils are rated "poor" if they (1) contain slightly larger amounts passing the No. 200 sieve than indicated for "good" or "fair" ratings, or have only small deposits of these materials, or (2) have suitable material that is difficult to obtain because the water table is high or because the soils are covered with an overburden of fine-grained materials. According to these criteria, the Barnstead and Merrimac soils are rated "good" as sources of both sand and gravel. Even if the material is given a good rating, however, considerable exploration may be necessary to find material that fulfills the requirements for specific construction.

The soils that are rated in table 7 as having high susceptibility to frost action are soils that are moderately well drained to very poorly drained.

A perched water table occurs in some soils, as the Elmwood, Gloucester and Scituate, Paxton, Melrose, Suffield, Sutton, and Woodbridge. When roads are to be constructed on such soils, a survey should be made to determine the need for underdrains. In highway cuts some underdrains will be needed in the roadway sections. The requirements for underdrains should be determined by field exploration.

Seepage in back slopes of roadcuts may cause the overlaying material to slump or slide. If the perched water table is only at a shallow depth below the pavement, differential volume change may occur, particularly within the depth of freezing, and the decrease in bearing capacity of the saturated or thawed foundation material may cause the pavement to deteriorate. Pockets of wet, fine-grained soil material should be removed and replaced by coarser grained material.

Some of the glacial till consists of fine sand and silt that is susceptible to frost heave. Where such material occurs, a sufficient thickness of free-draining material should be used in the highway subgrade to prevent detrimental heaving of the pavement. If there are pockets of fine-grained soil material in the coarse-grained moraine, differential frost heave can be prevented by mixing the fine-grained with the coarse-grained material so that heaving will be uniform, or it can be prevented by using a sufficient thickness of very permeable sandy gravel or coarse sand in the upper part of the subgrade.

In deep glacial till, bedrock may be exposed in deep cuts. In shallow glacial till the gradeline should be kept high so that the excavation of the bedrock will be minimized and seepage, which occurs at the point where the till and bedrock meet, will be avoided. Systems to provide adequate surface drainage and underdrainage should be provided, and coarse-grained soil materials should be used in the upper part of the subgrade.

Gravelly soils, if properly compacted, form good subgrades for roads. Underdrains may be needed wherever glaciolacustrine or marine sediments underlie these coarser grained materials and the roadcuts are deep

TABLE 7.—*Soil features affecting highway work*

Soil series	Adaptability to winter grading	Suitability as source of—			Susceptibility to frost action
		Topsoil[1]	Sand	Gravel	
Acton and Scituate	Poor to not adapted	Fair	Not suitable	Not suitable	High.
Balch and Littlefield peats	Not adapted	Poor to not suitable	Not suitable	Not suitable	Moderate to high.
Barnstead	Good	Fair	Good	Good[2]	None to slight.
Biddeford	Not adapted	Poor	Not suitable	Not suitable	Moderate to high.
Brimfield-Brookfield	Good	Fair for nonrocky soils.	Not suitable	Not suitable	Moderate.
Brookfield	Good	Fair	Not suitable	Not suitable	Moderate.
Buxton	Not adapted	Good	Not suitable	Not suitable	Moderate.
Charlton	Good	Good	Not suitable	Not suitable	Moderate.
Coastal beach and dune sand	Good	Not suitable	Not suitable	Not suitable	None to slight.
Elmwood	Poor	Good	Poor to not suitable	Not suitable	High.
Fresh water marsh	Not adapted	Not suitable	Not suitable	Not suitable	
Gloucester	Good	Poor	Not suitable	Not suitable	None to slight.
Hinckley	Good	Not suitable	Fair	Good	None to slight.
Hollis	Good	Good	Not suitable	Not suitable	None to slight.
Jaffrey	Good	Not suitable	Fair	Good	None to slight.
Leicester and Ridgebury	Poor to not adapted	Poor	Not suitable	Not suitable	High.
Leicester, Ridgebury, and Whitman.	Poor to not adapted	Poor	Not suitable	Not suitable	High.
Melrose	Poor	Good	Poor to not suitable	Not suitable	Moderate.[3]
Merrimac	Good	Fair to good[4]	Good	Good	None to slight.
Ondawa	Good	Good	Poor to fair	Not suitable	Slight.
Paxton	Fair	Good	Not suitable	Not suitable	High.
Podunk	Fair	Good	Poor to fair	Not suitable	High.
Rumney and Saco	Not adapted	Poor	Poor to not suitable	Not suitable	High.
Scantic	Not adapted	Poor	Not suitable	Not suitable	Moderate to high.
Scantic and Biddeford	Not adapted	Poor	Not suitable	Not suitable	Moderate to high.
Scarboro	Poor to not adapted	Poor	Not suitable	Poor[5]	High.
Scituate	Poor to not adapted	Fair	Not suitable	Not suitable	High.
Shapleigh-Gloucester	Good	Poor	Not suitable	Not suitable	None to slight.
Sudbury	Fair	Good	Good	Good	Moderate.
Suffield	Not adapted	Good	Not suitable	Not suitable	Moderate.
Sutton and Woodbridge	Poor to not adapted	Good	Not suitable	Not suitable	High.
Swanton	Not adapted	Poor	Not suitable	Not suitable	High.
Tidal marsh		Not suitable	Not suitable	Not suitable	
Urban and made land		Not suitable	Not suitable	Not suitable	
Walpole	Poor to not adapted	Poor	Not suitable	Poor	High.
Warwick	Good	Poor[4]	Poor	Good	None to slight.
Waterboro muck	Not adapted	Not suitable	Not suitable	Not suitable	
Whately	Not adapted	Poor	Not suitable	Not suitable	High.
Whitman	Poor to not adapted	Poor	Not suitable	Not suitable	High.
Windsor	Good	Not suitable	Good	Not suitable	None to slight.

[1] Suitability as source of topsoil depends on content of gravel and stones; rating is for nonstony soil.
[2] Deposit consists of strata of sand and gravel.
[3] Frost susceptibility depends on location of gradeline with respect to ground surface.
[4] Suitability as source of topsoil depends on content of gravel.
[5] Poor as source of gravel because of high water table.

enough to reach the underlying fine-grained materials. Road construction in glacial outwash generally requires somewhat less earthwork than construction in other deposits.

Glaciolacustrine and marine silts and clays do not make good foundations because they are fine textured and the water table is near the surface. Roads should be built on embankments over such soils, but this may not be practical, especially if good material is not available. If the wet, fine textured soil material is used in the subgrades or in embankments, the moisture content must be reduced so that it is only slightly above the optimum moisture content. Otherwise, adequate compaction cannot be obtained. The gradeline should be kept above the ground water table.

Muck and peat are not suitable for use as foundations for roads or other engineering structures, because of the low strength of the material and because the water table is normally high. Roads should be alined to avoid deep muck. Muck within a cut section of a roadway and at embankment sites should be wasted or removed and replaced by suitable soil materials. Some areas of muck may be too small to be shown on the map.

Construction of roads on river terraces ordinarily involves a minimum of earthwork except where the road ascends onto a high terrace or into the uplands. The gradeline should be kept above the level of the highest flooding on terraces and on alluvial bottoms.

All topsoil that contains a detrimental amount of organic matter should be removed in constructing embankments 5 feet or more in height. Where there is a mucky surface layer, it should be removed from the roadway section and wasted or placed on embankment slopes.

Wind erosion may occur in dune sands along coastal beaches and in the sandy Windsor soils that occur on low-lying terraces.

Materials in terraces, kames, and eskers may be used for surfacing secondary roads and in the base course for pavements of primary and secondary roads. The use of these materials will require inspection control while the highway is being constructed.

Soil features affecting soil conservation engineering

Table 8 shows specific features typical of the soils in the various series that may affect the selection, design, and application of systems for control of water on the land. These features have been evaluated on the basis of estimated data taken from table 6, from actual tests, and from field experience.

The principal engineering practices applied to conserve soil and water are drainage, irrigation, and construction of farm ponds and diversion terraces. The soils derived from glacial till present special problems because they contain many large stones and boulders and are shallow over bedrock. Shallow soils, such as those in the Brimfield-Brookfield, Hollis-Charlton, and Shapleigh-Gloucester complexes, need careful investigation before excavation begins.

Some of the soils derived from glacial till, as the Paxton, Woodbridge, Scituate, and Ridgebury, are underlain by a compact, platy substratum that retards the movement of water. When planning to install irrigation systems in these soils or in the soils that are shallow to bedrock, careful investigation is necessary because of the limited depth of noncompact soil.

Soils developed from glaciofluvial deposits, including those on glacial outwash plains and terraces, as a rule are composed of larger particles than the soils derived from glacial till. They are therefore more permeable. Soils in this group are the Barnstead, Hinckley, Jaffrey, Merrimac, Windsor, Sudbury, Walpole, and Scarboro.

If farm ponds to store water above the ground surface are planned for the soils developed from glaciofluvial deposits, a sealing agent should be used to prevent seepage of water from the reservoir. Where the water table is close to the surface of these soils, ponds that are dug out have been successful.

It may be necessary to install open ditches or subsurface drainage in the soils derived from glaciofluvial deposits, either to remove excess water or to drain other areas. Care is necessary where there are layers of ungraded silts, fine sands, or sands, because these are subject to erosion, sloughing, and slumping. Subsurface drainage systems installed in such layers must be protected against plugging by silts and fine sands. The Barnstead, Hinckley, Jaffrey, Merrimac, and Windsor soils are normally droughty and have a low water-holding capacity. This should be considered when planning an irrigation system.

Soils developed on glaciolacustrine or marine silts and clays, as the Suffield, Buxton, Scantic, and Biddeford, as a rule do not respond well to subsurface drainage, because of their slow internal drainage. Also, they have slow permeability. Using open ditches and shaping the land to help remove surface water will improve the drainage of these soils. The slow permeability must be considered if an irrigation system is to be planned.

Dugout ponds can be used in these relatively impervious soils. When planning a dike-type pond, however, the high shrink-swell potential and low stability of these soils must be considered.

Other glaciolacustrine or marine soils, as the Melrose, Elmwood, Swanton, and Whately, have a sandy surface layer that overlies silts and clays that have a high shrink-swell potential. The silts and clays lie at various depths. This should be considered when planning farm ponds and drainage systems.

The Balch and Littlefield peats generally occur in areas that are covered by water most of the year. Only a few acres have been developed for agricultural use.

Descriptions of Soils

Rockingham County lies within the region of Brown Podzolic soils of the northeastern United States. The soils have developed from glacial till, glacial outwash, alluvial material, and organic material. They range from loamy sand to silty clay loam in texture, but sandy loams, fine sandy loams, and loams predominate. The soils are acid; the surface layers range from very strongly acid to medium acid. The soils developed from till that was derived from schist are finer textured than those developed from till that was derived from granite. Those developed on the compact or firm, fine-textured till have a higher water-holding capacity than those developed on loose or friable till and thus are more desirable for agriculture.

Many of the soils of the county occur on uplands, but some are on terraces or bottom lands. The soils on uplands range from nearly level to steep but are predominantly gently rolling. All of the soils of the uplands were originally stony or very stony. The surface stones have been removed from many areas and used to build fences or walls. In many areas that recently have grown up to trees, the remains of old stone walls are found. These indicate that the soils were once cultivated.

Of the upland soils that have a fine-textured, compact substratum, a greater proportion is used for agriculture than of other upland soils. Because such soils absorb water more slowly than soils that have a more porous substratum, the hazard of erosion is greater if the soils are cultivated, especially if they are on steep slopes.

A fairly large proportion of the soils of uplands are shallow. Except for a few scattered areas, these shallow soils are mostly in forest or pasture. Therefore, erosion is generally not a serious problem except in a few scattered areas. On some of the steeper slopes, erosion has been active in the past.

Typically the soils of the terraces and bottom lands are fairly smooth. They are generally free of stones and are easy to till. Their drainage ranges from excessive in some of the coarse-textured soils to very poor in some of the soils in low areas and depressions. The coarse-textured soils of the terraces are lighter colored

TABLE 8.—*Factors affecting construction of drainage ditches, irrigation systems, farm ponds, and diversion terraces*

Soil series	Drainage	Irrigation	Farm ponds	Diversion terraces
Acton and Scituate:				
Acton	Stony	Tillable to depths of 18 to 30 inches.	Permeable layers	Stony.
Scituate	Seasonally high water table; compact layer at depths of 18 to 30 inches.			Stony.
Balch and Littlefield	(1)	(1)	(1)	(1)
Barnstead		Low water-holding capacity.	Highly permeable	
Biddeford	Subject to flooding; internal drainage very slow.	Very slow permeability and low intake rate.	High shrink-swell potential; poor stability.	Highly erodible.
Brimfield-Brookfield	Shallow to bedrock	Limited soil depth	Shallow to bedrock	Shallow to bedrock.
Brookfield	Stony		Permeable	Stony.
Buxton	Slow internal drainage	Slow permeability and low intake rate.	High shrink-swell potential; poor stability.	
Buxton and Scantic	(2)	(2)	(2)	(2)
Charlton	Stony			Stony.
Elmwood	Impervious at depth of 18 inches.	Tillable to depth of 18 inches.	Permeable surface layer overlying material with high shrink-swell potential.	
Gloucester	Stony		Lower horizons pervious	Stony.
Gloucester and Scituate	(3)	(3)	(3)	(3)
Hinckley		Very low water-holding capacity.	Rapid permeability	
Hollis-Charlton	Shallow to bedrock	Limited soil depth	Shallow to bedrock	Shallow to bedrock.
Jaffrey		Very low water-holding capacity.	Rapid permeability	
Leicester, Ridgebury, and Whitman.	Seepage; stony			Stony.
Leicester and Ridgebury	Compact layer at depths of 18 to 30 inches.	Tillable to depths of 18 to 30 inches.		
Melrose	Impervious layer at depths of 2½ to 3 feet.		Permeable surface layer overlies material with high shrink-swell potential.	
Merrimac		Low water-holding capacity.	Permeable	
Ondawa	Flooded occasionally		Permeable	
Paxton	Stony, impervious layer at depths of 1½ to 2 feet; seepage.	Tillable to depths of 1½ to 2 feet.		Stony.
Rumney and Saco	High water table; seepage; surface flooding.	Very low intake rate		
Scantic	High water table; slow internal drainage.	Permeability very slow and intake rate very low.	High shrink-swell potential; poor stability.	
Scantic and Biddeford	(4)	(4)	(4)	(4)
Scarboro	High water table		Permeable	
Shapleigh-Gloucester	Bedrock at depths of 18 to 30 inches.	Limited soil depth	Shallow to bedrock	Shallow to bedrock.
Sudbury	Sides of ditches unstable until plant cover established.		Permeable	
Suffield	Slow internal drainage		High shrink-swell potential.	Highly erodible.
Sutton and Woodbridge	Stony; seepage; compact layer at depths of 18 to 30 inches.	Tillable to depths of 1½ to 2 feet.		Stony.
Swanton	Impervious layer at depths of 18 to 30 inches; seepage.	Tillable to depths of 18 to 30 inches.	Permeable surface layer overlies material with high shrink-swell potential.	
Walpole	High water table; sides of ditches unstable until plant cover established.		Permeable	

See footnotes at end of table.

TABLE 8.—*Factors affecting construction of drainage ditches, irrigation systems, farm ponds, and diversion terraces*—Continued

Soil series	Drainage	Irrigation	Farm ponds	Diversion terraces
Walpole and Scarboro	(5)	(5)	(5)	(5)
Warwick			Permeable	
Waterboro	(1)	(1)	(1)	(1)
Whately	High water table; seepage	Limited soil depth	Permeable surface layer overlies material with high shrink-swell potential.	
Whitman	High water table; seepage; stony.			Stony.
Windsor		Low moisture-holding capacity.	Rapid permeability	Subject to wind erosion.

[1] Not developed for use.
[2] See Buxton and Scantic series.
[3] See Gloucester and Scituate series.
[4] See Scantic and Biddeford series.
[5] See Walpole and Scarboro series.

and more leached than the medium-textured soils and are especially more so than those medium-textured soils derived from marine silts and clays. The soils that have developed from marine silts and clays are the most erodible of any in the county. They were the first to be cleared and cultivated, and erosion has been active for a number of years.

The soils that have developed on kames are coarse textured and are excessively drained. They are highly leached. These soils are subject to severe erosion if they are used for cultivated crops. They are largely in forest or pasture or are idle.

As a rule, erosion has not been a serious problem in this county. The extensive use of the soils for pasture or hay has kept them under a cover of sod most of the time. Where more intensive farming is practiced, however, there is a severe hazard of erosion.

Soil Series and Mapping Units

This section contains descriptions of all the soils mapped in Rockingham County. Under each soil series name, a typical soil of the series is described in detail. Where a series contains but one mapping unit, only that unit is described. The approximate acreage and proportionate extent of each mapping unit are shown in table 9.

Acton and Scituate series

The soils of the Acton and Scituate series, mapped together in Rockingham County as an undifferentiated soil group, are level to gently sloping and are moderately well drained. They have formed on glacial till of Late Wisconsin age. The Acton soils have formed on loose granitic till, and the Scituate soils, on very firm, fine-grained granitic till.

These soils belong to the same catena as the well-drained Gloucester and Shapleigh soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils. They are associated with the Gloucester, Shapleigh, and Whitman soils. The forests on these soils consist of red maple, gray, black, and yellow birches, red oak, elm, ash, and hemlock.

The soils of both of these series belong to the Brown Podzolic great soil group. They occur throughout the county but are more extensive in the western part than along the coast. A profile typical of the Scituate soils is described under the Gloucester and Scituate series. The following is a profile of Acton sandy loam, 0 to 3 percent slopes.

3 to 0 inches, a thin layer of loose leaves underlain by dark-brown,[4] partly disintegrated leaves and twigs; in some places contains mineral matter from horizon immediately below; extremely acid.

0 to 3 inches, dark grayish-brown sandy loam that contains a moderate amount of organic matter, some coarse sand, and as much as 10 percent of small angular granite stones; dark grayish brown when moist or dry; coherent in place; very friable when disturbed; weak very fine granular structure; very strongly acid.

3 to 10 inches, yellowish-brown sandy loam that is light yellowish brown in lower part; contains some coarse sand, many small stones and cobbles, and a few large boulders; slightly coherent in place but loose when disturbed; weak very fine granular structure; medium to strongly acid.

10 to 18 inches, light yellowish-brown sandy loam faintly mottled with yellowish brown and light gray; contains some coarse sand, as much as 10 percent of small cobbles and stones, and a few large boulders; coherent in place but loose when removed; single grain (structureless) or weak very fine granular structure; medium to strongly acid.

18 to 30 inches, light yellowish-brown or light olive-brown sandy loam prominently mottled with yellowish brown, brown, and light gray; firm to loose in place and loose when removed; single grain (structureless); medium to strongly acid.

30 inches +, light olive-gray or olive-gray sandy loam till mottled with yellowish brown and brown; contains many small angular unweathered fragments of granite and many granite boulders; firm to loose in place and loose when disturbed; single grain (structureless); medium to strongly acid.

The texture of the Acton and Scituate soils ranges from stony sandy loam to sandy loam. Surface runoff is medium to rapid. During wet seasons internal drainage is somewhat retarded by a high water table, but during dry seasons, internal drainage is rapid. Permeability is very rapid to depths of 10 inches.

On dairy farms the areas that are free of stones are used for hay, oats, rye, corn for silage or grain, and improved pasture. The stony areas are mostly under

[4] Unless otherwise specified, color is that of moist soil.

TABLE 9.—*Approximate acreage and proportionate extent of soils mapped*

Soil	Acres	Percent
Acton and Scituate sandy loams, 3 to 8 percent slopes.	562	0.1
Acton and Scituate sandy loams, 0 to 3 percent slopes.	69	(1)
Acton and Scituate sandy loams, 0 to 8 percent slopes.	820	.2
Acton and Scituate stony sandy loams, 3 to 8 percent slopes.	1,351	.3
Acton and Scituate stony sandy loams, 0 to 3 percent slopes.	120	(1)
Acton and Scituate stony sandy loams, 0 to 8 percent slopes.	1,915	.4
Balch and Littlefield peats	12,130	2.7
Balch and Littlefield peats, shallow	591	.1
Barnstead fine sandy loam and sandy loam, 3 to 8 percent slopes.	797	.2
Barnstead fine sandy loam and sandy loam, 8 to 25 percent slopes.	525	.1
Biddeford silty clay loam, 0 to 3 percent slopes.	1,736	.4
Brimfield-Brookfield sandy loams, 3 to 8 percent slopes.	238	.1
Brimfield-Brookfield sandy loams, 8 to 15 percent slopes.	573	.1
Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes.	1,070	.5
Brimfield-Brookfield rocky sandy loams, 3 to 8 percent slopes.	495	.1
Brimfield-Brookfield rocky sandy loams, 15 to 25 percent slopes.	605	.1
Brimfield-Brookfield rocky sandy loams, 3 to 15 percent slopes.	70	(1)
Brimfield-Brookfield very rocky very stony sandy loams, 3 to 15 percent slopes.	2,634	.6
Brimfield-Brookfield very rocky very stony sandy loams, 15 to 25 percent slopes.	1,680	.4
Brimfield-Brookfield very rocky very stony sandy loams, 25 to 35 percent slopes.	7,776	1.7
Brookfield sandy loam, 3 to 8 percent slopes	285	.1
Brookfield sandy loam, 3 to 15 percent slopes	601	.1
Brookfield sandy loam, 0 to 3 percent slopes	3	(1)
Brookfield sandy loam, 8 to 15 percent slopes	148	(1)
Brookfield sandy loam, 15 to 25 percent slopes	30	(1)
Brookfield stony sandy loam, 8 to 15 percent slopes.	2,246	.5
Brookfield stony sandy loam, 0 to 8 percent slopes.	287	.1
Brookfield stony sandy loam, 15 to 25 percent slopes.	533	.1
Brookfield stony sandy loam, 0 to 15 percent slopes.	3,984	.9
Buxton silt loam, 3 to 8 percent slopes	1,147	.3
Buxton silt loam, 0 to 3 percent slopes	117	(1)
Buxton silt loam, 3 to 8 percent slopes, severely eroded.	55	(1)
Buxton and Scantic silt loams, 0 to 3 percent slopes.	1,720	.4
Charlton loam, 8 to 15 percent slopes	2,501	.6
Charlton loam, 3 to 8 percent slopes	1,505	.3
Charlton loam, 3 to 15 percent slopes	6,131	1.4
Charlton loam, 0 to 3 percent slopes	6	(1)
Charlton loam, 15 to 25 percent slopes	647	.1
Charlton loam, 25 to 35 percent slopes	62	(1)
Charlton stony loam, 8 to 15 percent slopes	3,750	.8
Charlton stony loam, 0 to 8 percent slopes	1,080	.2
Charlton stony loam, 15 to 25 percent slopes	537	.1
Charlton stony loam, 0 to 15 percent slopes	6,970	1.6
Coastal beach and dunes and	910	.2
Elmwood fine sandy loam, 3 to 8 percent slopes.	278	.1
Elmwood fine sandy loam, 0 to 3 percent slopes.	14	(1)
Fresh water marsh	729	.2
Gloucester sandy loam, 8 to 15 percent slopes	4,439	1.0
Gloucester sandy loam, 0 to 15 percent slopes	70	(1)
Gloucester sandy loam, 3 to 8 percent slopes	3,387	.8
Gloucester sandy loam, 15 to 25 percent slopes	234	0.1
Gloucester sandy loam, 3 to 15 percent slopes	10,565	2.4
Gloucester stony sandy loam, 8 to 15 percent slopes.	36,580	8.3
Gloucester stony sandy loam, 0 to 8 percent slopes.	7,747	1.8
Gloucester stony sandy loam, 15 to 25 percent slopes.	2,132	.5
Gloucester stony sandy loam, 0 to 15 percent slopes.	62,897	14.1
Gloucester very stony sandy loam, 15 to 25 percent slopes.	15,800	3.6
Gloucester very stony sandy loam, 3 to 15 percent slopes.	40,400	9.1
Gloucester and Scituate sandy loams, 3 to 8 percent slopes.	798	.2
Gloucester and Scituate sandy loams, 0 to 3 percent slopes.	13	(1)
Gloucester and Scituate sandy loams, 8 to 15 percent slopes.	251	.1
Gloucester and Scituate sandy loams, 15 to 25 percent slopes.	11	(1)
Gloucester and Scituate sandy loams, 3 to 15 percent slopes.	1,399	.3
Gloucester and Scituate stony sandy loams, 3 to 8 percent slopes.	874	.2
Gloucester and Scituate stony sandy loams, 8 to 15 percent slopes.	541	.1
Gloucester and Scituate stony sandy loams, 15 to 25 percent slopes.	91	(1)
Gloucester and Scituate stony sandy loams, 0 to 15 percent slopes.	1,957	.4
Hinckley loamy sand, 8 to 35 percent slopes	11,700	2.6
Hinckley loamy sand, 0 to 3 percent slopes	4,040	.9
Hinckley loamy sand, 3 to 8 percent slopes	10,200	2.3
Hinckley stony loamy sand, 3 to 25 percent slopes.	1,760	.4
Hollis-Charlton loams, 8 to 15 percent slopes	2,480	.6
Hollis-Charlton loams, 0 to 3 percent slopes	80	(1)
Hollis-Charlton loams, 3 to 8 percent slopes	1,040	.3
Hollis-Charlton loams, 15 to 25 percent slopes	502	.1
Hollis-Charlton rocky loams, 8 to 15 percent slopes.	3,973	.9
Hollis-Charlton rocky loams, 3 to 8 percent slopes.	583	.1
Hollis-Charlton rocky loams, 15 to 25 percent slopes.	1,153	.3
Hollis-Charlton rocky loams, 3 to 15 percent slopes.	7,411	1.7
Hollis-Charlton very rocky very stony loams, 3 to 15 percent slopes.	5,590	1.3
Hollis-Charlton very rocky very stony loams, 15 to 25 percent slopes.	3,190	.7
Hollis-Charlton very rocky very stony loams, 25 to 35 percent slopes.	2,280	.5
Jaffrey loamy sand, 0 to 3 percent slopes	106	(1)
Jaffrey loamy sand, 8 to 35 percent slopes	453	.1
Jaffrey loamy sand, 3 to 8 percent slopes	345	.1
Leicester and Ridgebury fine sandy loams, 3 to 8 percent slopes.	556	.1
Leicester and Ridgebury fine sandy loams, 0 to 3 percent slopes.	166	(1)
Leicester, Ridgebury, and Whitman stony fine sandy loams, 3 to 8 percent slopes.	10,000	2.3
Leicester, Ridgebury, and Whitman stony fine sandy loams, 0 to 3 percent slopes.	7,850	1.8
Melrose fine sandy loam, 3 to 8 percent slopes	462	.1
Melrose fine sandy loam, 0 to 3 percent slopes	340	.1
Melrose fine sandy loam, 8 to 15 percent slopes	193	.1
Merrimac fine sandy loam, 3 to 8 percent slopes.	1,109	.3
Merrimac fine sandy loam, 15 to 25 percent slopes.	59	(1)
Merrimac fine sandy loam, 0 to 3 percent slopes.	215	.1

See footnotes at end of table.

TABLE 9.—*Approximate acreage and proportionate extent of soils mapped*—Continued

Soil	Acres	Percent
Merrimac fine sandy loam, 8 to 15 percent slopes.	791	0.2
Merrimac sandy loam, 3 to 8 percent slopes	521	.1
Merrimac sandy loam, 0 to 3 percent slopes	170	(1)
Merrimac sandy loam, 8 to 15 percent slopes	214	.1
Merrimac sandy loam, 15 to 25 percent slopes	38	(1)
Merrimac fine sandy loam and sandy loam, 0 to 3 percent slopes.	501	.1
Merrimac fine sandy loam and sandy loam, 3 to 8 percent slopes.	2,120	.5
Merrimac fine sandy loam and sandy loam, 8 to 25 percent slopes.	1,434	.3
Ondawa fine sandy loam, 0 to 3 percent slopes	53	(1)
Paxton loam, 3 to 8 percent slopes	1,541	.4
Paxton loam, 0 to 3 percent slopes	40	(1)
Paxton loam, 3 to 15 percent slopes	3,587	.8
Paxton loam, 8 to 15 percent slopes	866	.2
Paxton loam, 15 to 25 percent slopes	317	.1
Paxton stony loam, 3 to 8 percent slopes	778	.2
Paxton stony loam, 8 to 15 percent slopes	955	.2
Paxton stony loam, 0 to 15 percent slopes	3,325	.8
Paxton stony loam, 15 to 25 percent slopes	822	.2
Podunk fine sandy loam, 0 to 3 percent slopes	85	(1)
Rumney and Saco fine sandy loams, 0 to 3 percent slopes.	1,420	.3
Rumney and Saco silt loams, 0 to 3 percent slopes.	2,060	.5
Scantic silt loam, 0 to 3 percent slopes	1,710	.4
Scantic silt loam, 3 to 8 percent slopes	1,395	.3
Scantic silt loam and Biddeford silty clay loam, 0 to 3 percent slopes.	2,254	.5
Scarboro fine sandy loam, 0 to 3 percent slopes	12,400	2.8
Shapleigh-Gloucester sandy loams, 8 to 15 percent slopes.	715	.2
Shapleigh-Gloucester sandy loams, 0 to 8 percent slopes.	545	.1
Shapleigh-Gloucester sandy loams, 15 to 35 percent slopes.	115	(1)
Shapleigh-Gloucester rocky sandy loams, 3 to 15 percent slopes.	10,100	2.3
Shapleigh-Gloucester rocky sandy loams, 15 to 35 percent slopes.	2,660	.6
Shapleigh-Gloucester very rocky very stony sandy loams, 3 to 15 percent slopes.	11,830	2.7
Shapleigh-Gloucester very rocky very stony sandy loams, 15 to 35 percent slopes.	6,120	1.4
Sudbury fine sandy loam, 0 to 3 percent slopes	1,025	.2
Sudbury fine sandy loam, 3 to 8 percent slopes	851	.2
Sudbury fine sandy loam, 0 to 8 percent slopes	2,444	.6
Suffield silt loam, 8 to 15 percent slopes	51	(1)
Suffield silt loam, 8 to 15 percent slopes, severely eroded.	11	(1)
Suffield silt loam, 15 to 25 percent slopes	25	(1)
Suffield silt loam, 15 to 25 percent slopes, severely eroded.	8	(1)
Suffield silt loam, 25 to 35 percent slopes	37	(1)
Sutton and Woodbridge loams, 3 to 8 percent slopes.	958	.2
Sutton and Woodbridge loams, 0 to 3 percent slopes.	71	(1)
Sutton and Woodbridge loams, 0 to 8 percent slopes.	1,334	.3
Sutton and Woodbridge stony loams, 0 to 8 percent slopes.	3,340	.8
Swanton fine sandy loam, 0 to 3 percent slopes	520	.1
Swanton fine sandy loam, 3 to 8 percent slopes	168	(1)
Tidal marsh	4,292	1.0
Urban and made land	6,940	1.6
Walpole fine sandy loam, 0 to 3 percent slopes	143	(1)
Walpole fine sandy loam, 3 to 8 percent slopes	62	(1)
Walpole and Scarboro fine sandy loams, 0 to 5 percent slopes.	267	.1
Warwick gravelly loam, 3 to 8 percent slopes	106	(1)
Warwick gravelly loam, 0 to 3 percent slopes	11	(1)
Warwick gravelly loam, 8 to 15 percent slopes	116	(1)
Warwick gravelly loam, 3 to 15 percent slopes	303	.1
Waterboro muck	2,630	.6
Waterboro muck, shallow	1,030	.2
Whately fine sandy loam, 0 to 3 percent slopes	448	.1
Whitman fine sandy loam, 0 to 3 percent slopes.	598	.1
Whitman fine sandy loam, 3 to 8 percent slopes.	672	.2
Windsor loamy sand, 3 to 8 percent slopes	508	.1
Windsor loamy sand, 0 to 3 percent slopes	131	(1)
Windsor loamy sand, 8 to 25 percent slopes	364	.1
Gravel pits	239	.1
Total	442,240	100.0

[1] Less than 0.1 percent.

forest, but some have been cleared and are used for unimproved pasture.

Acton and Scituate sandy loams, 3 to 8 percent slopes (Ac).—These are the most extensive of the nonstony Acton and Scituate sandy loams, but the areas are rather small. The soils have predominantly mild slopes, but some areas have slopes of more than 8 percent. The soils are associated with the Gloucester and Shapleigh soils. Some areas are in narrow strips between well drained and poorly drained soils. The areas on mild slopes receive seepage water from the slopes above.

Use and management.—More than 50 percent of this mapping unit is used for crops, less than 10 percent is in forest, and the rest is pastured or idle. The kinds of crops that can be grown are limited because the soils have only moderately good drainage. The principal crops are hay and corn grown for silage. Small acreages are in potatoes, oats, and vegetables grown for home use.

Erosion is not a serious problem. If the soils are to be used for cultivated crops, simple management practices are needed, however, to provide for water disposal and to protect the soils from erosion.

These soils are among the best in the county for pasture, but they need fertilizer for best yields. The principal native grasses in permanent pastures are Kentucky bluegrass, redtop, Colonial bentgrass, and Canada bluegrass. On neglected pastures and on idle areas, there is considerable hardhack, meadowsweet, blueberry, gray birch and aspen sprouts, common juniper, broomsedge, goldenrod, and daisies. These soils are in capability class II, subclass IIw, and in management group 3.

Acton and Scituate sandy loams, 0 to 3 percent slopes (Ab).—Except that these soils are level to nearly level, they are similar to Acton and Scituate sandy loams, 3 to 8 percent slopes, and are similar in use and management. The erosion hazard is not so great, however, because of the milder slopes. Approximately 50 percent

of this mapping unit is used for crops. These soils are in capability class II, subclass IIw, and in management group 3.

Acton and Scituate sandy loams, 0 to 8 percent slopes (Aa).—This mapping unit occurs only in the southern part of the county. The areas having milder slopes resemble Acton and Scituate sandy loams, 0 to 3 percent slopes, and are managed in about the same way. The areas on slopes of 3 to 8 percent resemble Acton and Scituate sandy loams, 3 to 8 percent slopes, and are about the same in use and management. This mapping unit is in capability class II, subclass IIw, and in management group 3.

Acton and Scituate stony sandy loams, 3 to 8 percent slopes (Af).—These gently sloping soils are more extensive than Acton and Scituate sandy loams, 3 to 8 percent slopes, with which they are associated. A few areas are very stony. In most places stones and boulders, as much as 3 or 4 feet in diameter, are so close together that they interfere with tillage.

The surface runoff and internal drainage are generally medium. Early in spring or during wet seasons, however, the subsoils are waterlogged.

Use and management.—These soils are largely in forests of red maple, gray, yellow, and black birches, red oak, elm, white ash, hemlock, and spruce, with a thick undergrowth of shrubs and herbs. Small cleared areas are used for pasture or are idle. The pasture plants and the plants on idle areas are the same as those on Acton and Scituate sandy loams, 3 to 8 percent slopes. Under similar management, however, the carrying capacity of the pastures will be slightly lower than on the nonstony soils. These soils are in capability class VI, subclass VIs, and in management group 12.

Acton and Scituate stony sandy loams, 0 to 3 percent slopes (Ae).—Except that the soils are level to nearly level, this mapping unit is similar to Acton and Scituate stony sandy loams, 3 to 8 percent slopes, and the management is about the same. It is in capability class VI, subclass VIs, and in management group 12.

Acton and Scituate stony sandy loams, 0 to 8 percent slopes (Ad).—This mapping unit occurs only in the southern part of the county. It is similar to the other Acton and Scituate stony sandy loams that have similar slopes, and it is used and managed in about the same way. This mapping unit is in capability class VI, subclass VIs, and in management group 12.

Balch and Littlefield peats

Balch and Littlefield peats (Ba).—These two soils were mapped together in Rockingham County as an undifferentiated soil group. Both occur in depressions where accumulated organic matter has remained wet enough so that some plant remains and cell structure were preserved. In most places this accumulation of organic matter is more than 3 feet deep, and in some places it is as much as 50 feet deep. These organic soils are associated with soils of the uplands and with soils of the glaciofluvial terraces.

Balch peat, the dominant soil of the undifferentiated group, is dark brown, poorly decomposed, and acid. It consists principally of woody, fibrous, organic material formed mainly from decayed red maple, spruce, alder, and hemlock trees and from other woody plants. These same kinds of trees and woody plants now grow in the areas.

Littlefield peat consists of the remains of sedges, rushes, and other herbaceous plants. It is acid, and trees rarely grow on this soil. In many places a shallow pond is in the center of an area.

Use and management.—About 90 percent of this mapping unit is forested, and the rest is idle. The soils are too wet for crops and are subject to frost during the growing season. In the areas that have a low content of ash, the peat would be desirable as a soil amendment or for bedding material. It is generally in potholes, however, that would have to be drained before the peat could be removed. In only a few places would the cost of drainage be worthwhile. This complex is in capability class VII, subclass VIIw, and in management group 13.

Balch and Littlefield peats, shallow (Bb).—In this group are areas of Balch and Littlefield peats that are less than 3 feet deep. In places the peat overlies gray sand or till. The areas are generally small and occur either along or at the edge of the larger deep areas of peat.

Use and management.—These areas are not satisfactory for crops, even if drained, because they would sink after being drained. Then it would be difficult to maintain the right amount of moisture for crops. Moreover, the peat is not deep enough to be mined. Almost all of this complex is in forest. This undifferentiated group is in capability class VII, subclass VIIw, and in management group 13.

Barnstead series

The soils of the Barnstead series are well drained to somewhat excessively drained and are level to steep. They have developed on glacial outwash. The outwash was derived mainly from granite, gneiss, and mica schist that was influenced appreciably by a slightly weathered, brown or rust-colored pyritiferous schist that gives a yellowish-brown or brownish-yellow color to the profile.

The Barnstead soils belong to the same catena as the well drained to excessively drained Jaffrey soils, the moderately well drained Sudbury soils, the poorly drained Walpole soils, and the very poorly drained Scarboro soils. They are associated with the Brimfield and Brookfield soils, which developed on till derived principally from slightly weathered, rust-colored pyritiferous schist. The forest vegetation on these soils consists of red and white oaks, red and sugar maples, gray birch, and white pine.

The Barnstead soils have a gravelly substratum similar to that of the Merrimac soils, but the color in the subsoil and the parent material differs from that of the Merrimac soils. The Barnstead soils belong to the Brown Podzolic great soil group. These soils occur principally in the town of Deerfield, but other small areas are scattered throughout the county.

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Profile of Barnstead fine sandy loam, 3 to 8 percent slopes, observed in a forested area:

2 to 0 inches, (forest floor) a thin layer of loose leaves underlain by dark-brown partly disintegrated leaves; this is mixed, in many places, with sandy material from the horizon immediately below; extremely acid.
0 to 2 inches, brown or dark yellowish-brown fine sandy loam moderately high in organic matter; fine to very fine granular structure; very strongly acid.
2 to 7 inches, brown or yellowish-red fine sandy loam, slightly stained with organic matter; firm in place, friable when removed; weak fine to very fine granular structure; very strongly acid.
7 to 24 inches, yellowish-brown or brownish-yellow sandy loam; loose; weak fine to very fine granular structure in the upper part but single grain (structureless) in lower part; strongly to very strongly acid.
24 inches +, stratified sand and gravel of granite, gneiss, and schist; loose; single grain (structureless); strongly to very strongly acid.

The surface layer ranges from 1 to 3 inches in thickness. In some places in the lower part of the subsoil or in the upper part of the substratum, there is a layer, 2 to 4 inches thick, that is darker colored than the typical soil. This layer is weakly cemented in places. The dark coloring is caused by iron and organic matter that has leached from the upper part of the profile. At a depth below 24 inches, in some places, the slightly weathered brown or rust-colored fragments of schist have stained the surfaces of the other rocks a yellowish-brown or brownish-yellow color. The proportion of schist in relation to granite and gneiss is small.

Barnstead fine sandy loam and sandy loam, 3 to 8 percent slopes (Bc).—These soils are nearly level to gently sloping. Except that in some areas the texture of the surface layer is sandy loam, this mapping unit is similar to the typical soil described for the series.

Surface runoff is slow. Internal drainage is rapid to very rapid, depending on whether the predominant texture is fine sandy loam or sandy loam. Roots, air, and water penetrate readily. At depths between 7 and 24 inches, the permeability is very rapid.

Use and management.—Approximately 80 percent of the acreage is in forest. The rest is used mainly for pasture or is idle, but some is cultivated. On the small part that is cultivated, the principal crops are hay, corn grown for silage, sweet corn, and vegetables.

These soils are free of stones. They are easy to cultivate, and they warm early in spring. The soils are mellow and friable. They can be tilled soon after rains. The relief is favorable for use of heavy farm machinery.

Crops on this soil respond well to soil amendments. If heavy applications of manure, commercial fertilizer, and lime are used, good yields of general crops can be obtained. Inadequate moisture, however, is a limiting factor in obtaining the best yields.

The dominant vegetation on idle areas and pasture is broomsedge, poverty oatgrass, sweetfern, common juniper, cinquefoil, blueberries, and gray birch sprouts. The woodlands consist chiefly of white pine. These soils are in capability class III, subclass IIIs, and in management group 6.

Barnstead fine sandy loam and sandy loam, 8 to 25 percent slopes (Bd).—Except that they have stronger slopes, these soils are similar to Barnstead fine sandy loam and sandy loam, 3 to 8 percent slopes.

Use and management.—Approximately 82 percent of the acreage is in forest. Most of the rest is pastured or idle, and less than 10 percent is under cultivation. Because of the strong slopes, erosion is a hazard if the soils are not carefully managed. The soils on the lower slopes require intensive management. On the soils on the higher slopes, cultivation should be limited. Nevertheless, if heavy applications of manure, commercial fertilizer, and lime are used, good yields of general crops can be obtained. These soils are in capability class IV, subclass IVs, and in management group 9.

Biddeford series

The soils of the Biddeford series are very poorly drained. They have developed on neutral to moderately acid marine and glaciolacustrine silts and clays. In some places they surround soils derived from till and the resulting soil pattern is complex.

These soils belong to the same catena as the well drained Suffield soils, the moderately well drained Buxton soils, and the poorly drained Scantic soils. They belong to the Humic Gley great soil group. The forest vegetation consists of red maple, alder, elm, and gray birch. Only one soil of this series is mapped in this county.

Biddeford silty clay loam, 0 to 3 percent slopes (Be).—Most of this soil is level to nearly level, but some of it has mild slopes. It occurs throughout the eastern part of the county near the coast.

Typical profile of a cultivated soil:

0 to 5 inches, very dark gray silty clay loam; dark gray or grayish brown when dry; moderately high in organic matter; firm in place when moist; plastic and sticky when wet; coarse granular structure; strongly acid.
5 to 12 inches, olive-gray silty clay; has a few mottles of light gray; dense and hard when dry and in place; very firm when moist and plastic and sticky when wet; weak medium or coarse blocky structure; medium to strongly acid.
12 inches +, olive-gray clay or silty clay; has coarse mottles of brown and light gray; very compact in place; plastic and sticky when wet and very hard when dry; coarse blocky structure that is indistinct when soil is dry; neutral to medium acid.

In many places there is a thin mucky layer on the surface of the soil. Surface runoff is slow, and internal drainage is very slow. During wet spells water stands in some of the depressions for several days at a time, but water rarely stands on the surface for long periods. Unless the soil is artificially drained, the water table is generally at depths of about 12 inches. This soil is very slowly permeable throughout. It therefore is a desirable site for farm ponds (fig. 2).

Use and management.—Approximately 60 percent of this soil is under forest. The rest is mainly in pasture or idle, but about 10 percent is cultivated.

Unless it is drained, this soil is suitable only for grazing, for growing poor-quality hay, or for trees. A few areas have been drained by tile or open ditches. These areas are used mainly for growing hay.

Pastures generally provide good grazing except during unusually dry seasons. On the better native pastures the most common grasses and legumes are Kentucky bluegrass, whiteclover, and redtop. Sedges are common on the wetter areas, and hardhack, golden-

Figure 2.—**A farm pond on an area of Biddeford silty clay loam, 0 to 3 percent slopes. The pond is used for fire protection and to provide water for livestock.**

rod, meadowsweet, common juniper, alder, gray birch sprouts, aster, fern, and hairycapmoss are common on the neglected pastures and idle areas. This soil is in capability class VI, subclass VIw, and in management group 11.

Brimfield-Brookfield complexes

The Brimfield-Brookfield complexes consist mainly of Brimfield soils, but they include areas of Brookfield soils too small to map separately. The Brimfield-Brookfield complexes lie next to areas of Charlton and Gloucester soils.

These complexes consist mainly of sandy loams, rocky sandy loams, and very rocky very stony sandy loams, but small areas of fine sandy loam are mapped with the sandy loams. Locally, the rocky sandy loams and very rocky very stony sandy loams are called ledgy soils.

Loose fragments of schist, granite, and gneiss are imbedded in these soils and are scattered over the surface. Exposed bedrock can be seen in most of the areas, and in some places it occupies a large part of an area. In places the soil has developed on material weathered from the underlying rock. Runoff and internal drainage are rapid, and in places the soils are droughty.

The Brimfield-Brookfield complexes occur mainly in the northwestern part of the county in the towns of Northwood and Deerfield. Small, widely scattered areas also occur elsewhere in the county. The Brookfield soils are described under the Brookfield series. The following is a description of the Brimfield soils.

The Brimfield soils are shallower over bedrock than the Brookfield soils, and their parent material is a brighter color. They are gently sloping to steep. The Brimfield soils are well drained. They are in the same catena as the well drained Brookfield soils, the moderately well drained Sutton soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils.

These soils have developed on glacial till of Late Wisconsin age. The till was derived from mica schist or thin-banded gneiss that weathered to a yellowish-brown or brownish-yellow limonitic color. The schist is pyritiferous mica schist, quartz mica schist, or biotite-muscovite mica schist. These soils belong to the Brown Podzolic great soil group. A description of a profile of Brimfield sandy loam, 3 to 8 percent slopes, follows. This profile was observed in a forested area.

3 to 0 inches, thin layer of undecomposed leaves underlain by dark-brown partly decomposed leaves and twigs; extremely acid.

0 to 3 inches, brown micaceous sandy loam, about 10 percent of which is small fragments of micaceous schist; contains many roots; very friable; weak very fine granular structure; very strongly acid.

3 to 12 inches, yellowish-brown micaceous sandy loam, 20 percent of which is small fragments of micaceous schist; loose or slightly coherent in place and friable when removed; weak very fine granular structure; very strongly acid.

12 to 20 inches, layer is similar to layer immediately above, but color is slightly weaker and there are a greater number of small schist fragments.

20 inches +, bedrock; very micaceous schist, or thin-banded gneiss stained a limonitic color, rust color, or brown on the outside; in places the rock was shattered by glacial action; in many places the weathered fragments crush easily in the hand.

The surface layer ranges in thickness from 2 to 4 inches. The upper part of the subsoil ranges from yellowish brown to brownish yellow. Depth to bedrock varies, but it is generally less than 2 feet. Outcrops, or exposed ledges, occupy between 10 and 20 percent of the surface.

The moisture-holding capacity varies with the depth of the soil. Where the soils are as much as 18 inches deep, there is a fair amount of moisture. Where the soils are shallower, however, crops sometimes are damaged by lack of moisture.

Brimfield-Brookfield sandy loams, 3 to 8 percent slopes (Bn).—The soils of this complex are gently sloping to undulating. They are generally much shallower than the Brookfield sandy loams mapped separately, schist fragments are more numerous throughout, and outcrops are common.

Use and management.—The complex is among the most important agriculturally of all the Brimfield-Brookfield complexes. About 35 percent of it is cultivated. Less than 20 percent is under forest, and the rest is in pasture or idle. Hay is the principal crop, but yields are generally fair to poor. Some corn is grown, and vegetables and potatoes are grown for home use.

On the idle areas the vegetation is chiefly broomsedge, common juniper, gray birch sprouts, sweetfern, sumac, poison-ivy, poverty oatgrass, cinquefoil, devils-paintbrush, and daisies. On the better native pastures are redtop, Colonial bentgrass, and Kentucky bluegrass.

The forests are made up mostly of white and pitch pines, white, red, and scrub oaks, red maple, and gray birch. The undergrowth consists of blueberries, sheep laurel, sweetfern, witch-hazel, and wintergreen. The soils of this complex do not erode easily, but in cultivated areas practices are needed to control erosion. This complex is in capability class II, subclass IIs, and in management group 4.

Brimfield-Brookfield sandy loams, 8 to 15 percent slopes (Bo).—Except for its steeper slopes, this complex is similar to Brimfield-Brookfield sandy loams 3 to 8

percent slopes. Its steeper relief causes more rapid runoff, and therefore the soils are more susceptible to erosion if clean-tilled crops are grown.

Use and management.—About 65 percent of this complex has been cleared. The soils are used for hay, for pasture, or are idle. They should be cultivated only to a limited extent, and intensive practices are needed to control erosion. Otherwise this complex is managed the same as Brimfield-Brookfield sandy loams, 3 to 8 percent slopes. It is in capability class IV, subclass IVs, and in management group 9.

Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes (Bh).—This is the most extensive of the Brimfield-Brookfield rocky sandy loams. Except that it contains stones and boulders, it is similar to Brimfield-Brookfield sandy loams, 8 to 15 percent slopes. The stones, boulders, and rock outcrops hinder tillage and, in some places, prevent the soils from being cultivated.

Use and management.—This complex is chiefly in timber and brush, and less than 5 percent is in pasture. As in Brimfield-Brookfield sandy loams, 8 to 15 percent slopes, the cleared areas are in hay or are pastured or idle. This complex is in capability class VI, subclass VIs, and in management group 12.

Brimfield-Brookfield rocky sandy loams, 3 to 8 percent slopes (Bg).—This complex is similar to Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes, except that it has milder slopes. Some areas are level or nearly level. This complex is practically all in forest. It is in capability class VI, subclass VIs, and in management group 12.

Brimfield-Brookfield rocky sandy loams, 15 to 25 percent slopes (Bk).—Except for its steeper slopes, this complex is similar to Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes. In some places the slopes are greater than 25 percent. This complex is practically all in forest. It is in capability class VII, subclass VIIs, and in management group 14.

Brimfield-Brookfield rocky sandy loams, 3 to 15 percent slopes (Bf).—Part of this complex resembles Brimfield-Brookfield rocky sandy loams, 3 to 8 percent slopes, and part more nearly resembles Brimfield-Brookfield rocky sandy loams, 8 to 15 percent slopes, depending on the predominant relief in the given area. The complex occurs only in the southern part of the county. It is in capability class VI, subclass VIs, and in management group 12.

Brimfield-Brookfield very rocky very stony sandy loams, 3 to 15 percent slopes (Br).—This complex is predominantly gently sloping to rolling, but a few areas have slopes of less than 3 percent. It occurs in association with the other Brimfield-Brookfield soils. This complex differs from the Brimfield-Brookfield rocky sandy loams in having a greater number of stones and boulders throughout the profile and a greater number of outcrops. Also the stones on the surface are generally larger and more difficult to remove.

Use and management.—Almost all of this complex is in forest. The small acreage that is cleared is not so good for pasture as the Brimfield-Brookfield rocky sandy loams, because of the many stones, boulders, and bedrock outcrops. This soil is in capability class VII, subclass VIIs, and in management group 14.

Brimfield-Brookfield very rocky very stony sandy loams, 15 to 25 percent slopes (Bs).—Except that it has steeper slopes, this complex is similar to Brimfield-Brookfield very rocky very stony sandy loams, 3 to 15 percent slopes. It is practically all in forest. This complex is in capability class VII, subclass VIIs, and in management group 14.

Brimfield-Brookfield very rocky very stony sandy loams, 25 to 35 percent slopes (Bt).—Except for slope, this complex is similar to the other Brimfield-Brookfield very rocky very stony sandy loams. In one small area the slopes are greater than 35 percent.

Use and management.—This complex is too steep, rocky, and stony to be used for agriculture. Practically all of it is in forest. It is in capability class VII, subclass VIIs, and in management group 14.

Brookfield series

The soils of the Brookfield series are nearly level to moderately steep. These soils are well drained. They have developed on loose till of Late Wisconsin age. The till was derived mostly from pyritiferous mica schist. The weathered schist, a yellowish-brown, brownish-yellow, or olive color, is at depths of 22 to 30 inches.

Some of the Brookfield soils contain stones, and both stony and stone-free soils occur close together. The soils belong to the same catena as the well drained shallow Brimfield soils, the moderately well drained Sutton soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils. The Brookfield soils are associated with the Brimfield and Charlton soils. The associated soils have developed from strongly acid till derived chiefly from materials similar to those from which the Brookfield soils have developed.

The forest vegetation on these soils is mainly white and pitch pines, gray birch, red maple, and white, red, and scrub oaks. The undergrowth is comprised mainly of blueberries, sheep laurel, sweetfern, witch-hazel, and wintergreen. On the idle areas the vegetation is chiefly broomsedge, common juniper, gray birch sprouts, sweetfern, sumac, poison-ivy, poverty oatgrass, cinquefoil, devils-paintbrush, and daisies.

These soils belong to the Brown Podzolic great soil group. They occur in the northern part of the county in the towns of Northwood and Deerfield and farther south in the town of Danville.

Brookfield sandy loam, 3 to 8 percent slopes (Bw).—This soil is gently sloping to gently undulating. It is well drained.

Typical profile observed in a forested area:

2 to 0 inches, litter consisting of decomposed grass and roots.
0 to 4 inches, dark yellowish-brown sandy loam that contains many roots; friable; weak fine granular structure strongly acid.
4 to 10 inches, yellowish-red sandy loam that contains many roots; friable; medium granular structure; strongly acid.
10 to 18 inches, strong-brown sandy loam that contains many roots; friable; weak medium granular structure; strongly acid.
18 to 23 inches, yellowish-brown loamy sand; friable; weak medium granular structure.

23 inches +, yellowish-brown loamy sand that contains a few roots; friable; loose or slightly coherent in place; strongly acid.

The color of the surface layer ranges from dark yellowish brown to yellowish brown. The color of the subsoil ranges from yellowish red to yellowish brown, and the texture of the subsoil ranges from sandy loam to fine sandy loam.

Surface runoff is medium and internal drainage is rapid. The moisture-holding capacity is only fair.

Use and management.—Approximately 35 percent of this soil is cultivated, 45 percent is idle, and the rest is in woods or pasture. Hay and corn grown for silage are the principal crops, and small acreages of potatoes and vegetables are grown for home use.

This porous, friable soil does not erode easily if it is carefully managed. Crops are sometimes damaged from lack of moisture, and for good yields they need large amounts of fertilizer and lime. This soil is in capability class II, subclass IIe, and in management group 2.

Brookfield sandy loam, 3 to 15 percent slopes (Bv).—The characteristics of this soil and its use and management are similar to those of Brookfield sandy loam, 3 to 8 percent slopes, or to Brookfield sandy loam, 8 to 15 percent slopes, depending on which one of these soils is predominant in the given area. This soil is in capability class III, subclass IIIe, and in management group 5.

Brookfield sandy loam, 0 to 3 percent slopes (Bu).—The few areas of this soil are level to nearly level. This soil is better suited to farming than the steeper phases because the surface drainage is less rapid, the soil retains slightly more water, and it is less likely to erode.

Use and management.—The principal management this soil needs for clean-tilled crops is the addition of large amounts of fertilizer and lime. Yields are about the same or slightly higher than on the steeper soils. This soil is in capability class I and in management group 1.

Brookfield sandy loam, 8 to 15 percent slopes (Bx).—This soil differs from Brookfield sandy loam, 3 to 8 percent slopes, chiefly in having steeper slopes and more rapid surface drainage.

Use and management.—About 35 percent of this soil is cultivated, and the rest is pastured, in woods, or idle. Additions of large amounts of fertilizer and lime are needed, and more intensive practices to control erosion are required for this soil than for Brookfield sandy loam, 3 to 8 percent slopes, but yields are the same or slightly less. This soil is in capability class III, subclass IIIe, and in management group 5.

Brookfield sandy loam, 15 to 25 percent slopes (By).—This soil has more rapid runoff than the other Brookfield sandy loams. If it is used for clean-tilled crops, it is more likely to erode than the other Brookfield soils. It is in capability class IV, subclass IVe, and in management group 7.

Brookfield stony sandy loam, 8 to 15 percent slopes (Bzb).—This soil is sloping to strongly sloping. It is associated with the other Brookfield sandy loams. Boulders and stones of schist and granite are scattered on the surface and throughout the profile.

In forested areas the surface is covered with a layer of leaf litter 2 to 3 inches thick. The surface layer, which is 1 to 1½ inches thick, is grayish-brown to dark-brown friable sandy loam that is matted with many small roots. The subsoil is reddish-brown or brown to rust-colored sandy loam. Otherwise, the profile is similar to that of Brookfield sandy loam, 3 to 8 percent slopes.

In places the color of this soil varies because of differences in the parent material. Surface runoff and internal drainage are medium. Included with this soil are small areas that have a texture of fine sandy loam.

Use and management.—More than 95 percent of this soil is in forest. Pastured areas are given little care. The vegetation is mostly common juniper, sweetfern, hardhack, broomsedge, and poverty oatgrass. This soil is in capability class VI, subclass VIs, and in management group 12.

Brookfield stony sandy loam, 0 to 8 percent slopes (Bza).—This level to gently sloping soil occurs in small, scattered areas that are normally on the crests of hills. It has less rapid surface runoff and retains slightly more moisture than Brookfield stony sandy loam, 8 to 15 percent slopes. If it is cleared it is somewhat better suited to farming than the more sloping soil. It is also better suited to trees, and most of it is in forest. This soil is in capability class VI, subclass VIs, and in management group 12.

Brookfield stony sandy loam, 15 to 25 percent slopes (Bzc).—This soil has steeper slopes than the other Brookfield stony sandy loams. Because of the steep slopes and many stones, it is best used for trees or pasture. A large part is under forest. If this soil is cleared and planted to clean-tilled crops, intensive methods of erosion control must be practiced. This soil is in capability class VI, subclass VIs, and in management group 12.

Brookfield stony sandy loam, 0 to 15 percent slopes (Bz).—In some areas of this soil, the slopes are less than 8 percent, and in others the slopes are between 8 and 15 percent. The less sloping areas are similar to Brookfield stony sandy loam, 0 to 8 percent slopes, and the more sloping ones resemble Brookfield stony sandy loam, 8 to 15 percent slopes. This soil is in capability class VI, subclass VIs, and in management group 12.

Buxton series

The soils of the Buxton series are moderately well drained and are level to gently sloping. They have developed on marine and glaciolacustrine silts and clays that are neutral to medium acid.

The Buxton soils belong to the same catena as the well drained Suffield soils, the poorly drained Scantic soils, and the very poorly drained Biddeford soils. In contrast to the Suffield soils, their mottling begins at depths of 12 to 18 inches. In the Suffield soils the mottling begins at a depth of about 24 inches. The Buxton soils have a browner surface layer than the Scantic, and the mottling occurs at greater depths.

The Buxton soils are associated with the other soils of the catena and with the Melrose, Merrimac, Hollis, Warwick, and Charlton soils. In some places, especially near the coast, the Buxton soils and other members of the catena surround soils derived from till and the soil

pattern is complex. In forested areas the principal trees are white ash, basswood, beech, gray and yellow birches, elm, hemlock, red maple, red and black oaks, and white pine.

These soils belong to the Brown Podzolic great soil group. They occupy small areas that are scattered throughout the eastern part of the county.

Buxton silt loam, 3 to 8 percent slopes (Bze).—This gently sloping soil is the most extensive of the Buxton silt loams. The small areas are scattered throughout the eastern part of the county.

Typical profile observed in a forested area:

2 to 0 inches, a thin layer of leaves, underlain by dark-brown partly decomposed organic matter mixed to some extent with soil from the horizon immediately below; very strongly acid.

0 to 5 inches, light brownish-gray silt loam free of pebbles and stones; moderately high in organic matter; firm in place, very friable when removed; granular structure; strongly acid.

5 to 12 inches, yellowish-brown silt loam; firm in place, very friable when removed; sticky and plastic when wet; fine granular structure; strongly acid.

12 to 15 inches, faintly mottled olive silty clay loam; firm in place, very friable when removed; sticky and plastic when wet; fine granular structure; medium to strongly acid.

15 to 24 inches, light olive-gray or olive silty clay; strongly mottled with brown and light gray, and mottles increase in number with depth; very firm in place, firm when removed; moderate medium to coarse blocky structure; medium acid.

24 inches +, light olive-gray or olive, varved glaciolacustrine deposits of silt and clay and unstratified marine deposits of silty clay or clay; strongly mottled with brown and light gray; very compact in place; sticky and plastic when wet, hard when dry; coarse blocky structure; neutral to slightly acid.

The surface layer ranges in thickness from 4 to 6 inches and in color from light brownish gray to brown or grayish brown. In places, at depths between 5 and 12 inches, the soil is faintly mottled. In places there is a gradual transition from the soil in the 5- to 12-inch layer to yellowish-gray silt loam or silty clay loam mottled with rust color, brown, and yellow.

The surface runoff is medium, and internal drainage is medium to slow. Water sometimes stands on the surface after heavy rains. The upper part of the profile has moderate permeability, but at depths below 12 inches the permeability is slow.

Use and management.—This is one of the better soils of the county for hay and pasture. About 75 percent of it has been cleared and is used chiefly for hay and pasture or is idle. Small areas are used to grow corn for silage, oats for forage, and vegetables for home use.

This soil is limited for row crops because it has only moderately good drainage. It must not be plowed too wet or too dry. The soil warms slowly in spring. Considerable power is needed to cultivate it. Lime and fertilizer are needed to grow hay, corn for silage, oats for hay, and pasture plants. For clean-tilled crops, practices must be used to control erosion.

Pasture plants on the native pastures are mostly Colonial bentgrass, Canada bluegrass, redtop, whiteclover, and some povetry oatgrass. In the neglected areas are hardhack, meadowsweet, gray birch sprouts, broomsedge, and sedge. This soil is in capability class II, subclass IIw, and in management group 3.

Buxton silt loam, 0 to 3 percent slopes (Bzd).—Except for slope this soil is similar to Buxton silt loam, 3 to 8 percent slopes. It occurs in small, scattered, level to nearly level areas and is less susceptible to erosion than the more sloping soils.

Use and management.—About 75 percent of this soil has been cleared and is used chiefly for hay and pasture or is idle. This soil can be used for the same crops as Buxton silt loam, 3 to 8 percent slopes, and management is about the same. It is in capability class II, subclass IIw, and in management group 3.

Buxton silt loam, 3 to 8 percent slopes, severely eroded (Bzf).—Except that it is eroded and the surface layer contains less organic matter, this soil is similar to Buxton silt loam, 3 to 8 percent slopes. From 2 to 6 inches of the surface soil has been lost, chiefly through sheet erosion. Simple practices to control erosion are needed. This soil is in capability class II, subclass IIw, and in management group 3.

Buxton and Scantic soils

Buxton and Scantic silt loams, 0 to 3 percent slopes (Bzg).—This undifferentiated soil group is made up of moderately well drained Buxton silt loam, 0 to 3 percent slopes, and poorly drained Scantic silt loam, 0 to 3 percent slopes. The Buxton soil is predominant. The use of this group is about the same as that described for the individual soils, and the management is about the same but is more like that of the Buxton soil. This group was mapped only in the southern part of the county. It is in capability class IV, subclass IVw, and in management group 9.

Charlton series

The soils of the Charlton series are level to steep. They are well drained but retain moisture well. Generally these soils are only moderately stony. They have developed on fairly deep, noncalcareous Late Wisconsin till derived from schistose or phyllitic rocks. The till consists of olive or greenish-gray gravelly sandy loam and lies at depths of 22 to 24 inches. It is firm to slightly compact in place and has a weak platy structure.

The Charlton soils belong to the same catena as the moderately well drained Sutton, the poorly drained Leicester, and the very poorly drained Whitman soils. They are associated with the Hollis, Brookfield, and Paxton soils, which also formed from strongly acid till. These soils occur in the north-central part of the county, principally in the towns of Northwood, Deerfield, Nottingham, and Epping. They belong to the Brown Podzolic great soil group. The trees on forested areas are mainly white pine, red and white oaks, hickory, gray birch, and red maple.

Charlton loam, 8 to 15 percent slopes (Cd).—This soil occurs mainly on smooth rolling areas. Most of it is in the north-central part of the county.

Typical profile observed in a cultivated area:

0 to 7 inches, very dark grayish-brown loam in weak clods; friable; weak fine granular structure when crushed; strongly acid.

7 to 13 inches, yellowish-brown loam; friable; weak medium granular structure; strongly acid.

13 to 24 inches, dark yellowish-brown (10YR 4/4) loam that contains many roots; friable when moist; weak medium granular structure; strongly acid; clear, wavy boundary.
24 inches +, light olive-brown gravelly or sandy loam; friable; moderate medium platy structure; strongly acid.

The surface layer ranges in color from very dark grayish brown to brown or strong brown. Its texture ranges from loam to fine sandy loam. In places the subsoil is yellow.

Surface runoff and internal drainage are medium. This soil has a fairly high moisture-holding capacity. Roots, air, and water penetrate the subsoil readily.

Mapped with this soil are small areas in which a pan occurs at depths of 28 to 30 inches. Also included are some areas that are less acid than the typical soil. Some included areas of this soil are coarser textured than normal. In these areas the till is made up of loose, gritty, gravelly loamy sand.

Use and management.—Between 30 and 35 percent of this soil is cultivated. A large part is pastured or used to grow hay, and the rest is in woods or idle. Small areas are used to grow potatoes, sweet corn, field corn, fruit trees, and vegetables for home use.

This soil is easy to work and responds well to good management. It is low in plant nutrients, but soil tests should be made to determine the kind and amount of fertilizer to use and the amount of lime needed. Generally erosion is not a problem except on scattered areas that have been farmed intensively.

In neglected pastures common juniper, gray birch, aspen sprouts, broomsedge, hardhack, hackweed, moss, sweetfern, sumac, and other weeds have almost replaced the desirable grasses. In small abandoned areas young forests of mixed white pine and hardwoods have grown up. This soil is in capability class III, subclass IIIe, and in management group 5.

Charlton loam, 3 to 8 percent slopes (Cc).—This soil occurs in small scattered areas in association with other Charlton soils. Because of its milder slopes, it has slower runoff and is not so erodible as Charlton loam, 8 to 15 percent slopes. It is therefore more desirable for agriculture.

Use and management.—About 50 percent of this soil is used for hay, forage crops, potatoes, and vegetables. The rest is in forest or pasture or is idle.

Although this soil is not highly erodible, it is desirable to rotate the crops and to include stripcropping in the management practices. Fertilizer is needed to keep the soil productive. This soil is in capability class II, subclass IIe, and in management group 2.

Charlton loam, 3 to 15 percent slopes (Cb).—This soil occurs only in the southern part of the county. Some areas are similar to Charlton loam, 3 to 8 percent slopes, in characteristics and in use and management, and others are more like Charlton loam, 8 to 15 percent slopes, depending on which of those soils is dominant in a given area. This soil is in capability class III, subclass IIIe, and in management group 5.

Charlton loam, 0 to 3 percent slopes (Ca).—This soil occurs in association with other Charlton soils. It has slow surface runoff and the risk of erosion is not great. Therefore if it is cultivated it needs no special management practices to prevent erosion. This soil is in capability class I and in management group 1.

Charlton loam, 15 to 25 percent slopes (Ce).—This soil occurs in only a few scattered areas. It is on steep slopes that are generally short and irregular. It is similar to Charlton loam, 8 to 15 percent slopes. Nevertheless, because of its steep slopes, it has more rapid surface runoff and is more erodible.

Use and management.—About 40 percent of this soil is used for crops. The rest is under forest or is pastured or idle. Generally, the pastured and idle areas are neglected and are covered by broomsedge, common juniper, gray birch sprouts, poverty oatgrass, and redtop. This soil is in capability class IV, subclass IVe, and in management group 8.

Charlton loam, 25 to 35 percent slopes (Cf).—Except for its steep slopes, this soil is similar to Charlton loam, 8 to 15 percent slopes. It is too steep for cultivation and is best used for pasture or as woodland. It is covered mainly by broomsedge, common juniper, gray birch sprouts, poverty oatgrass, and redtop. This soil is in capability class VI, subclass VIe, and in management group 10.

Charlton stony loam, 8 to 15 percent slopes (Ck).—Except that stones are on the surface and throughout the profile, this soil is similar to Charlton loam, 8 to 15 percent slopes. In forested areas, however, a layer of leaves and branches, about 2 inches thick, covers the surface and a 2- to 3-inch surface layer of dark-brown to strong-brown granular loam is matted with small roots.

Surface runoff and internal drainage are medium, and the soil retains moisture well. Roots, water, and air penetrate the subsoil readily.

Use and management.—The cost of removing the stones is too great to justify using this soil for tilled crops, and it is mainly under forest. Scattered areas have been cleared and are pastured or idle. The pastures are less productive than those in stone-free areas.

The plant cover in neglected areas consists chiefly of common juniper, broomsedge, gray birch sprouts, and poverty oatgrass. The small areas between the stones are used to grow hay or vegetables. The forest trees are mostly beech, gray birch, hickory, white and red oaks, and white pine. The undergrowth consists mainly of blueberries, blackberries, brackenfern, witch-hazel, sumac, and poison-ivy. This soil is in capability class VI, subclass VIs, and in management group 12.

Charlton stony loam, 0 to 8 percent slopes (Ch).—Except that it is nearly level to undulating, this soil resembles Charlton stony loam, 8 to 15 percent slopes. It has less rapid surface runoff, however, and retains more moisture.

Use and management.—The small, widely scattered areas of this soil are mostly in forest. The trees are of about the same kind as the ones growing on Charlton stony loam, 8 to 15 percent slopes. In areas where it is practical to remove the stones, this soil is good for farming. It is in capability class VI, subclass VIs, and in management group 12.

Charlton stony loam, 15 to 25 percent slopes (Cm).—Except that it has steeper slopes, this soil resembles Charlton stony loam, 8 to 15 percent slopes. Most of the slopes are fairly short, and surface runoff is more rapid than on the less sloping soil. Because of its strong slopes and numerous stones, this soil should not be cleared. It is in capability class VI, subclass VIs, and in management group 12.

Charlton stony loam, 0 to 15 percent slopes (Cg).—This soil resembles the other Charlton stony loams but varies according to the slope that is predominant in a given area. This soil is used and managed about the same as the other Charlton stony loams. It is in capability class VI, subclass VIs, and in management group 12.

Coastal beach and dune sand

Coastal beach and dune sand (Cn).—This mapping unit is made up of beaches and coastal sands, or dunes, that are behind the beaches. Coastal beach consists of narrow, sloping strips of compact sand or gravel that are covered by water at high tide and exposed at low tide. The sands back of the beaches have been blown into ridges, hummocks, or dunes on which there is a sparse growth of beachgrass.

This mapping unit occurs along the coast from Portsmouth and New Castle south to Seabrook. The largest areas are Jenness Beach in the town of Rye; North and Hampton Beaches in the town of Hampton; and Seabrook Beach in the town of Seabrook. This mapping unit is in capability class VIII, subclass VIIIs, and in management group 16.

Elmwood series

The soils of the Elmwood series are level to gently sloping. They are moderately well drained and have formed on sandy gravel-free outwash derived from granite or schist. These soils are underlain by neutral to medium acid glaciolacustrine or marine silts and clays. They belong to the same catena as the well drained Melrose, the poorly drained Swanton, and the very poorly drained Whately soils and are associated with the Hollis, Charlton, and Gloucester soils.

The forest trees on these soils are chiefy white ash, gray and yellow birches, hemlock, red maple, white and black oaks, and white pine. The undergrowth consists of high-bush blueberries, brakenfern, sweetfern, witch-hazel, and cinquefoil. The soils belong to the Brown Podzolic great soil group. They are in the eastern part of the county near the coast.

Elmwood fine sandy loam, 3 to 8 percent slopes (Eb).—This gently sloping soil is the most extensive of the Elmwood soils. It is in the eastern part of the county.

Typical profile observed in a cultivated field:

0 to 7 inches, dark grayish-brown or brown fine sandy loam; very friable; very fine granular structure; strongly acid.

7 to 16 inches, yellowish-brown fine sandy loam free of pebbles; very friable; weak very fine granular structure; medium acid.

16 to 20 inches, light yellowish-brown or light olive-brown fine sandy loam mottled with gray; loose; single grain (structureless); medium acid.

20 inches +, olive or olive-gray clay, silty clay, or laminated silt and clay; very compact in place; plastic and sticky when wet; coarse blocky or platy structure; neutral to medium acid; the materials that are of lacustrine origin are laminated, but those that are of marine origin are not.

In places the surface layer is grayish brown. It ranges from 6 to 8 inches in thickness. Depth to the clay, silty clay, or laminated silt and clay ranges from 18 to 30 inches but is generally between 18 and 24 inches. Included are small areas of sandy loam and small areas that are poorly drained.

This soil has slow surface runoff and internal drainage. The substratum has rather slow permeability. The profile above the substratum is affected by a perched water table.

Use and management.—Most of this soil has been cleared and is cultivated, pastured, or idle. A small acreage is in forest. The slow drainage limits the crops that can be grown successfully. Roots seldom penetrate to depths greater than 2 feet because the soil has a high water table and a clay substratum. The principal crops are hay, grass and corn grown for silage, and vegetables grown for home use. Pastures are fair to good, even in dry years. If the soil is used for clean-tilled crops, it must be managed carefully to prevent erosion. Fertilizer is needed, but tests should be made to determine the kinds and amounts required. This soil is in capability class II, subclass IIw, and management group 3.

Elmwood fine sandy loam, 0 to 3 percent slopes (Ea).—Except for relief, this soil is similar to Elmwood fine sandy loam, 3 to 8 percent slopes. It is less susceptible to erosion. Most of this soil has been cleared and is cultivated, pastured, or idle. A small acreage is in forest. This soil should be managed in about the same way as Elmwood fine sandy loam, 3 to 8 percent slopes, and crops and yields are about the same. It is in capability class II, subclass IIw, and management group 3.

Fresh water marsh

Fresh water marsh (Fa).—This land consists of wet, periodically flooded areas covered dominantly with grasses, cattails, rushes, or other herbaceous plants. It is inland from the coast and, unlike Tidal marsh, it is influenced by fresh water and not by sea water. It is covered mostly with grasses and similar plants rather than trees. This soil is in capability class VIII, subclass VIIIw, and management group 15.

Gloucester series

The soils of the Gloucester series are well drained. The predominant relief is gently rolling to rolling but ranges from nearly level to hilly. The soils have developed on glacial till derived largely from granite and gneiss. Some of them contain few stones, but most are moderately stony or very stony.

These soils belong to the same catena as the well drained shallow Shapleigh soils, the moderately well drained Acton soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils. They are associated with the Paxton and Charlton soils. The soils belong to the Brown Podzolic great soil group.

The forest trees on these soils are hardwoods and conifers that grow in a mixed stand. They are mainly gray birch, red maple, oak, and white pine. These soils occur throughout the county, mainly in the towns of Auburn, Brentwood, Candia, Chester, Danville, Fremont, Raymond, and Sandown. Scattered areas occur in Northwood, Newington, and Portsmouth in the northwestern and northeastern parts of the county.

Gloucester sandy loam, 8 to 15 percent slopes (Gd).—This soil occupies small, scattered areas. It occurs in many places throughout the county.

Typical profile observed in a forested area:

0 to 2 inches, very dark grayish-brown to very dark brown sandy loam that is darker colored near the surface; very friable; weak fine to very fine granular structure.
2 to 14 inches, dark-brown coarse sandy loam; friable; weak fine granular structure.
14 to 30 inches, yellowish-brown gravelly and stony coarse sandy loam; very friable; very weak fine granular structure.
30 inches +, light olive-brown to olive stony gravelly coarse loamy sand; firm in place, friable when disturbed; mostly single grain (structureless); the pebbles and stones are generally angular.

In areas where this soil is associated with Brookfield or Charlton loams, the surface layer and subsoil in places are browner than typical. A few fragments of angular granite and gneiss are scattered on the surface in most places. A few areas in which the texture of the surface layer is fine sandy loam are included with this soil.

Surface runoff and internal drainage are medium to rapid, and the soil is somewhat droughty. This is an acid soil; the surface layer is very strongly acid, but the subsoil is slightly less acid.

Use and management.—About 40 percent of this soil is cultivated. The rest is pastured, in woods, or idle. Hay and corn for silage are the chief crops. Small acreages are used to grow field corn, potatoes, sweet corn, and vegetables for home use. Yields are generally low because of the low fertility and droughtiness of this soil, but if adequate fertilizer is used, fair to good yields are obtained. The soil warms early in spring so that early vegetables can be grown. As a rule it needs lime, and the amount needed can be determined by soil tests. Careful management is needed to prevent erosion from damaging this soil, but erosion is not so serious as on the finer textured soils.

As a rule pastures are given little care, and the carrying capacity is low. The plant cover on pastures and idle areas consists mostly of blackberries, blueberries, broomsedge, gray birch sprouts, common juniper, poison-ivy, redtop, sumac, and sweetfern. This soil is in capability class III, subclass IIIe, and in management group 5.

Gloucester sandy loam, 0 to 3 percent slopes (Ga).—Except that it is level to nearly level, this soil resembles Gloucester sandy loam, 8 to 15 percent slopes. Runoff is less rapid than on the more sloping soil, so this soil is better suited to crops. Even though clean-tilled crops are grown, erosion is not a problem. This soil is managed about the same as Gloucester sandy loam, 8 to 15 percent slopes, but less intensive practices are needed to prevent erosion. It is in capability class I and in management group 1.

Gloucester sandy loam, 3 to 8 percent slopes (Gb).—Except for slope, this soil resembles Gloucester sandy loam, 8 to 15 percent slopes. It has less rapid surface runoff than the steeper soil, and the risk of erosion is not so great.

Use and management.—A little more than 50 percent of this soil is used for crops. The rest is pastured, in forest, or idle. If the soil is cultivated, only simple practices are needed to control erosion. This soil is in capability class II, subclass IIe, and in management group 2.

Gloucester sandy loam, 15 to 25 percent slopes (Ge).—This soil occurs in association with the less sloping Gloucester soils. It has more rapid surface runoff than the associated soils, and the risk of erosion is greater.

Use and management.—This soil has limited use for cultivated crops because of the risk of erosion. Most of it is in forest. The rest is used for crops or pasture or is idle. This soil is in capability class IV, subclass IVe, and in management group 7.

Gloucester sandy loam, 3 to 15 percent slopes (Gc).—This soil is similar to Gloucester sandy loam, 3 to 8 percent slopes, or to Gloucester sandy loam, 8 to 15 percent slopes, depending on the predominant relief in the given area. It is in capability class III, subclass IIIe, and in management group 5.

Gloucester stony sandy loam, 8 to 15 percent slopes (Gg).—Except for the many stones and the layer of organic debris that has accumulated on the forest floor, this soil is similar to the cultivated Gloucester sandy loams. Many stones and boulders as large as 3 to 4 feet in diameter occur on the surface at intervals of 5 to 20 feet and throughout the profile (fig. 3). This is one of the most extensive soils in the county.

Use and management.—Almost all of this soil is in forest. The forests consist largely of second- and third-growth trees, chiefly beech, gray birch, hemlock, hickory, red maple, red and white oaks, and pitch and white pines. The undergrowth is mainly barberries, blueberries, brackenfern, poison-ivy, sheep laurel, sweetfern, sumac, wintergreen, and witch-hazel.

On the few native pastures, Colonial bentgrass, Kentucky bluegrass, poverty oatgrass, and redtop grow in the more fertile parts. On the neglected areas are aspen sprouts, gray birch, broomsedge, hardhack, common juniper, poverty oatgrass, sumac, and sweetfern. Because of the many stones on the surface, pastures on this soil have a slightly lower carrying capacity than pastures on the other Gloucester sandy loams, even though managed the same. This soil is in capability class VI, subclass VIs, and in management group 12.

Gloucester stony sandy loam, 0 to 8 percent slopes (Gf).—Except that it has milder slopes, this soil is similar to Gloucester stony sandy loam, 8 to 15 percent slopes. It occurs in small, scattered areas, normally on the crests of hills. The plant cover is the same as that growing on Gloucester stony sandy loam, 8 to 15 percent slopes.

Use and management.—Most of this soil is in forest, but small areas have been cleared and are pastured or idle (fig. 4). Because this soil has slower runoff, it is slightly better for pasture and crops than the more

Figure 3.—Profile of a Gloucester stony sandy loam. The underlying glacial till contains many stones, and there are many stones throughout the profile.

sloping soil. It is in capability class VI, subclass VIs, and in management group 12.

Gloucester stony sandy loam, 15 to 25 percent slopes (Gk).—Except for its short, steep slopes, this soil is similar to the other Gloucester stony sandy loams. It occurs in small, scattered areas in association with the other Gloucester soils. Because of more rapid runoff, it is more erodible than the associated soils.

Use and management.—Most of this soil is in forest. The trees and undergrowth are the same kind as those growing on the other Gloucester stony sandy loams. This soil is best kept under forest or used for grazing. It is in capability class VI, subclass VIs, and in management group 12.

Gloucester stony sandy loam, 0 to 15 percent slopes (Gh).—Except that part of this soil has milder slopes, it is similar to Gloucester stony sandy loam, 8 to 15 percent slopes, and it is used and managed in about the same way. It is in capability class VI, subclass VIs, and in management group 12.

Gloucester very stony sandy loam, 15 to 25 percent slopes (Gn).—Except that it has a greater number of stones and boulders on the surface and throughout the profile, this soil is similar to Gloucester stony sandy loam, 15 to 25 percent slopes. The stones and boulders on the surface are about 2 to 5 feet apart.

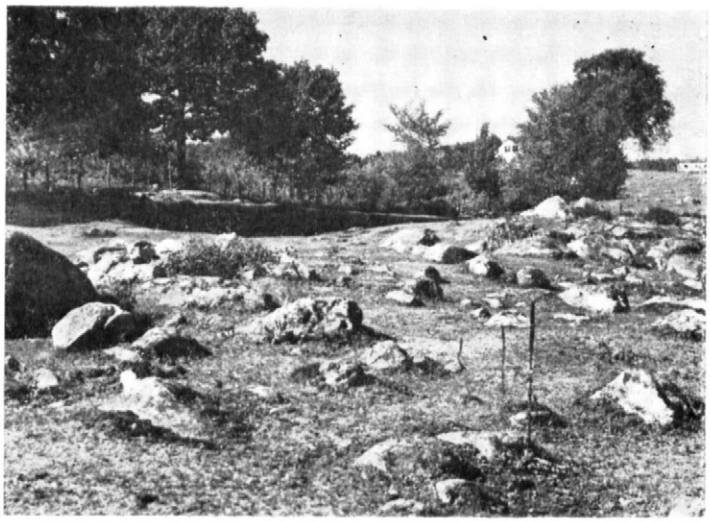

Figure 4.—Pasture on a stony Gloucester soil. The pastures on the Gloucester soils generally have many stones and boulders.

Use and management.—This soil is of little agricultural value. It is all under forest and is best used for that purpose. This soil is in capability class VII, subclass VIIs, and in management group 14.

Gloucester very stony sandy loam, 3 to 15 percent slopes (Gm).—This soil occurs in the southern part of the county. Except that it has milder slopes, it is similar to Gloucester very stony sandy loam, 15 to 25 percent slopes. It is in capability class VII, subclass VIIs, and in management group 14.

Gloucester and Scituate series

This is an undifferentiated soil group composed of the well drained soils of the Gloucester series and the moderately well drained soils of the Scituate series. The soils occur in the west-central and south-central parts of the county. On forested areas the trees are mainly alder, ash, gray and yellow birches, elm, red maple, and white oak. In open areas there are various grasses, blackberries, high-bush blueberries, dandelions, hardhack, and meadowsweet. The Gloucester soils have been described under the Gloucester series. The following is a description of the Scituate soils.

The Scituate series consists of level to strongly sloping soils formed on very firm, fine-grained granitic till of Late Wisconsin age. The soils belong to the same catena as the poorly drained Ridgebury and the very poorly drained Whitman soils. They are associated with the Gloucester soils, formed from loose granitic till, and with the Hinckley and Merrimac soils, formed on outwash of granitic origin. The Scituate soils differ from the moderately well drained Acton soils, also formed on loose granitic till, in that their parent matarial is finer textured and is very firm. Like the Gloucester soils, they belong to the Brown Podzolic great soil group. A description of a profile of Scituate sandy loam, 0 to 3 percent slopes, which is typical of the Scituate series, follows. This profile was observed in a forested area.

1 to ¾ inch, loose pine needles and a few leaves of hardwood trees.
¾ to ½ inch, pine needles from preceding year, whole but dirty.
½ to ¼ inch, matted needles, partly decomposed.
¼ to 0 inch, discontinuous layer of black, well-decomposed humus, mixed in places with soil; has a 2- to 4-inch microrelief showing evidence of the activity of insects or small animals.
0 to 3 inches, very dark grayish-brown sandy loam that is dark brown when dry; contains many roots, as well as much organic matter that colors upper part of profile darker than lower part; very friable; weak fine granular structure.
3 to 16 inches, dark-brown fine sandy loam that is yellowish brown when dry; contains many roots; has coarse, very faint mottles of a darker color around the decaying roots; very friable; weak fine granular structure.
16 to 24 inches, dark yellowish-brown to olive-brown fine sandy loam that is olive brown when dry; common, coarse, distinct, yellowish-brown mottles; very friable; weak fine granular structure in upper part and weak platy, in places, in lower part; contains between 10 and 20 percent of fine gravel.
24 to 36 inches +, light olive-brown to olive fine sandy loam with common, coarse, prominent mottles that are light brownish gray, yellowish brown, and strong brown; very firm in place, friable if disturbed; moderate medium platy structure; roots penetrate this pan layer.

The mottling generally occurs at depths between 14 and 18 inches. It varies in distinctness but generally becomes more distinct with depth. In places where the upper part of the subsoil is mottled, the surface soil is somewhat darker than normal.

Surface runoff is medium to slow, and internal drainage is rather slow. The very firm substratum retards internal drainage to some extent.

Gloucester and Scituate sandy loams, 3 to 8 percent slopes (Gr).—The soils of this mapping unit have small fragments of granite and gneiss scattered on the surface and throughout the profile. The larger stones have been removed.

Surface drainage is medium. In areas where the substratum is compact, internal drainage is slow. The very firm or compact layer holds above it a supply of water for crops, grasses, and trees. In wet seasons the water moves laterally along the firm layer and seepage spots develop along the lower slopes and in low places.

Use and management.—About 60 percent of this mapping unit is cultivated, 10 percent is in forest, and the rest is in pasture or idle. The soils have slopes that are suitable for the use of tractors and other farm machinery, and most fields are large enough for that purpose.

The soils respond well to good management, including the use of fertilizer. Hay and forage crops yield fairly well. If the soils are planted to cultivated crops, simple practices are needed to control erosion.

The native grasses are mainly Colonial bentgrass, Canada and Kentucky bluegrass, broomsedge, poverty oatgrass, and redtop. Weeds that grow on neglected pastures are broomsedge, gray birch sprouts, common juniper, hardhack, hawkweed, and hairycapmoss. This mapping unit is in capability class II, subclass IIw, and in management group 3.

Gloucester and Scituate sandy loams, 0 to 3 percent slopes (Go).—Except for relief, the soils of this mapping unit are similar, in most respects, to Gloucester and Scituate sandy loams, 3 to 8 percent slopes, and management is about the same. They are more desirable for crops, however, because runoff is slower, erosion is not a problem, and the soils require no special cultivation practices. This mapping unit is in capability class II, subclass IIw, and in management group 3.

Gloucester and Scituate sandy loams, 8 to 15 percent slopes (Gs).—Except that they have stronger slopes, the soils of this mapping unit are similar to Gloucester and Scituate sandy loams, 3 to 8 percent slopes. They are more erodible because surface runoff is more rapid.

Use and management.—More than 60 percent of this mapping unit is cultivated. The rest is under forest, in pasture, or idle. The soils are suited to all of the crops commonly grown, but if they are used for tilled crops, intensive practices are needed to prevent erosion. In other ways the soils are managed in about the same way as Gloucester and Scituate sandy loams, 3 to 8 percent slopes. This mapping unit is in capability class III, subclass IIIw, and in management group 5.

Gloucester and Scituate sandy loams, 15 to 25 percent slopes (Gt).—Except for having stronger slopes, the soils of this mapping unit are similar to Gloucester and Scituate sandy loams, 8 to 15 percent slopes. They are highly erodible if clean-tilled crops are grown. Intensive practices are needed to control erosion, and cultivation should be limited. The soils are best used for hay and pasture. This mapping unit is in capability class IV, subclass IVe, and in management group 7.

Gloucester and Scituate sandy loams, 3 to 15 percent slopes (Gp).—The soils are similar to Gloucester and Scituate sandy loams, 3 to 8 percent slopes, or to Gloucester and Scituate sandy loams, 8 to 15 percent slopes, depending on the predominant relief in a given area. In some areas the slopes are less than 3 percent, and in others they are greater than 15 percent. This mapping unit is in capability class III, subclass IIIw, and in management group 5.

Gloucester and Scituate stony sandy loams, 3 to 8 percent slopes (Gv).—These soils have stones and boulders, chiefly of granite and gneiss, on the surface and throughout the profile. The stones have been removed from some areas, but there are still enough to prevent the use of heavy farm machinery. The soils are associated with the stone-free Gloucester and Scituate sandy loams.

Use and management.—Almost 90 percent of this mapping unit is in forest. The rest is pastured, in crops, or idle. The forest trees are chiefly gray and yellow birches, hemlock, red maple, white and red oaks, and white pine. The undergrowth consists of blueberries, brackenfern, witch-hazel, mountain-holly, and wintergreen.

If the same management is used, including the use of fertilizer, pasture plants similar to those grown on the stone-free Gloucester and Scituate soils can be grown, but the carrying capacity is slightly lower. This mapping unit is in capability class VI, subclass VIs, and in management group 12.

Gloucester and Scituate stony sandy loams, 8 to 15 percent slopes (Gw).—Except for steeper slopes, these soils are similar to Gloucester and Scituate stony sandy

loams, 3 to 8 percent slopes. They are more erodible than the more nearly level Gloucester and Scituate soils. About 90 percent of the acreage is in forest, a few acres are in crops, and the rest is in pasture or idle. This mapping unit is in capability class VI, subclass VIs, and in management group 12.

Gloucester and Scituate stony sandy loams, 15 to 25 percent slopes (Gx).—Except for their steeper slopes, these soils are similar to Gloucester and Scituate stony sandy loams, 3 to 8 percent slopes. The areas are practically all under forest. These soils are in capability class VI, subclass VIs, and in management group 12.

Gloucester and Scituate stony sandy loams, 0 to 15 percent slopes (Gu).—These soils are similar to Gloucester and Scituate stony sandy loams, 3 to 8 percent slopes, or to Gloucester and Scituate stony sandy loams, 8 to 15 percent slopes, depending on the predominant relief in the given area. They are in capability class VI, subclass VIs, and in management group 12.

Hinckley series

The Hinckley soils are coarse textured and are excessively drained. They have developed from glaciofluvial deposits derived largely from granite, gneiss, and schist. Relief ranges from hummocky and strongly sloping to level and nearly level.

These soils occur throughout the county. The largest areas are in the towns of Newington and Portsmouth. The soils belong to the Brown Podzolic great soil group.

Hinckley loamy sand, 8 to 35 percent slopes (Hc).—This soil has developed from coarse sand and gravel that were derived mainly from granite. It occurs in small to fairly large, widely separated areas throughout the county. This soil is associated with the Merrimac soils. Its relief is hummocky, hilly, or uneven and steep.

Typical profile observed in a forested area:

2 to 0 inches, a thin layer of leaves underlain by dark-brown partly disintegrated leaves and twigs that are mixed in places with soil from the horizon immediately below; extremely acid.
0 to 3 inches, grayish-brown or dark grayish-brown loose gravelly loamy sand; weak fine granular structure; extremely acid.
3 to 9 inches, yellowish-brown loose gravelly loamy sand; weak fine granular structure; strongly acid.
9 to 15 inches, light yellowish-brown loose gravelly loamy sand; single grain (structureless); strongly acid.
15 inches +, light-gray or light yellowish-brown, loose, stratified, rounded sand and gravel; single grain (structureless); strongly acid.

The color of the surface layer ranges from grayish brown or dark grayish brown to brown. The depth to the stratified layer ranges from 14 to 20 inches. The sand and gravel are waterworn, and the layer contains some cobblestones and boulders that range in diameter from a few inches to several feet. A variable amount of gravel occurs in places on the surface and throughout the profile, but, except for a few scattered areas, this soil is generally free of stones.

Permeability is rapid in the upper part of this soil and very rapid at a depth below 15 inches. Therefore, the soil stores little water for plants.

Use and management.—Most of this soil is covered by a forest of scrubby trees that are mainly gray birch, red maple, scrub and white oaks, and white and pitch pines. On native pastures the plants are mostly broomsedge and poverty oatgrass, which provide poor grazing. Sweetfern, blueberries, and moss are also common in the pastures or in idle areas. Careful management is needed on cleared areas or this soil will be damaged by wind or sheet erosion will occur. Crops and grasses do not grow well because of lack of moisture. If fertilizers are added, they are leached out rapidly.

There are many gravel pits in this soil, and the gravel taken from the gravelly substratum is used extensively for roadbuilding. Generally, the soil is more valuable for this use than for agriculture. It is in capability class VII, subclass VIIs, and in management group 14.

Hinckley loamy sand, 0 to 3 percent slopes (Ha).—Except for texture and depth to the stratified layer, this soil resembles the Merrimac soils. It is coarser textured, looser, and less coherent throughout. The surface layer is mainly loamy sand, but some scattered areas of loamy fine sand are included. In some areas the soil is slightly wind eroded, and there are several blowholes. The soil occurs throughout the county in small to large areas. Fairly large areas are in the towns of Brentwood, Auburn, Chester, Fremont, Newington, Raymond, and Sandown.

Use and management.—Most of this soil is in forest. A small acreage is in pasture or idle. Only a few small areas are cultivated, and the principal crops are hay and vegetables. Yields are generally low unless large amounts of fertilizer are added, but manure, fertilizer, and lime leach out rapidly.

The pastures have a low carrying capacity. The main pasture plants are broomsedge, cinquefoil, moss, poverty oatgrass, and sweetfern.

The forests on some areas consist of almost pure stands of white pine or pitch pine. In other places white pine is predominant, but the stands contain some gray birch, red maple, and white oak. This soil is in capability class III, subclass IIIs, and in management group 6.

Hinckley loamy sand, 3 to 8 percent slopes (Hb).—Except for slope, this soil is similar to Hinckley loamy sand, 0 to 3 percent slopes, with which it is associated.

Use and management.—This soil is largely in forest. Because of its excessive drainage, only a small acreage is cultivated. Hay and vegetables are the chief crops, but yields are low. The use and management of this soil are about the same as for Hinckley loamy sand, 0 to 3 percent slopes, and the trees and other plants in the forests and on idle areas are about the same. This soil is in capability class III, subclass IIIs, and in management group 6.

Hinckley stony loamy sand, 3 to 25 percent slopes (Hd).—This soil is associated with the nonstony Hinckley loamy sands. It consists of areas of Hinckley loamy sand that have boulders or stones scattered on the surface. This soil is used only for forest. It is in capability class VII, subclass VIIs, and in management group 14.

Hollis-Charlton complexes

In these complexes the Hollis soils are dominant. The areas of Charlton soils are too small to map separately

but are important from a management standpoint. The complexes occur throughout the county but are mainly in the town of Chester in the west-central part of the county and in the towns of Greenland, Newington, Newmarket, North Hampton, Portsmouth, Rye, and Stratham in the northeastern part. The Charlton soils have been described under the Charlton series. The following is a description of the Hollis soils.

The Hollis soils are level to steep, but in most places the slopes are between 8 and 15 percent. The soils are shallow and are well drained. They have developed on till of Late Wisconsin age. The till was derived from a shattered, uneven bedrock of gray, acid mica schist or phyllite.

The Hollis soils belong to the same catena as the well drained Charlton soils, the moderately well drained Sutton soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils. They adjoin areas of Shapleigh, Gloucester, Brimfield, and Brookfield soils. Of these adjoining soils, the Shapleigh and Brimfield soils are also shallow, the Brookfield soils are moderately deep, and the Gloucester soils are deep. The Gloucester soils have developed on sandy granitic till, and the Brookfield soils, on slightly weathered, limonitic mica schistose till.

The most extensive soil types are loam, rocky loam, and very rocky very stony loam, but some areas of fine sandy loam are included. In many places loose stones occur on the surface, and in places there are outcrops. In the rocky loams and very rocky very stony loams, outcrops are so numerous that farm machinery cannot be used. A description of a profile of Hollis loam, 8 to 15 percent slopes, which is typical of this series, follows. This profile was observed in a cultivated area.

0 to 6 inches, brown micaceous loam that contains a few coarse sand particles and a few small flattened fragments of mica schist; has a moderate amount of organic matter; weak very fine granular structure; strongly acid.

6 to 17 inches, light to medium yellowish-brown micaceous loam that contains a few coarse sand particles and small fragments of flattened mica schist; has a rather low amount of organic matter; coherent in place, but very friable when disturbed; weak very fine granular structure; strongly acid.

17 to 24 inches, olive, pale-olive, or yellowish-brown loamy till that contains many fragments of flattened mica schist; weak very fine granular structure; firm to loose in place, and loose when disturbed; medium to strongly acid.

24 inches +, an uneven layer of shattered mica schist or phyllite with tilted strata; less shattered with increasing depth; firm bedrock at a depth of 3 to 4 feet.

Differences in the parent rock have brought about differences in the Hollis soils. The depth to which the solum is developed varies, but in most places the solum extends down to the bedrock and there is no C horizon. In 50 to 60 percent of the acreage, the bedrock is less than 2 feet below the surface. In some places the bedrock is smooth, but in others it is weathered and the lower part of the profile contains small pieces of platy schist. In areas where the bedrock is weathered, there are knolls of rock chips.

The Hollis soils have medium to rapid surface runoff and internal drainage. They are not especially droughty, however, because water is stored locally in low places in the uneven bedrock. Roots, air, and water penetrate readily.

Hollis-Charlton loams, 8 to 15 percent slopes (Hg).—This is the most extensive of the rock-free Hollis-Charlton complexes, and it is the most important agriculturally. Most of the loose stones have been removed from its surface and used to build stone walls or fences. This complex occurs in association with the Charlton loams. The soils are generally much shallower than the Charlton loams, outcrops are more numerous, and a greater number of schist fragments are in the surface layer and subsoil. The soils are well drained.

Use and management.—Although the soils of this complex respond well to fertilizer, they are not easy to work because they are shallow and have many fragments of schist in the surface layer. Also, for tilled crops, erosion control practices must be used intensively. Where the soils are more than 18 inches deep, they retain moisture well. In the shallower areas, however, crops are damaged occasionally by lack of moisture.

The principal crop is hay, and small acreages are planted to clover, oats, rye, potatoes, vegetables for home use, corn for silage, field corn, and sweet corn. Some native grasses in fertile areas are Colonial bentgrass, Kentucky bluegrass, poverty oatgrass, and redtop. On neglected or idle areas, the vegetation is mostly gray birch sprouts, blueberries, broomsedge, hardhack, common juniper, meadowsweet, poverty oatgrass, sweetfern, and sumac. This complex is in capability class IV, subclass IVs, and in management group 9.

Hollis-Charlton loams, 0 to 3 percent slopes (He).—The soils of this complex are associated with the soils of the other Hollis-Charlton complexes. They need no special management to control erosion. This complex is in capability class II, subclass IIs, and in management group 4.

Hollis-Charlton loams, 3 to 8 percent slopes (Hf).—Except for slope, this complex is similar to Hollis-Charlton loams, 8 to 15 percent slopes. Because of its milder slopes, it has slower surface runoff, slightly higher water-holding capacity, and is less erodible if clean-tilled crops are grown.

Use and management.—Less than 25 percent of this complex is cultivated. The rest is in forest, pasture, or idle. This complex is better for farming than Hollis-Charlton loams, 8 to 15 percent slopes. Only simple management practices are needed to control erosion. It is desirable to rotate crops on these soils and to add fertilizer. This complex is in capability class II, subclass IIs, and in management group 4.

Hollis-Charlton loams, 15 to 25 percent slopes (Hh).—Except that it has stronger slopes, this complex is similar to Hollis-Charlton loams, 8 to 15 percent slopes.

Use and management.—Less than 50 percent of this complex is cultivated. The rest is in forest, pasture, or idle. The soils are highly erodible; therefore cultivation should be limited and intensive methods used to control erosion. About the same crops are grown on this complex as on Hollis-Charlton loams, 8 to 15 percent slopes. Under the same management, however, yields are lower. This complex is in capability class VI, subclass VIe, and in management group 10.

Hollis-Charlton rocky loams, 8 to 15 percent slopes (Hn).—This complex is associated with the Hollis-Charlton loams that are free of rocks. The soils have developed largely from a thin mantle of till derived mainly from schist but partly from weathered bedrock. Outcrops are common. In the areas where the bedrock occurs at depths greater than 18 to 24 inches, the Charlton soils are predominant. In more than half of the acreage, however, the soils are shallow, ranging from a few inches in depth to less than 2 feet. Erosion has been slight.

In areas under forest there is a 1½- to 3-inch layer of organic debris on the surface. The surface soil in these areas is dark-brown or strong-brown loam, matted with roots, and its structure is weak granular in places.

The shallowness of these soils limits the water-holding capacity. In most seasons, however, the moisture supply is adequate for trees and grasses. Surface runoff and internal drainage are medium. Roots, air, and water penetrate the soil readily down to the bedrock.

Use and management.—This shallow, rocky complex is practically all in forest. The principal trees are gray birch, hickory, red maple, red and white oaks, and white pine. This complex is in capability class VI, subclass VIs, and in management group 12.

Hollis-Charlton rocky loams, 3 to 8 percent slopes (Hm).—Except that it has milder slopes, this complex is similar to Hollis-Charlton rocky loams, 8 to 15 percent slopes. The soils retain slightly more moisture, and if they are cleared of trees, they are better for pasture.

Use and management.—The native pasture grasses on this complex are mostly Colonial bentgrass, Kentucky bluegrass, broomsedge, and poverty oatgrass. The plant cover on neglected pastures consists mainly of gray birch sprouts, blueberries, cinquefoil, dewberries, hardhack, common juniper, meadowsweet, poison-ivy, sumac, and sweetfern. Most of this complex is in forest, and the same kinds of trees grow on it as on Hollis-Charlton rocky loams, 8 to 15 percent slopes. It is in capability class VI, subclass VIs, and in management group 12.

Hollis-Charlton rocky loams, 15 to 25 percent slopes (Ho).—Except that it has stronger slopes, this complex is similar to Hollis-Charlton rocky loams, 8 to 15 percent slopes. Some small areas are included in which the slopes are steeper than 25 percent. Almost all of this complex is in forest, and the trees are of the same kind as those growing on Hollis-Charlton rocky loams, 8 to 15 percent slopes. This complex is in capability class VII, subclass VIIs, and in management group 14.

Hollis-Charlton rocky loams, 3 to 15 percent slopes (Hk).—This soil is similar in characteristics and in use and management to Hollis-Charlton rocky loams, 3 to 8 percent slopes, or to Hollis-Charlton rocky loams, 8 to 15 percent slopes, depending on the predominant relief of the area. This complex is in capability class VI, subclass VIs, and in management group 12.

Hollis-Charlton very rocky very stony loams, 3 to 15 percent slopes (Hp).—This complex has more exposed bedrock than the Hollis-Charlton rocky loams and more stones and boulders throughout the profile. The surface stones are generally larger and more difficult to remove. A few nearly level areas are included.

Use and management.—Almost all of this complex is in forest. It has little value for agriculture. If it is cleared, the soils are not so valuable for pasture as the rocky loams, because stones, boulders, and outcrops of bedrock occupy more of the surface. This complex is in capability class VII, subclass VIIs, and in management group 14.

Hollis-Charlton very rocky very stony loams, 15 to 25 percent slopes (Hr).—Except for slope, this complex is similar to Hollis-Charlton very rocky very stony loams, 3 to 15 percent slopes. Practically all of it is in forest. It is in capability class VII, subclass VIIs, and in management group 14.

Hollis-Charlton very rocky very stony loams, 25 to 35 percent slopes (Hs).—Except that it has stronger slopes, this complex is similar to Hollis-Charlton very rocky very stony loams, 3 to 15 percent slopes. Almost all of it is in forest. It is in capability class VII, subclass VIIs, and in management group 14.

Jaffrey series

The soils of the Jaffrey series are level to steep and are well drained to excessively drained. They have developed on kames, eskers, or terrace escarpments of stratified sand and gravel that were derived principally from granite, gneiss, and mica schist. A slightly weathered, brown or rust-colored micaceous or pyritiferous schist gives the profile a yellowish-brown or brownish-yellow color.

These soils belong to the same catena as the well drained to somewhat excessively drained Barnstead soils, the moderately well drained Sudbury soils, the poorly drained Walpole soils, and the very poorly drained Scarboro soils. They are not so fine textured as the Barnstead soils, although the Barnstead soils have formed on outwash plains or terraces and have the same kind of parent material. The Jaffrey soils are associated with the Brimfield and Brookfield soils, which have developed on till. They are similar in texture, structure, and consistence to the Hinckley soils but differ in color and were derived from a different kind of parent material.

These soils belong to the Brown Podzolic great soil group. They occur in widely separated areas, mainly in the north-central part of the county. Their excessive drainage and the steep slopes that occur in some places limit their use for agriculture. The soils are largely in forest. The stands consist mainly of white pine but include some gray birch, red maple, and white oak.

Jaffrey loamy sand, 0 to 3 percent slopes (Ja).—This excessively drained soil is similar to Hinckley loamy sand, 0 to 3 percent slopes. Some of the areas are slightly wind eroded, and there are several blowholes.

Profile observed in a forested area:

2 to 0 inches, (forest floor) thin layer of loose leaves underlain by dark-brown, partly disintegrated leaves that, in places, are mixed with sandy material from the horizon immediately below; strongly acid.

0 to 2 inches, grayish-brown loamy sand that is moderately high in organic matter; loose; fine to very fine granular structure; strongly acid.

2 to 7 inches, brown or yellowish-red loamy sand, slightly stained with organic matter; friable; weak fine to very fine granular structure; strongly acid.
7 to 24 inches, yellowish-brown or brownish-yellow gravelly loamy sand; loose; weak fine to very granular structure in upper part and single grain (structureless) in lower part; strongly to very strongly acid.
24 inches +, stratified sand and gravel of granite, gneiss, and schist; a few slightly weathered rust-colored or brown fragments of schist have stained the surfaces of the rocks yellowish brown; loose; single grain (structureless); strongly acid.

The surface layer ranges in color from grayish brown to dark brown. Depth to the deposits of sand and gravel ranges from 14 to 24 inches. In some places the color of the stratified sand and gravel is grayish brown. The amount of gravel on the surface and throughout the profile varies. Reaction in the surface soil ranges from extremely acid to strongly acid, but the upper part of the subsoil is slightly less acid. Permeability is very rapid at depths below 7 inches.

Use and management.—Almost all of this soil is in forests of white pine. A small acreage is cultivated or idle. The plant cover on idle areas consists mainly of broomsedge, poverty oatgrass, moss, and sweetfern. This soil is of more value as a source of road building, material than for agriculture. If it is used for crops, it needs commercial fertilizer, manure, and lime. If these are used, however, they rapidly leach out. This soil is in capability class III, subclass IIIs, and in management group 6.

Jaffrey loamy sand, 8 to 35 percent slopes (Jc).—This soil is of little value for agriculture. Its gravelly substratum and the open, porous texture of the surface layer and subsoil have caused drainage to be excessive. Surface runoff and internal drainage are rapid to very rapid, and most of the organic matter and plant nutrients have leached out of the profile. Field crops and grasses on this soil are damaged by lack of moisture, and trees do not grow well. This soil is in capability class VII, subclass VIIs, and in management group 14.

Jaffrey loamy sand, 3 to 8 percent slopes (Jb).—Except that it has stronger slopes, this soil is similar to Jaffrey loamy sand, 0 to 3 percent slopes, with which it is associated. Its use and management are about the same except for differences caused by the steeper slopes.

Use and management.—Most of this soil is under forest consisting mainly of white pine. It is of little value for agriculture, and only a small part is cultivated. The principal crops are hay and vegetables, which produce low yields. Broomsedge, poverty oatgrass, sweetfern, and moss grow on the idle areas. This soil is in capability class III, subclass IIIs, and in management group 6.

Leicester and Ridgebury series

The soils of the Leicester and Ridgebury series, mapped together in this county, are level to gently sloping and are poorly drained. They have formed on till of Late Wisconsin age. The till was derived mainly from granite or schist. These soils occur on uplands throughout the county, associated with other soils developed on till. A few areas occur in depressions. The following is a description of the soils of these two series.

The Leicester soils occur in rather small areas. They differ from the Ridgebury soils in that their substratum is loose to firm rather than compact and platy. They belong to the same catenas as the well drained Charlton, Brookfield, and Gloucester soils; the moderately well drained Sutton and Acton soils; and the very poorly drained Whitman soils. They differ from the Whitman soils in that they have a lighter colored surface layer that contains less organic matter. The vegetation on the Leicester soils is mainly red maple, gray birch, speckled alder, blueberries, winterberries, and a few white pines. The Leicester soils belong to the Low-Humic Gley great soil group. A profile description of Leicester fine sandy loam, 0 to 3 percent slopes, follows. This profile was observed in a forested area.

2 to 0 inches, forest litter of loose leaves and fragments of twigs; extremely acid.
0 to 1 inch, nearly black loam; very high content of organic matter and permeated with small roots; very friable; fine granular structure; extremely acid.
1 to 7 inches, very dark gray or very dark grayish-brown fine sandy loam that generally is as much as 10 percent granite or schist fragments; gray when dry; very friable; very weak, very fine or fine granular structure; very strongly acid.
7 to 14 inches, predominantly gray sandy loam, indistinctly mottled with yellowish brown or pale yellow; contains some fragments of gneiss and schist; rather low in organic matter; very friable; weak very fine granular structure; strongly acid.
14 to 30 inches, generally pale-yellow or yellowish-brown sandy loam that has distinct coarse mottles of red and gray; in places contains many grains of sharp-edged coarse sand; friable to very friable; single grain (structureless); strongly acid.
30 inches +, light-gray sandy loam or loamy sand till, distinctly mottled with yellowish brown and pale yellow; as much as 25 percent small to large fragments of gneiss or schist; loose to firm; single grain (structureless); strongly acid.

In the better drained areas, the plow layer is light grayish brown, but it is nearly black where the soils are transitional to the Whitman soils. In most places it is very dark gray when moist and light gray when dry.

Surface runoff is slow to medium. Permeability is very rapid. Included are some small areas in which the surface layer is loam.

The Ridgebury soils have a compact, platy substratum. They have developed on till of Late Wisconsin age, derived from granite, gneiss, or schist.

These poorly drained soils belong to the same catena as the well drained Paxton, the moderately well drained Woodbridge, and the very poorly drained Whitman soils. They belong to the Low-Humic Gley great soil group and are associated with soils of the Brown Podzolic great soil group.

The forests on these soils consist mainly of black alder, elm, red maple, and white pine. A profile description of Ridgebury fine sandy loam, 0 to 3 percent slopes, follows. This profile was observed in a forested area.

2 to 0 inches, (forest floor) a layer consisting mainly of white pine needles.
0 to 3 inches, very dark brown fine sandy loam that contains many roots; very friable; moderate medium granular structure; evidence of earthworm activity.
3 to 7 inches, light olive-brown fine sandy loam with distinct coarse mottles of light olive brown, dark grayish brown and some dark brown; very friable; very weak granular structure.

7 to 14 inches, light olive-brown gravelly sandy loam mottled with grayish brown and yellowish brown; friable to firm in place, and friable when disturbed; weak fine granular structure; water seeps laterally along this horizon.
14 to 24 inches, olive-brown gravelly sandy loam with distinct coarse common mottles of yellowish brown and grayish brown; very firm in place, friable when disturbed; moderate medium platy structure; fewer stones than in the horizons above.
24 to 40 inches +, dark yellowish-brown to olive-brown material that has many prominent coarse mottles of grayish brown and dark brown; color becomes lighter and is olive brown at depths of about 30 inches, and the consistence is less firm; very firm in place, but friable when disturbed; somewhat brittle when dry; weak thick platy structure, vertical cracks indicate large prisms.

Depth to the compact, platy parent material ranges from 15 to 24 inches. The degree of mottling varies, and the depth at which mottling occurs also varies.

Surface runoff is medium and internal drainage is slow. The compact substratum causes the soil moisture to move laterally.

Included are a few areas in which the surface soil is brown and some areas in which the surface soil has a loam texture.

Leicester and Ridgebury fine sandy loams, 3 to 8 percent slopes (Lb).—The soils of this mapping unit are poorly drained. Their profiles are similar to the typical profiles described for the Leicester and Ridgebury soils.

Use and management.—More than 60 percent of this mapping unit is in crops or pasture. The rest is woodland or idle. Hay is the principal crop. The hay crops yield well, but sedges tend to replace the better plants. If drainage is intensive, row crops can be grown but yields are low. Pasture grasses on these soils are birdsfoot trefoil, bromegrass, alsike and Ladino clovers, redtop, and reed canarygrass. This mapping unit is in capability class IV, subclass IVw, and in management group 8.

Leicester and Ridgebury fine sandy loams, 0 to 3 percent slopes (La).—Except that the soils are level to nearly level, this mapping unit is similar to Leicester and Ridgebury fine sandy loams, 3 to 8 percent slopes, and use and management are about the same. About 60 percent of it is in crops or pasture. The rest is in forest or idle. This mapping unit is in capability class IV, subclass IVw, and in management group 8.

Leicester, Ridgebury, and Whitman series

This undifferentiated soil group consists mainly of poorly drained Leicester and Ridgebury soils, but it includes the very poorly drained Whitman soils. The Leicester and Ridgebury soils have been described under the undifferentiated soil group consisting of Leicester and Ridgebury soils. The Whitman soils have been described under the Whitman series. The soils occur in small to large areas throughout the county and are associated with other soils that have developed on till.

Leicester, Ridgebury, and Whitman stony fine sandy loams, 3 to 8 percent slopes (Ld).—These soils have mild slopes. More than 95 percent of the mapping unit is under forest, which is its best use. Forest vegetation consists of rushes, sedges, alder, gray birch, and hemlock, soft maple, and other hardwoods. Generally it is too expensive to clear and drain these soils for crops. These soils are in capability class VI, subclass VIs, and in management group 12.

Leicester, Ridgebury, and Whitman stony fine sandy loams, 0 to 3 percent slopes (Lc).—These soils occupy level to nearly level areas. More than 95 percent of the acreage is under forest, its best use. The vegetation is similar to that on the steeper Leicester, Ridgebury, and Whitman soils. These soils are in capability class VI, subclass VIs, and in management group 12.

Melrose series

The soils of the Melrose series are level to sloping and are well drained. They have developed on gravel-free sandy deposits. These deposits occur at depths of 2 or more feet and overlie neutral to medium acid deposits of silt and clay of marine or glaciolacustrine origin.

These soils belong to the same catena as the moderately well drained Elmwood soils, the poorly drained Swanton soils, and the very poorly drained Whately soils. They are associated with the Suffield soils and lie next to areas of Hollis, Charlton, and Gloucester soils. They differ from the Suffield soils in that they have developed on sandy rather than on silty or clayey materials.

These soils belong to the Brown Podzolic great soil group. The forest trees growing on them are mainly white ash, gray birch, pin cherry, elm, red maple, red oak, white pine, and popple. The soils occur in the eastern part of the county near the coast.

Melrose fine sandy loam, 3 to 8 percent slopes (Mb).—This well-drained soil has mild slopes. It is free of gravel.

Typical profile observed in a forested area:

2 to 0 inches, layer of leaves and other forest debris, underlain by a dark-brown, thin, loose layer of partly disintegrated leaves that, in places, is mixed with a small amount of soil from the horizon immediately below; very strongly acid.
0 to 3 inches, brown or grayish-brown fine sandy loam that is free of pebbles; contains a moderate amount of organic matter; firm in place, very friable when disturbed; weak very fine granular structure; very strongly acid.
3 to 10 inches, yellowish-brown fine sandy loam; firm in place, very friable when disturbed; weak very fine granular structure; strongly acid.
10 to 24 inches, similar to layer immediately above but light yellowish brown in the upper part and pale olive or olive below depths of 12 to 14 inches.
24 to 30 inches, pale-olive or olive loamy fine sand; firm in place, very friable when disturbed; single grain (structureless); medium acid.
30 inches +, olive or olive-gray clay, silty clay, or varved clay and silt; very compact in place; plastic and sticky when wet; coarse blocky when dry; neutral to medium acid.

In cultivated fields the surface layer is brown to light brown and is 6 to 8 inches thick. Below depths of 20 to 24 inches, the soil in places is gray to yellowish-gray light fine sandy loam or loamy fine sand underlain by olive-gray clay at depths of 30 to 36 inches. Depth to the substratum ranges from 24 to 60 inches, but in most places the silt and clay occur at depths between 30 and 40 inches.

Surface runoff is slow to medium. Internal drainage is retarded by the clay in the lower part of the profile.

Permeability is rapid in the upper part of the profile but is slow at depths below about 30 inches. Because the capacity for holding moisture is fairly high, crops have adequate moisture except in unusually dry seasons.

Mapped with this soil are small areas in which the texture of the surface soil is very fine sandy loam or loamy sand. Also included are small areas of Suffield silt loam that are too small to map separately.

Use and management.—About 25 percent of this soil is cultivated, 50 percent of it is under forest, and the rest is pastured or idle. The principal crops are timothy or timothy and clover mixed, corn grown for silage, and potatoes. A small acreage is planted to clover grown alone, alfalfa, rye, oats for hay, sweet corn, field corn, and winter squash and other vegetables.

This soil is easily managed and responds well to good management, including the use of fertilizer. Nevertheless, if it is planted to clean-tilled crops, it must be managed carefully to prevent erosion.

On the better native pastures the principal pasture plants are Colonial bentgrass, Kentucky bluegrass, whiteclover, and redtop. On neglected pastures or idle areas are wild aster, broomsedge, gray birch sprouts, cinquefoil, goldenrod, hairycapmoss, hardhack, and sweetfern. This soil is in capability class II, subclass IIe, and in management group 2.

Melrose fine sandy loam, 0 to 3 percent slopes (Ma).—Except that it has milder slopes and is less erodible, this soil is similar to Melrose fine sandy loam, 3 to 8 percent slopes. About the same proportion is cropped, and similar crops are grown. This soil needs about the same kind of management as Melrose fine sandy loam, 3 to 8 percent slopes, and yields are about the same. It is in capability class I and in management group 1.

Melrose fine sandy loam, 8 to 15 percent slopes (Mc).—Except that it has stronger slopes, this soil is similar to Melrose fine sandy loam, 3 to 8 percent slopes. About the same proportion has been cleared, and the soil is used for similar crops.

This soil has more rapid surface runoff and is more likely to erode than the less sloping soil. If cultivated crops are grown, careful management is needed to prevent erosion. Otherwise, management is similar to that of Melrose fine sandy loam, 3 to 8 percent slopes. This soil is in capability class III, subclass IIIe, and in management group 5.

Merrimac series

The soils of the Merrimac series are generally excessively drained and are level to moderately steep. They have developed on terraces or on plains of glacial outwash derived largely from granite, gneiss, or schist.

These soils belong to the same catena as the moderately well drained Sudbury soils, the poorly drained Walpole soils, and the very poorly drained Scarboro soils, and they are associated with the Hinckley soils. They belong to the Brown Podzolic great soil group. The small to fairly large areas occur throughout the county.

The Merrimac soils are fairly free of stones and are easy to till. Nevertheless, the excessive drainage often limits their use for crops. The fine sandy loams are not so droughty as the sandy loams and are more generally used for cultivated crops or for pasture.

Merrimac fine sandy loam, 3 to 8 percent slopes (Me).—This soil occurs in scattered areas throughout the county. It is gently sloping and has good drainage.

Typical profile observed in a forested area:

1 to 0 inch, layer of partly decomposed needles and leaves.
0 to 5 inches, very dark grayish-brown fine sandy loam; friable; weak fine granular structure; strongly acid.
5 to 9 inches, dark-brown sandy loam; friable; weak medium granular structure; strongly acid.
9 to 14 inches, strong-brown sandy loam consisting of 30 percent pebbles as large as 3 or 4 inches in diameter; friable; weak medium granular structure; strongly acid.
14 to 27 inches, yellowish-brown coarse sand; very friable; weak fine granular structure; very strongly acid.
27 inches +, white coarse sand; loose; single grain (structureless); very strongly acid.

In many places, at depths below 24 inches, there are alternating layers of coarse sand and gravel. In cultivated areas the surface layer is brown and overlies a yellowish-brown upper subsoil that is transitional, between depths of 14 and 16 inches, to pale-yellow or yellow noncoherent sandy loam or loamy sand. At depth of about 24 inches the soil is gray, or yellowish-gray to white, stratified coarse sand and gravel of granitic origin. All the horizons are acid.

Surface runoff is very slow. Internal drainage is rapid in the fine sandy loams and very rapid in the sandy loams.

Use and management.—Most of this soil has been cultivated, but now only about 25 percent is used for crops, for pasture, or is idle. On the small part that is cultivated, the principal crops are corn grown for silage, mixed hay crops, potatoes, and vegetables. A small acreage is planted to alfalfa, sweet corn, and small fruits.

This soil is free of stones and has good tilth. It is easy to cultivate and warms early in spring. It can be tilled soon after rains, and the relief is favorable for mechanized farming.

Crops on this soil respond well to soil amendments. If heavy applications of manure, commercial fertilizer, and lime are used, yields are fair to good. Inadequate moisture, however, is a limiting factor in obtaining good yields.

The trees in the areas under forest are mainly white pine, but there is some gray birch, red maple, white and red oaks, and pitch pine. The undergrowth consists of blueberries, blackberries, common juniper, and sweetfern. On idle areas or on native pastures are common juniper, broomsedge, gray birch sprouts, cinquefoil, dewberries, goldenrod, poverty oatgrass, and sweetfern, with a little Colonial bentgrass, Kentucky bluegrass and redtop. Pastures are poor. The soil is in capability class II, subclass IIe, and in management group 2.

Merrimac fine sandy loam, 0 to 3 percent slopes (Md).—Except that it has milder slopes, this soil is similar to Merrimac fine sandy loam, 3 to 8 percent slopes. Surface runoff is less rapid. The risk of erosion is slight, and the soil needs no special management. This soil is in capability class I and in management group 1.

Merrimac fine sandy loam, 8 to 15 percent slopes (Mf).—Except that it has stronger slopes, this soil is similar

to Merrimac fine sandy loam, 3 to 8 percent slopes, with which it is associated. It is of little value for agriculture and is largely in forest. A small acreage is in hay or row crops. The soil needs intensive use of methods to control erosion (fig. 5). It is in capability class III, subclass IIIe, and in management group 5.

Merrimac fine sandy loam, 15 to 25 percent slopes (Mg).—This strongly sloping soil occurs in association with Merrimac fine sandy loam, 8 to 15 percent slopes. If it is cultivated extensively, it is subject to severe erosion. Practices to control erosion should be used intensively, and cultivation must be limited. This soil is in capability class IV, subclass IVe, and in management group 7.

Merrimac sandy loam, 3 to 8 percent slopes (Mo).—Except for its coarser texture, this soil is similar to Merrimac fine sandy loam, 3 to 8 percent slopes, with which it is associated. Its coarser texture makes it more droughty. The small areas occur throughout the county.

Use and management.—Most of this soil is in forest or idle. A small acreage is cultivated. The principal crops are hay and vegetables. Intensive erosion control practices are needed, and large amounts of fertilizer must be added for high yields. This soil is in capability class III, subclass IIIs, and in management group 6.

Merrimac sandy loam, 0 to 3 percent slopes (Mn).—Except that it has milder slopes, this soil is similar to Merrimac sandy loam, 3 to 8 percent slopes. Surface runoff is less rapid, and less intensive practices are needed to control erosion. This soil is in capability class II, subclass IIs, and in management group 4.

Merrimac sandy loam, 8 to 15 percent slopes (Mp).—Except that it has stronger slopes, this soil is similar to Merrimac sandy loam, 3 to 8 percent slopes. Surface runoff is more rapid.

Use and management.—Most of this soil is in forest. Its use for crops is limited because of the strong slopes and the risk of erosion. This soil is in capability class IV, subclass IVs, and in management group 9.

Figure 5.—**Tomatoes on a terraced area of Merrimac fine sandy loam.**

Merrimac sandy loam, 15 to 25 percent slopes (Mr).—This soil is similar to the other Merrimac sandy loams, but it has stronger slopes. It is practically all in forest and is best used for that purpose. This soil is in capability class VII, subclass VIIs, and in management group 14.

Merrimac fine sandy loam and sandy loam, 0 to 3 percent slopes (Mh).—The soils of this undifferentiated soil group resemble Merrimac fine sandy loam, 3 to 8 percent slopes, but they have milder slopes. Also, in the areas of sandy loam the soils are coarser textured.

These soils are used and managed in the same way as Merrimac fine sandy loam, 0 to 3 percent slopes, or as Merrimac sandy loam, 0 to 3 percent slopes, depending on which soil is predominant in the area. This soil group is in capability class II, subclass IIs, and in management group 4.

Merrimac fine sandy loam and sandy loam, 3 to 8 percent slopes (Mk).—Except that the soils have stronger slopes, this undifferentiated soil group is similar to Merrimac fine sandy loam and sandy loam, 0 to 3 percent slopes. It is in capability class III, subclass IIIs, and in management group 6.

Merrimac fine sandy loam and sandy loam, 8 to 25 percent slopes (Mm).—This undifferentiated soil group is similar to Merrimac fine sandy loam and sandy loam, 0 to 3 percent slopes. It is in capability class IV, subclass IVs, and in management group 9.

Ondawa series

The Ondawa soils are well drained, but they are flooded occasionally. They have developed on flood plains from fairly recent deposits that were mainly derived from granite. The areas are small and narrow. They occur along drainageways.

These soils belong to the same catena as the moderately well drained Podunk soils, the poorly drained Rumney soils, and the very poorly drained Saco soils. They belong to the Alluvial great soil group. Only one soil of this series, Ondawa fine sandy loam, 0 to 3 percent slopes, occurs in this county.

Ondawa fine sandy loam, 0 to 3 percent slopes (Oa).—This soil has developed from fairly recent alluvium. The alluvium was mainly derived from granite and contains some very fine mica flakes derived from schist. The soil occupies small areas along the Lamprey and Taylor Rivers.

Typical profile observed in a cultivated field:

0 to 8 inches, brown fine sady loam, the uppermost few inches darker brown than the lower part; friable.
9 to 18 inches, brownish-yellow or yellowish-brown fine sandy loam or very fine sandy loam that becomes lighter in color and texture with increasing depth.
19 to 30 inches, yellowish-gray fine sandy loam that becomes lighter in color and texture with increasing depth.
30 inches +, similar to layer immediately above but has some yellow and rust-colored or brown streaks or mottles.

This soil is acid throughout. It retains moisture well and erosion is not a problem. The occasional floods that cover it come only in winter or early spring. Therefore, crops are not damaged. The floods add fresh deposits of alluvial material. As a result the soil has a good supply of plant nutrients, and little of the nutrients

leach out. Included in mapping are some areas that have a surface layer of very fine sandy loam. Also included are small areas of loamy sand.

Use and management.—Only a small part of this soil is cultivated or pastured because the small, scattered areas are inaccessible. The trees in forested areas are mainly aspen, gray birch, elm, red maple, and red oak. There is a thick undergrowth of shrubs and herbs. This soil is in capability class I and in management group 1.

Paxton series

The soils of the Paxton series are well drained. Their relief ranges from level to steep, but mild slopes predominate. The soils have developed on deep, compact, platy till of Late Wisconsin age. The till was derived mainly from mica schist, gneiss, and granite.

The Paxton soils belong to the same catena as the moderately well drained Woodbridge soils, the poorly drained Leicester and Ridgebury soils, and the very poorly drained Whitman soils. They are associated with the Brimfield and Brookfield soils, the Shapleigh and Gloucester soils, and with the Hollis, Charlton, and Woodbridge soils. In forested areas the stand consists mainly of basswood, gray and yellow birches, hemlock, red maple, red and black oaks, and white pine. The soils belong to the Brown Podzolic great soil group.

These soils are the most extensive in the towns of Deerfield, Northwood, and Nottingham in the northern part of the county and in the town of Hampton Falls in the southern part.

Paxton loam, 3 to 8 percent slopes (Pc).—This soil has mild slopes. It occurs on smooth, rounded hills that resemble drumlins.

Typical profile observed in a cultivated area:

0 to 9 inches, dark-brown loam that contains many roots; friable; coarse granular structure; strongly acid; distinct, wavy lower boundary.
9 to 15 inches, light olive-brown loam; roots common; friable; medium granular structure; strongly acid; distinct, wavy lower boundary.
15 to 21 inches, olive fine sandy loam that contains a few roots; friable; weak medium granular structure; very strongly acid; distinct, wavy lower boundary.
21 inches +, olive fine sandy loam that contains few roots and is 5 percent partly decomposed limestone pebbles; very firm and brittle; platy structure; very strongly acid.

This soil is acid throughout, but it ranges from strongly acid to medium acid. Depth to the olive, compact, platy substratum ranges from 18 to 24 inches. This layer restricts the downward movement of water. Early in spring or in wet seasons, water moves laterally along it and seeps out along the lower slopes. Although this layer slows the downward movement of water, it retains a good supply for growing crops.

Surface runoff is generally medium to slow but is rapid on some slopes. Internal drainage is rather slow because of the compact substratum. Roots, water, and air penetrate the surface soil and subsoil readily.

Use and management.—About half of this soil is used for crops, mainly hay. The rest is largely in pasture, but some is in woods or idle. A small acreage is used to grow field corn, sweet corn, fruit trees, and vegetables for home use (fig. 6).

This soil has good tilth and is fairly easy to manage. It responds well to good management, including the use of fertilizer. The soil can be built up so that good yields can be maintained. Lime is needed, but the amounts are best determined by soil tests.

On neglected areas gray birch sprouts, broomsedge, hawkweed, hardhack, common juniper, and other weeds crowd out the desirable grasses. On the small areas in forest, the stand consists of second-growth gray and black birches, hemlock, red maple, black and red oaks, and white pine. This soil is in capability class II, subclass IIe, and in management group 2.

Paxton loam, 0 to 3 percent slopes (Pa).—This soil is better for farming than Paxton loam, 3 to 8 percent slopes. It has slower surface runoff and a slightly greater water-holding capacity. Also this soil is less erodible. Good yields can be maintained by rotating crops and adding fertilizer. This soil is in capability class I and in management group 1.

Paxton loam, 3 to 15 percent slopes (Pb).—This soil is similar to Paxton loam, 3 to 8 percent slopes, and to Paxton loam, 8 to 15 percent slopes, depending on which soil is dominant in the given area. It is in capability class III, subclass IIIe, and in management group 5.

Paxton loam, 8 to 15 percent slopes (Pd).—This soil has stronger slopes than Paxton loam, 3 to 8 percent slopes, but otherwise it is similar. It has more rapid surface runoff, but the water-holding capacity is fairly high. Except on a few intensively farmed areas, erosion has not been severe.

Use and management.—Most of this soil is cultivated. The rest is pastured, under forest, or idle. The soil is easy to work. It responds well to good management that includes the use of fertilizer. This soil is in capability class III, subclass IIIe, and in management group 5.

Paxton loam, 15 to 25 percent slopes (Pe).—This soil is similar to Paxton loam, 3 to 8 percent slopes, but it

***Figure 6.*—Peach trees growing on Paxton loan in the town of Northwood. The area has been terraced to conserve runoff water and to prevent erosion.**

has steeper slopes and its surface layer is not so thick. Surface runoff is rapid, and the soil is erodible.

Use and management.—Most of this soil is used to grow hay. Erosion is a hazard if the soil is used for clean-tilled crops. The soil needs management that includes stripcropping, tilling on the contour, and use of diversion ditches. In areas that are under forest, the trees are of the same kind as those growing on Paxton loam, 3 to 8 percent slopes. This soil is in capability class IV, subclass IVe, and in management group 7.

Paxton stony loam, 3 to 8 percent slopes (Pg).—Except that it has milder slopes, this soil is similar to Paxton stony loam, 8 to 15 percent slopes. Surface runoff is less rapid, and the water-holding capacity is greater. Therefore this soil is better for farming where it is practical to clear the surface of stones. About 80 percent of this soil is in forest. It is in capability class VI, subclass VIs, and in management group 12.

Paxton stony loam, 8 to 15 percent slopes (Ph).—Except that it is moderately stony, this soil is similar to Paxton loam, 3 to 8 percent slopes. In forested areas it has a layer of leaves and branches, about 2 inches thick, on the surface; the 2- to 3-inch surface layer is dark-brown to strong-brown loam matted with many small roots, and it has a granular structure. Drainage is similar to that of the nonstony Paxton loams. Roots, water, and air readily penetrate to the substratum.

Use and management.—This soil is largely in forest, but small areas are pastured or idle. Generally the areas are only moderately stony, but there are enough stones and boulders on the surface so that the soil is difficult to till. Scattered areas that have been cleared are in pasture or idle. The areas used to grow hay or vegetables are generally very small and are cultivated between the stones. The carrying capacity of the pastures on this soil is slightly lower than on the nonstony loams. This soil is in capability class VI, subclass VIs, and in management group 12.

Paxton stony loam, 0 to 15 percent slopes (Pf).—This soil is similar to Paxton stony loam, 3 to 8 percent slopes, or to Paxton stony loam, 8 to 15 percent slopes, depending on which soil is dominant in a given area. It is in capability class VI, subclass VIs, and in management group 12.

Paxton stony loam, 15 to 25 percent slopes (Pk).—Except that it has steeper slopes, this soil is similar to Paxton stony loam, 8 to 15 percent slopes. Most of it is in forest. This soil is in capability class VI, subclass VIs, and in management group 12.

Podunk series

The Podunk soils are moderately well drained and are strongly acid. They are level to nearly level. The areas are small and narrow and occur on flood plains. These soils are associated with the well-drained Ondawa and the poorly drained Rumney soils. They belong to the Alluvial great soil group. Only one soil of this series, Podunk fine sandy loam, 0 to 3 percent slopes, occurs in this county.

Podunk fine sandy loam, 0 to 3 percent slopes (Pm).—This level to nearly level soil is moderately well drained, but it is subject to flooding. It receives fresh deposits of alluvium from the occasional floods. This soil occupies small areas along the Exeter and Lamprey Rivers and along Taylor River in the town of Hampton Falls.

Typical profile:

0 to 7 inches, grayish-brown or brown fine sandy loam that contains a moderate amount of organic matter; very friable; weak very fine granular structure; very strongly acid to strongly acid.
7 to 20 inches, light yellowish-brown or light-gray fine sandy loam or loamy fine sand; loose; single grain (structureless); strongly acid.
20 to 36 inches, similar to layer immediately above but has distinct mottles of light gray and yellowish brown.
36 inches +, gravel or sandy material of lighter texture than the layers above; derived mostly from granite, but contains some gneiss or mica schist.

Surface runoff is medium, but the soil has limited use for crops because the fluctuating water table hampers drainage. The permanent water table is at depths of 4 to 5 feet during the drier parts of the year. During the wetter parts of the year—normally in spring and winter—the water table is nearer the surface and extends into the 20- to 36-inch layer. The upper part of the profile has rapid to very rapid permeability.

Some areas in which the soil varies from the typical profile in texture, color, and drainage are included in this mapping unit.

Use and management.—Less than half of this soil is used for crops or pasture. The rest is in forest. The crops are mainly hay and corn grown for silage. The pastures need lime and manure or other fertilizer. If these are not used, weeds soon replace the more desirabl pasture plants. The principal trees in forested areas are alder, elm, red maple, and willow. This soil is in capability class II, subclass IIw, and in management group 3.

Rumney and Saco soils

This undifferentiated soil group consists of Rumney and Saco soils. The soils are developing from alluvium derived mainly from granite but containing some gneiss and schist. They are level to nearly level and occupy small, narrow areas on the flood plains of streams. These soils are flooded frequently. They are widely scattered throughout the county but are mainly along the Exeter, Lamprey, Hampton Falls, and Powwow Rivers.

The soils are practically all under forest. The principal trees are red maple, gray birch, alder, and willow. The soils of both series belong to the Alluvial great soil group.

Typical profile of Rumney fine sandy loam, 0 to 3 percent slopes, observed in a cultivated area:

0 to 7 inches, grayish-brown or brown fine sandy loam; has a few pebbles and indistinct mottles in some places; contains a large amount of organic matter; very friable; weak fine granular structure; very strongly to strongly acid.
7 to 20 inches, light yellowish-brown fine sandy loam or loamy fine sand that has distinct mottles of yellowish brown and light gray; loose; single grain (structureless); strongly acid.
20 inches +, mostly gray or light-gray gravel and fine sand mottled with brown or yellowish brown; loose; single grain (structureless); strongly acid; stratified in most places.

The Rumney soil is poorly drained. It is rapidly permeable to a depth of 20 inches and very rapidly permeable below.

Typical profile of Saco silt loam, 0 to 3 percent slopes, observed in a pastured area:

0 to 10 inches, very dark gray or dark grayish-brown silt loam; somewhat mottled in most places; firm in place, and very friable when disturbed; weak or moderate fine granular structure; strongly acid.
10 inches +, pale-olive or gray silt or silty clay strongly mottled with brown and light gray; very firm in place; hard when dry, and plastic and slightly sticky when wet; massive (structureless); medium acid to neutral.

The Saco soils are very poorly drained and have more distinct mottling than the Rumney. Like the Rumney soils they have slow to very slow surface runoff and internal drainage. The water table is high during most of the year. Roots, water, and air penetrate the upper part of the Saco soils, but below a depth of 10 inches, permeability is very slow.

Rumney and Saco fine sandy loams, 0 to 3 percent slopes (Ra).—The poorly drained Rumney soils are dominant in this undifferentiated soil group. The use of the soils depends upon their drainage. The areas that have the best natural drainage or that have been drained artificially can be used for cultivated crops to a limited extent. The rest of the soils are suitable only for pasture or forest. Practically all of these soils are under forest, but some areas are pastured. In the pastured areas there is a mixture of alder, sedges, hardhack, and goldenrod. This group is in capability class IV, subclass IVw, and in management group 8.

Rumney and Saco silt loams, 0 to 3 percent slopes (Rb).—The very poorly drained Saco soils are dominant in this undifferentiated soil group. Practically all of the soils are under forest. This soil group is in capability class VI, subclass VIw, and in management group 11.

Scantic series

The soils of the Scantic series are poorly drained and are level to gently sloping. They have developed on mildly alkaline to slightly acid deposits of gray or olive-gray silt and clay of glaciolacustrine or marine origin. The soils belong to the same catena as the well drained Suffield soils, the moderately well drained Buxton soils, and the very poorly drained Biddeford soils.

The parent material of the Scantic soils differs from that of the associated poorly drained Walpole soils, which have developed on gravelly or sandy outwash. It also differs from that of the poorly drained Swanton soils, which have developed on sandy deposits that are underlain by silt or clay at depths between 18 and 40 inches. The trees on forested areas consist mainly of speckled alder, elm, hemlock, larch, red maple, and some white pine.

These soils belong to the Low-Humic Gley great soil group. They occur throughout the eastern part of the county from the southeastern part of the town of Nottingham in the north to the northwestern part of the town of Newton in the south, and east to the coast.

Scantic silt loam, 0 to 3 percent slopes (Sa).—This soil is nearly level. It is poorly drained.

Typical profile observed in a cultivated area:

0 to 7 inches, grayish-brown heavy silt loam that contains many roots; very friable; moderate fine granular structure; evidence of much earthworm activity.
7 to 20 inches, silty clay loam that contains many roots; peds are olive gray outside but have common, coarse, distinct, olive and olive-brown mottles inside; coarse moderate to strong subangular blocky structure, but peds not alined vertically; friable as a whole but peds are firm.
20 to 32 inches, clay that is about 60 percent olive brown in color; very firm; weak coarse prismatic structure in place; breaks to thick medium platy, and finally to coarse angular strong blocky structure; the vertical faces of the prisms are gray, and inside, the prisms have olive-colored mottles.
32 to 36 inches, silty clay loam; very firm in place, friable when disturbed; strong moderate to coarse angular blocky structure; peds are gray outside and mottled with common, coarse, distinct, olive and olive-brown splotches inside.

The surface layer ranges in color from gray to grayish brown. Surface runoff is slow, and internal drainage is very slow.

Use and management.—Nearly 50 percent of this soil is used for pasture and crops, more than 30 percent is in forest, and the rest is idle. Hay is the principal crop. It makes fairly good yields on areas that are drained, but sedges tend to replace the better grasses. Drainage needs to be improved. This is frequently done by bedding. Commonly, open ditches are used, but tile drainage is used infrequently. This soil is in capability class IV, subclass IVw, and in management group 8.

Scantic silt loam, 3 to 8 percent slopes (Sb).—Except that it has steeper slopes, this soil is similar to Scantic silt loam, 0 to 3 percent slopes. It is in capability class IV, subclass IVw, and in management group 8.

Scantic and Biddeford soils

Scantic silt loam and Biddeford silty clay loam, 0 to 3 percent slopes (Sc).—This undifferentiated soil group is made up of poorly drained Scantic soils and very poorly drained Biddeford soils. The soils belong to the same catena as the well drained Suffield soils and the moderately well drained Buxton soils.

This group is similar in characteristics and use to either Scantic silt loam, 0 to 3 percent slopes, or Biddeford silty clay loam, 0 to 3 percent slopes, depending upon which soil is dominant in a given area. It is in capability class VI, subclass VIw, and in management group 11.

Scarboro series

The soils of the Scarboro series occur on stream terraces. They have developed on glacial outwash. These soils are the very poorly drained members of several catenas. They are the most extensive in the catenas that include the excessively drained Hinckley, Jaffrey, and Windsor soils; the well drained to somewhat excessively drained Barnstead, Merrimac, and Warwick soils; the moderately well drained Sudbury soils; and the poorly drained Walpole soils. The plant cover is mainly red maple, yellow birch, white pine, and water-tolerant shrubs and herbs. The soils of this series belong to the Humic Gley great soil group. Only one soil of this series, Scarboro fine sandy loam, 0 to 3 percent slopes, occurs in this county.

Scarboro fine sandy loam, 0 to 3 percent slopes (Sd).—This soil generally occurs on glacial outwash and on stream terraces. Some areas are at the heads of small drainageways or along the borders of lakes or streams. In places the soil occurs in slight depressions. The areas are scattered throughout the county.

Typical profile observed in a forested area:

2 to 0 inches, a thin layer of forest litter; extremely acid.
0 to 2 inches, very dark brown or black fine sandy loam that has a high content of organic matter and is mucky in places; loose when disturbed; fine granular structure; very strongly acid.
2 to 6 inches, dark grayish-brown or dark-brown fine sandy loam that is mottled in places; very friable; weak very fine granular structure; very strongly acid.
6 to 12 inches, yellowish-brown or grayish-brown fine sandy loam mottled with light gray; contains some pebbles in places; loose when disturbed; strongly acid.
12 inches +, gray sand and gravel, streaked or mottled with yellowish brown; loose; single grain (structureless); medium to strongly acid.

The amount of gravel in the different horizons varies. In some places the surface soil is loamy sand or silt loam, and in places it is mottled. The parent materials are variable.

Surface runoff is very slow, and internal drainage is retarded by the high water table. During most of the year, the soil is saturated below a depth of 12 inches unless drainage has been provided.

Use and management.—About 90 percent of this soil is under forest. Some areas have been cleared and are used for growing wild hay or for pasture. This soil must be drained if row crops are to be grown, but the cost of drainage may not be justified. It is in capability class VI, subclass VIw, and in management group 11.

Shapleigh-Gloucester complexes

The Shapleigh soils are dominant in these complexes. The Gloucester soils occur only in areas too small to map separately that are within larger areas of Shapleigh soils. They are important from a management standpoint, however, so the areas where the Shapleigh and Gloucester soils are intermingled are mapped as complexes. These complexes occur throughout the central, western, and southern parts of the county. They are the most extensive in the southwestern part of the county in the towns of Londonderry, Derry, Hampstead, Windham, Atkinson, and Salem. The Gloucester soils are described under the Gloucester series. The following is a description of the Shapleigh soils.

The Shapleigh soils are well drained and are level to steep. They are shallow over bedrock. These soils have developed on glacial till of Late Wisconsin age. The till was derived mainly from granite or gneiss.

These soils belong to the same catena as the well drained Gloucester soils, the moderately well drained Acton soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils. They occur in association with other soils of the catena. They are also associated with the Hollis, Charlton, Paxton, and Brookfield soils, which have developed from till derived mainly from mica schist. Like the Shapleigh soils, the Hollis soils are shallow, but the Shapleigh and Hollis soils differ because they were derived from different parent materials.

The Shapleigh soils have a fine sandy loam or sandy loam texture, but in this county the fine sandy loams are predominant. Bedrock is exposed in nearly all of the areas. In places the soils are covered with loose stones. The depth of the soil varies. Where the soils are as much as 24 to 30 inches deep over bedrock, they are similar to the Gloucester soils. In the shallower soils the horizons that occur in the lower part of the profile of the deeper soils are absent. The Shapleigh soils belong to the Brown Podzolic great soil group. A description of a profile of Shapleigh sandy loam, 8 to 15 percent slopes, which is typical of these soils, follows. It was observed in a forested area.

2 to 0 inches, thin layer of leaves underlain by dark-brown partly disintegrated leaves and twigs that are mixed in places with soil from the horizon below.
0 to 2 inches, grayish-brown sandy loam that has a moderate amount of organic matter; contains some coarse sand and 10 percent or more small, angular, granitic stones; coherent in place, loose when disturbed; weak very fine granular structure; very strongly acid.
2 to 9 inches, yellowish-brown sandy loam that contains some coarse sand, many small stones, and a few large boulders; slightly coherent in place, loose when disturbed; weak very fine granular structure; medium to strongly acid.
9 to 24 inches, horizon is similar to that immediately above, but the light yellowish-brown material is transitional to pale yellow or light gray in the lower part.
24 to 30 inches, light olive-gray, gray, or light-gray sandy till; contains much coarse sand, many small unweathered angular fragments of granite or gneiss, and some subangular boulders of granite; slightly coherent to firm in place, loose when disturbed; single grain (structureless); medium to strongly acid.
30 inceh es, +, rather smooth granite or gneiss bedrock.

The profile is very rapidly permeable throughout. The surface layer is brown in places and ranges from 2 to 5 inches in thickness. Surface runoff is rapid during heavy rains, but normally the rainfall is absorbed. Internal drainage is rapid.

Shapleigh-Gloucester sandy loams, 8 to 15 percent slopes (Sf).—In this complex most of the slopes are short and uneven, but a few are smooth. In most of the areas, various amounts of small stones of crystalline gneiss and a few large boulders of granite are on the surface. The depth of the soils varies greatly within short distances. In many areas the soils are less than 30 inches deep. In some areas, as on ridgetops, the depth is fairly uniform over wide areas. The bedrock is generally not parallel to the surface, however, and it outcrops in many places.

Use and management.—About 75 percent of this soil has been cleared and is in crops or is pastured or idle. Hay is the principal crop, but yields are generally fair to poor. The use of the soil for cultivated crops should be limited because of the risk of erosion.

Bentgrass, broomsedge, poverty oatgrass, and witchgrass are common in old pastures on this complex. Many pastures are overgrown with various tree sprouts and hardhack, juniper, sweetfern, and other annual weeds. On forested areas the trees are mainly white pine, hemlock, and various kinds of hardwoods. This complex is in capability class IV, subclass IVs, and in management group 9.

Shapleigh-Gloucester sandy loams, 0 to 8 percent slopes (Se).—Except that it has steeper slopes, this com-

plex is similar to Shapleigh-Gloucester sandy loams, 8 to 15 percent slopes, and about the same proportion has been cleared. The soils have less rapid surface runoff and are less susceptible to erosion. Only simple erosion control practices are needed if cultivated crops are grown. This complex is in capability class II, subclass IIs, and in management group 4.

Shapleigh-Gloucester sandy loams, 15 to 35 percent slopes (Sg).—Except for its steeper slopes, this complex is similar to Shapleigh-Gloucester sandy loams, 8 to 15 percent slopes. Erosion is a hazard if cultivated crops are grown. Therefore, the use of the soils for cultivated crops should be limited, and the soils on the steeper slopes are best used only for pasture or forest. This complex is in capability class VI, subclass VIe, and in management group 10.

Shapleigh-Gloucester rocky sandy loams, 3 to 15 percent slopes (Sh).—This complex is similar to the nonrocky Shapleigh-Gloucester sandy loams, but it has more rugged relief and contains many stones and boulders. The stones, boulders, and rock outcrops on the surface limit or prevent the use of modern farm machinery. The relief is mainly gently sloping to moderately sloping. Some included areas are level or nearly level.

Use and management.—This complex is chiefly in timber or brush. Less than 5 percent is in pasture. The forest trees are mainly aspen, gray birch, northern red oak, and white pine. Most of the pastures are weedy, and their carrying capacity is low. The steeper slopes should be used to only a limited extent for grazing. This complex is in capability class VI, subclass VIs, and in management group 12.

Shapleigh-Gloucester rocky sandy loams, 15 to 35 percent slopes (Sk).—Except that it has steeper slopes, this complex is similar to Shapleigh-Gloucester rocky sandy loams, 3 to 15 percent slopes. Included are soils that have slopes steeper than 35 percent. This complex is almost all in forest, which is its best use. It is in capability class VII, subclass VIIs, and in management group 14.

Shapleigh-Gloucester very rocky very stony sandy loams, 3 to 15 percent slopes (Sm).—Except that it contains more stones and rocks, this complex is similar to Shapleigh-Gloucester rocky sandy loams, 3 to 15 percent slopes. It is practically all in forest and is too rocky and stony to be of any use except for that purpose. Some spots that have slopes of less than 3 percent are included in these areas. This complex is in capability class VII, subclass VIIs, and in management group 14.

Shapleigh-Gloucester very rocky very stony sandy loams, 15 to 35 percent slopes (Sn).—This complex is similar to Shapleigh-Gloucester rocky sandy loams, 15 to 35 percent slopes, except that it contains more rocks and stones. Included are areas in which the slopes are steeper than 35 percent. This complex is practically all in forest. The soils are too rocky and stony to be of any use except for that purpose. The complex is in capability class VII, subclass VIIs, and in management group 14.

Sudbury series

The soils of the Sudbury series are nearly level to gently sloping. They have developed on glacial outwash terraces and plains. These soils are the moderately well drained members of several catenas. They are the most extensive in the catena that includes the well drained to excessively drained Merrimac and Hinckley soils, which have developed on glaciofluvial deposits mainly of granite and mica schist. They also belong to the same catena as the well drained to excessively drained Jaffrey, Barnstead, and Windsor soils and to the same catena as the poorly drained Walpole soils and the very poorly drained Scarboro soils. The Sudbury soils differ from the well-drained members of the various catenas in that they are mottled at depths between 15 and 36 inches.

These soils occur mainly in association with the Merrimac soils, but they also occur in association with the Jaffrey, Barnstead, Warwick, and Hinckley soils. Where they are associated with the Merrimac and Hinckley soils, their parent materials were mainly from granite and schist. Where they are associated with the Warwick soils, their parent materials were mainly from schist, phyllite, and slate mixed with a small amount of siliceous limestone. Where they are associated with the Barnstead and Jaffrey soils, their parent materials were influenced by weathered brown schist. The texture ranges from loamy sand to loam, but in this county the soils of this series are fine sandy loams.

Forest trees on these soils are chiefly white ash, gray and yellow birches, hemlock, red maple, white and black oaks, and white pine. The undergrowth in the forests consists mainly of high-bush blueberries, brackenfern, cinquefoil, sweetfern, wintergreen, and witch-hazel. The Sudbury soils belong to the Brown Podzolic great soil group. They occur throughout the county in depressions in the plains or on terraces and gentle slopes at the bases of uplands.

Sudbury fine sandy loam, 0 to 3 percent slopes (Sp).—This soil is level to nearly level. It is moderately well drained.

Typical profile in a forested area:

3 to 0 inches, layer of leaves and forest debris, underlain by a dark-brown, thin, loose layer of partly disintegrated leaves that, in places, is mixed slightly with soil from the horizon immediately below; very strongly acid.

0 to 3 inches, dark grayish-brown (grayish brown when dry) fine sandy loam that contains a moderate amount of organic matter; loose; weak fine to very fine granular structure; strongly acid.

3 to 11 inches, yellowish-brown sandy loam; loose if disturbed; weak very fine granular structure; strongly acid.

11 to 20 inches, light yellowish-brown loamy sand that contains some pebbles; in some places has faint mottles in the lower part; loose; single grain (structureless) or weak very fine granular structure; strongly acid.

20 to 30 inches, mostly light yellowish-brown loamy sand that contains some pebbles; has distinct mottles of light gray and brown; loose if disturbed; single grain (structureless); strongly acid.

30 inches +, mostly light-gray stratified sand and gravel; a few to many distinct brown mottles in places; loose.

In places the layer of forest litter is as much as 4 inches thick; the topmost inch of the surface layer is nearly black and has a high content of organic matter;

and a brown or dark-brown, friable layer of fine sandy loam, 4 to 6 inches thick, underlies the surface layer.

In cultivated fields the surface layer is dark grayish-brown fine sandy loam or sandy loam, 6 to 7 inches thick. This overlies yellowish-brown fine sandy loam that has a few gray and rust-colored or brown mottles. The next layer, which is at depths of 16 to 18 inches, is mottled gray or yellowish-gray loamy fine sand or sand. This is underlain, at depths below 24 inches, by gray or light-gray loamy sand mottled with brown and yellow. In places the lower part of the layer contains a fairly large amount of gravel.

Surface runoff is slow to rapid, depending on the slope. In most of the profile, permeability is rapid, but it is very rapid at depths between 11 and 20 inches.

Use and management.—About 75 percent of this soil is in forest, 10 percent is in crops, and the rest is in pasture or idle. The principal crops are hay and pasture, grass and corn for silage, and vegetables for home use. Yields are good in dry seasons but are only fair in wet seasons.

This soil remains wet longer in spring than the well-drained soils with which it is associated. The lack of adequate drainage limits the kind of crops that can be grown. The pastures provide fair to good grazing even in dry years. In wet seasons the soil will become packed if it is overgrazed. This soil is in capability class II, subclass IIw, and in management group 3.

Sudbury fine sandy loam, 3 to 8 percent slopes (Sr).—Except that it has steeper slopes, this soil is similar to Sudbury fine sandy loam, 0 to 3 percent slopes. Because it has more rapid runoff than the less sloping soil, practices will be needed to control erosion if this soil is used for cultivated crops. This soil is in capability class II, subclass IIw, and in management group 3.

Sudbury fine sandy loam, 0 to 8 percent slopes (So).—This soil is similar in profile characteristics and management to Sudbury fine sandy loam, 0 to 3 percent slopes, or to Sudbury fine sandy loam, 3 to 8 percent slopes, depending on which soil is dominant in a given area. It is in capability class II, subclass IIw, and in management group 3.

Suffield series

The soils of the Suffield series are generally well drained, although drainage is retarded somewhat by the heavy subsoil. They are sloping to steep. The soils have developed on neutral to medium acid silts and clays of marine and glaciolacustrine origin.

The Suffield soils belong to the same catena as the moderately well drained Buxton, the poorly drained Scantic, and the very poorly drained Biddeford soils. In some places the Suffield soils and other members of the catena surround soils derived from till and the resulting soil pattern is complex.

Forest trees on these soils are white ash, beech, gray birch, elm, hemlock, red maple, red oak, and white pine. On the native pastures the plants are mainly Colonial bentgrass, Canada and Kentucky bluegrass, white-clover, and redtop. Common pests in many hayfields are wild carrot, field daisies, hawkweed, mullein, narrow leaf plantain, and sorrel.

The Suffield soils belong to the Brown Podzolic great soil group. They occur mostly in the eastern and northeastern parts of the county. Near Exeter and Epping, the clay in these soils has been used for making bricks.

Suffield silt loam, 8 to 15 percent slopes (Ss).—This soil is practically free of stones and gravel. It occupies small areas mainly in the eastern and northeastern parts of the county.

Typical profile observed in a forested area:

3 to 0 inches, layer of loose leaves underlain by dark-brown fibrous organic matter that, in places, is mixed slightly with soil from the horizon immediately below; strongly acid.

0 to 4 inches, dark grayish-brown or grayish-brown (brown when dry) silt loam, free of pebbles and stones; contains a moderate amount of organic matter; firm in place, friable if disturbed; slightly sticky when wet; fine granular structure; strongly acid.

4 to 12 inches, yellowish-brown silt loam; firm in place, very friable if disturbed; plastic and slightly sticky when wet; fine granular structure; strongly acid.

12 to 24 inches, light yellowish-brown silty clay loam; lower part of horizon olive colored; very compact in place, friable if disturbed; plastic and slightly sticky when wet; moderately fine subangular blocky structure; slightly to medium acid.

24 inches +, olive or olive-gray silty clay or clay that in places has indistinct mottles of brown and light gray in the upper part; very compact in place, hard when dry, sticky and plastic when wet; strong coarse subangular blocky structure very evident when dry; slightly acid to neutral.

In cultivated fields the surface layer overlies a friable layer and is 5 to 7 inches thick. The upper part of the subsoil breaks to irregular clods or fragments that crush easily to soft granules. At depths between 16 and 18 inches, is olive-colored silt loam or silty clay loam that is transitional to olive-gray heavy clay. The clay is interbedded with silt at a depth of about 24 inches. This material is very compact in place but breaks to angular blocks that are hard when dry but plastic when wet.

Surface runoff is moderately rapid, but internal drainage is somewhat retarded by the texture and structure of the silty subsoil and the heavy clay substratum. The soil has a high moisture-holding capacity. It retains adequate moisture for grasses and cultivated crops, even in unusually dry seasons.

Use and management.—About 40 percent of this soil is cultivated. The rest is in forest or pasture. The soil is used mainly for forage crops, chiefly mixed hay crops and corn grown for silage. A small acreage is planted to clover, alfalfa, oats, potatoes, and vegetables.

If this soil is used for tilled crops, intensive practices are needed to control erosion. Crops on this soil respond well to fertilizer, and under good management the soil can be kept productive. This soil warms rather slowly in spring. It cannot be worked so early or so soon after heavy rains as the lighter textured soils. Also, more power is needed to cultivate it. The soil should be tested to determine the amount of lime needed to make the pH approximately 6.5. This soil is in capability class III, subclass IIIe, and in management group 5.

Suffield silt loam, 8 to 15 percent slopes, severely eroded (St).—Except that it is severely eroded, this soil is similar to Suffield silt loam, 8 to 15 percent slopes. Erosion, chiefly sheet erosion, has removed from 2 to 6 inches of the upper part of the soil. As a result, silty

clay or clay occurs at shallower depths than in the uneroded soil. The surface layer contains less organic matter than that of the uneroded soil, but erosion has not progressed to the extent that yields have been reduced seriously. This soil needs about the same management as Suffield silt loam, 8 to 15 percent slopes. It is in capability class III, subclass IIIe, and in management group 5.

Suffield silt loam, 15 to 25 percent slopes (Su).—Except that it has steeper slopes, this soil is similar to Suffield silt loam, 8 to 15 percent slopes. The steep slopes make it more susceptible to erosion than the less sloping soil.

Use and management.—This soil is mainly in pasture or forest. A small part is used for cultivated crops, but cultivation should be limited. If cultivated crops are grown, the soil needs to be tilled on the contour and such practices as stripcropping and use of diversion terraces will be required to control erosion. This soil is in capability class IV, subclass IVe, and in management group 8.

Suffield silt loam, 15 to 25 percent slopes, severely eroded (Sv).—This soil is similar to Suffield silt loam, 15 to 25 percent slopes, except that it is severely eroded. From 2 to 6 inches of the soil has been lost, chiefly from sheet erosion, so that the depth to silt and clay is not so great as in the uneroded soil. Also, the surface layer contains less organic matter. This soil is in capability class IV, subclass IVe, and in management group 8.

Suffield silt loam, 25 to 35 percent slopes (Sw).—Except that it has steeper slopes, this soil is similar to Suffield silt loam, 15 to 25 percent slopes. Because of its steep slopes, this soil is highly erodible. It is entirely in pasture and forest, its best use. It is in capability class VI, subclass VIe, and in management group 10.

Sutton and Woodbridge series

The soils of the Sutton and Woodbridge series, mapped together in this county as an undifferentiated soil group, are level to gently sloping and are moderately well drained. They occur in small to fairly large areas in the north-central part of the county in the towns of Northwood, Nottingham, and Deerfield; in the southeastern part of the county in the towns of East Kingston, Kensington, Hampton Falls, and South Hampton; and in the northeastern part of the county, where the Sutton soils predominate. The Sutton and Woodbridge soils belong to the Brown Podzolic great soil group. The following are descriptions of these soils.

The Sutton soils have developed on till of Late Wisconsin age. The till was derived mainly from gray mica schist but partly from granitic materials. Both stony and nonstony loams are mapped, but some areas of fine sandy loam are included with the loams.

The moderately well drained Sutton soils belong to the same catena as the well drained Hollis and Charlton soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils. They are also members of the catena that includes the well-drained Brimfield and Brookfield soils. Unlike the Charlton soils, their subsoil is mottled.

The Sutton soils occur in slight depressions within larger areas of well-drained soils. They are also on gentle slopes that receive seepage water from higher areas or in narrow strips between areas of well drained and poorly drained soils. They occur in association with the moderately well drained Acton and Scituate soils.

Forests on the Sutton soils consist mainly of gray birches, elms, red and sugar maples, red and white oaks, and white pines. The plants on cleared areas of stony soils are alder, blueberries, hardhack, juniper, meadowsweet, and sweetfern. These areas are used as unimproved permanent pasture. The areas of nonstony soils that have been cleared are used mainly to grow timothy, redtop, and clover for hay, corn for silage, oats, potatoes, and some market vegetables. A description of a profile of Sutton loam, 0 to 3 percent slopes, which is typical of the Sutton soils, follows. The profile was observed in a forested area.

3 to 0 inches, layer of loose leaves underlain by dark-brown, partly disintegrated leaves mixed with soil from the horizon immediately below; extremely acid.

0 to 4 inches, grayish-brown loam that contains some coarse angular sand and a few fragments of mica schist and quartz; has a moderate amount of organic matter; loose; fine granular structure; medium to strongly acid.

4 to 10 inches, yellowish-brown loam that contains some coarse sand and small fragments of stone; in places has indistinct mottles in lower part of the horizon; firm in place, but very friable if disturbed; fine to very fine granular structure; medium to slightly acid.

10 to 20 inches, light yellowish-brown loam transitional to olive-colored loam in lower part of horizon; similar to layer immediately above but has distinct mottles of yellowish brown, brown, and light gray.

20 inches +, olive or pale-olive loamy till from unweathered mica schist that in some places contains slightly weathered pyritiferous schist and in most places, quartz and granitic material; distinctly mottled with light gray, yellowish brown, and brown; firm in place, but friable if disturbed; medium platy; slightly or medium acid.

In some places mottling occurs only in the substratum at depths between 24 and 30 inches. In most places it occurs at depths between 14 and 16 inches.

Surface runoff is moderately rapid to rapid. Internal drainage is slow, particularly in wet seasons. Then, the water table rises to the lower part of the subsoil or to the upper part of the substratum.

Most of the Sutton soils have been cleared. The areas that are free of stones are used mainly as pasture or to grow feed for dairy cattle. The stony areas are used as unimproved permanent pasture.

The Woodbridge soils occur on drumlins or drumloid slopes. They have developed on very compact, platy till of Late Wisconsin age. The till was derived mainly from gray mica schist. Both stony and nonstony loams are mapped, but some areas of fine sandy loam are included with the loams.

The moderately well drained Woodbridge soils belong to the same catena as the well drained Paxton soils, the poorly drained Leicester soils, and the very poorly drained Whitman soils.

On forested areas of these soils, the trees are mainly white and gray birches, red and sugar maples, white and red oaks, white pines, and hemlocks. A description of a profile of Woodbridge loam, 0 to 3 percent slopes, which is typical of the Woodbridge soils, follows. This profile was observed in a forested area.

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3 to 0 inches, thin layer of loose leaves underlain by dark-brown, partly disintegrated, fibrous, spongy organic matter; very strongly acid.
0 to 4 inches, dark grayish-brown loam that contains many subangular fragments of schist and has a high content of organic matter; loose and porous; weak fine granular structure; very strong acid.
4 to 12 inches, brown loam that contains many subangular fragments of schist and a moderate amount of organic matter; firm in place, but very friable if disturbed; porous; very fine granular structure with a trace of weak platiness in places; very strongly acid.
12 to 21 inches, yellowish-brown loam that contains many subangular fragments of schist; firm in place, but very friable if disturbed; porous; weak very fine granular structure; strongly acid.
21 to 24 inches, olive loamy stony till that has many coarse sand particles and indistinct mottles of yellowish brown and light gray; compact in place, but friable if disturbed; platy; medium to strongly acid.
24 inches +, pale-olive or olive-gray loamy stony till that contains enough sand to have a sandy feel; slightly mottled in places; very compact in place, but very firm if disturbed; weak medium or thick platy structure; medium or strongly acid.

Surface runoff is rapid, but internal drainage is restricted by the hard substratum. Water seeps along the substratum so that small, wet, seepy spots are formed on the surface. Below a depth of 21 inches, the soil is slowly permeable.

Sutton and Woodbridge loams, 3 to 8 percent slopes (Sza).—The soils of this mapping unit are the most extensive of the Sutton and Woodbridge loams, but they occur only in small areas. They are generally on mild slopes, but some areas with slopes steeper than 8 percent are included. The soils occur in association with the Paxton, Charlton, Hollis, Brimfield, and Brookfield soils. They are on narrow strips between well drained and poorly drained areas or in positions where they receive seepage water from higher areas. Surface drainage is medium to rapid, and internal drainage is medium. Erosion is not a problem.

Use and management.—More than 35 percent of this mapping unit is cultivated, about 25 percent is in woods, and the rest is in pasture or idle. The kinds of crops that can be grown are limited because of restricted drainage. The principal crops are timothy grown for hay and corn grown for silage. A small acreage is in potatoes, oats, and vegetables grown for home use.

These soils are among the best in the county for pasture. The pastures respond well to fertilizer. The principal native pasture grasses are Colonial bentgrass, Canada and Kentucky bluegrass, and redtop. Idle areas or neglected pastures have aspen sprouts, broomsedge, gray birch, blueberries, daisies, goldenrod, hardhack, common juniper, and meadowsweet growing on them. Only simple methods are needed to control erosion. These soils are in capability class II, subclass IIw, and in management group 3.

Sutton and Woodbridge loams, 0 to 3 percent slopes (Sz).—The soils of this mapping unit occupy small areas. They occur in association with the Paxton, Charlton, Hollis, Brimfield, and Brookfield soils.

Use and management.—About 50 percent of this mapping unit is in forest, 25 percent is cultivated, and the rest is in pasture or idle. The management is about the same as that of Sutton and Woodbridge loams, 3 to 8 percent slopes, and use is about the same. This mapping unit is in capability class II, subclass IIw, and in management group 3.

Sutton and Woodbridge loams, 0 to 8 percent slopes (Sy).—These soils are similar to Sutton and Woodbridge loams, 0 to 3 percent slopes, or to Sutton and Woodbridge loams, 3 to 8 percent slopes, depending on which of these dominates in a given area. Their use and management are also about the same. They are in capability class II, subclass IIw, and in management group 3.

Sutton and Woodbridge stony loams, 0 to 8 percent slopes (Szb).—These soils are more extensive than the nonstony Sutton and Woodbridge loams with which they are associated. Except for a few very stony areas, they are moderately stony, and the stones and boulders are 5 to 20 feet apart. The trees on forested areas are mainly white ash, gray, yellow, and black birches, elm, hemlock, red maple, red oak, and spruce. There is a thick undergrowth of shrubs and herbs.

Surface runoff is medium and internal drainage is slow. The subsoil is saturated early in spring and during wet seasons.

Use and management.—These soils are mainly in forest, but small areas have been cleared and are pastured or idle. Under similar management the carrying capacity of the pastures is slightly lower than that of the nonstony soils . The same kinds of plants grow on the idle areas and neglected pastures as on the nonstony loams. These soils are in capability class VI, subclass VIs, and in management group 12.

Swanton series

The soils of the Swanton series are poorly drained and are level to gently sloping. They have developed from sandy materials that overlie glaciolacustrine and marine silts and clays. In places they are in slight depressions surrounded by better drained soils.

These poorly drained soils belong to the same catena as the well drained Melrose, the moderately well drained Elmwood, and the very poorly drained Whately soils. They occur in association with the Walpole, Scarboro, Scantic, and Biddeford soils. Unlike the Swanton soils, the Walpole soils have developed from sandy materials, and the Scantic have developed entirely from silt and clay. The predominant texture of the Swanton soils is fine sandy loam. The series also includes sandy loams, very fine sandy loams, and loamy sands, but these do not occur in Rockingham County.

About two-thirds of the acreage has been cleared and is used for crops or is pastured or idle. On forested areas the trees are mainly alders, gray birch, red maple, and some white and black oaks, white pines, and water-tolerant shrubs and herbs. These soils belong to the Low-Humic Gley great soil group. They occur in the eastern part of the county near the coast.

Swanton fine sandy loam, 0 to 3 percent slopes (Szc).—This is the most extensive soil of the Swanton series. It is level to nearly level and is poorly drained.

Typical profile observed in a forested area:

1 to 0 inch, thin layer of leaves and twigs underlain by partly decomposed to well-decomposed leaves and other plant remains.

0 to 1 inch, very dark brown fine sandy loam that contains a large amount of organic matter; very friable; weak fine granular structure; very strongly acid.
1 to 4 inches, dark-gray fine sandy loam; very friable; very strongly acid.
4 to 18 inches, light brownish-gray fine sandy loam mottled with strong brown; very friable, but slightly sticky when wet; weak medium subangular blocky structure; very strongly acid.
18 to 30 inches, dark-brown fine sandy loam mottled with light gray; very friable; very strongly acid.
30 to 48 inches, light-gray and dark yellowish-brown silty clay; plastic when wet; medium to thick platy structure; strongly acid to medium acid.

The depth to the silty clay ranges from 18 to 40 inches, but it normally is 24 to 36 inches. In cultivated areas the color of the surface layer ranges from gray to very dark grayish brown. The color and number of mottles in the subsoil vary. Grayish colors predominate in the areas that border the very poorly drained Whately soils. Yellowish or brownish colors predominate in areas that border the moderately well drained Elmwood soils, and in these areas there is some mottling.

Surface runoff is slow. The soil above the silty clay is generally rapidly permeable. In wet seasons, as in winter, spring, and late fall, the water table is often 6 to 18 inches from the surface. In dry seasons, the silty clay in the substratum retards the downward movement of water and the water moves laterally along this layer.

Use and management.—This soil is best suited to hay and pasture. The pastures provide good grazing during the summer. Drainage needs to be improved, however, and, where feasible, this should be done by means of open ditches and tile drains. This will improve yields, and grasses and legumes of better quality can be grown on the drained areas. On the unimproved pastures the principal grasses are timothy, Kentucky bluegrass, and redtop. This soil is in capability class IV, subclass IVw, and in management group 8.

Swanton fine sandy loam, 3 to 8 percent slopes (Szd).—Except that it has steeper slopes, this soil is similar to Swanton fine sandy loam, 0 to 3 percent slopes, and its use and management are about the same. About the same proportion has been cleared. This soil is in capability class IV, subclass IVw, and management group 8.

Tidal marsh

Tidal marsh (Ta).—This organic soil is on shallow tidal flats that are covered by water at high tide. It occupies large areas along the coast from Portsmouth south to the town of Seabrook. It also lies in narrow strips along small inlets near Great Bay and along the Squamscott, Hampton, and Blackwater Rivers and Mill and Sagamore Creeks. The plants growing on this soil are mainly saltgrass, eelgrass, and sedges.

The surface layer is a brown, fibrous mat of grasses and the roots of grasses mixed with sand and silt. It generally overlies dark-gray fine sandy loam or sand that is firm in place but loose and friable if disturbed. This is transitional to loose, gray sand that is at depths of 2½ to 3 feet.

Use and management.—This soil has little agricultural value. In colonial days the saltmarsh hay growing on it was highly prized for young stock. Now, the saltgrass is cut for hay on only a few areas in the towns of Hampton and Seabrook. The hay is commonly stacked on small platforms or pilings that extend 2 or 3 feet above the tidal flats. The stacks hold from 2 to 5 tons each and are cone shaped. They give a distinctive appearance to the landscape. This soil is in capability class VIII, subclass VIIIw, and management group 15.

Urban and made land

Urban and made land (Ua).—Urban areas are the closely settled or thickly populated areas in the county. They include the city of Portsmouth and the centers of towns. Made land consists of areas that have been excavated or filled in. This mapping unit is not used for agriculture and has not been placed in a management group.

Walpole series

The soils of the Walpole series are poorly drained and are level to gently sloping. They are scattered throughout the county. The soils have developed on plains or terraces of sandy and gravelly glacial outwash. The outwash was derived mainly from granite and schist.

These are the most extensive soils in the catena that includes the well drained Merrimac soils, the moderately well drained Sudbury soils, and the very poorly drained Scarboro soils. They are also the poorly drained members of the same catena as the well-drained Warwick soils and the well drained to excessively drained Barnstead, Hinckley, Jaffrey, and Windsor soils. These soils belong to the Low-Humic Gley great soil group. On forested areas the trees are mostly speckled alder, gray birch, red maple, and white pine.

Walpole fine sandy loam, 0 to 3 percent slopes (Wa).—This is the most extensive soil of this series in the county. It is poorly drained and is level to nearly level.

Typical profile observed in a forested area:

3 to 0 inches, forest litter, mostly from white pine or speckled pine, that in places is decomposed in the lower part; mucky; granular structure; extremely acid.
0 to 4 inches, very dark gray or dark grayish-brown fine sandy loam (light gray or grayish brown when dry); very friable; weak very fine granular structure; strongly acid.
4 to 15 inches, yellowish-brown fine sandy loam or sandy loam mottled with pale yellow and gray; contains some pebbles in places; very friable; weak very fine granular structure; strongly acid.
15 to 24 inches, similar to horizon immediately above but is lighter colored.
24 inches +, pale-yellow or light yellowish-brown sand and gravel, mainly of granite or schist origin; loose.

In a few places the surface layer is light gray or gray. In places the soil just below the plow layer is dark yellowish brown or dark brown. In a few places there is a weak cemented layer in the lower part of the subsoil.

Surface runoff and internal drainage are slow, but permeability is rapid. The water table is normally less than 3 feet from the surface even in the drier seasons of the year. It fluctuates, however, and in wet seasons, especially in winter, late in fall, and early in spring, it rises to within a few inches of the surface. Areas of sandy loam are included in this soil.

Use and management.—About 75 percent of this soil is in forest. The rest has been cleared and is used for crops or pasture or is idle. Hay gives good yields on this soil, but sedges soon come in. Intensively drained areas are used for row crops, but yields are not high. This soil is in capability class IV, subclass IVw, and in management group 8.

Walpole fine sandy loam, 3 to 8 percent slopes (Wb).—Except that it has steeper slopes, this soil is similar to Walpole fine sandy loam, 0 to 3 percent slopes. More than 50 percent of it is under forest. The rest is used for crops and pasture or is idle. This soil is in capability class IV, subclass IVw, and in management group 8.

Walpole and Scarboro series

This is a group of undifferentiated soils made up of the poorly drained Walpole soils and the very poorly drained Scarboro soils. The soils are level to gently sloping. They occur in the southern part of the county in small areas that interfinger. Each soil is described separately in the descriptions of the Walpole series and the Scarboro series. Only one mapping unit of this undifferentiated soil group is mapped in the county.

Walpole and Scarboro fine sandy loams, 0 to 5 percent slopes (Wc).—These soils are level to gently sloping. Their management is based on the management needs of the very poorly drained Scarboro soil because this wetter soil will need drainage and more careful methods of seeding and cultivating than the better drained Walpole soil. This soil group is in capability class VI, subclass VIw, and in management group 11.

Warwick series

The soils of the Warwick series are well drained and are level to sloping. They have developed from glaciofluvial deposits. The deposits were derived mainly from products of schist and phyllite that contain a small amount of siliceous limestone. The profile, therefore, is only slightly acid at depths of about 30 inches. The phyllite contained lime at one time, but this has now leached out.

These soils belong to the same catena as the moderately well drained Sudbury soils, the poorly drained Walpole soils, and the very poorly drained Scarboro soils. They occur in association with the Merrimac soils. The texture of the Warwick soils is finer than that of the Merrimac soils.

These soils belong to the Brown Podzolic great soil group. They are mostly in the northeastern part of the county in the town of Stratham and in nearby towns.

Warwick gravelly loam, 3 to 8 percent slopes (Wf).—This well-drained soil is gently sloping to sloping.

Typical profile observed in a cultivated area:

0 to 7 inches, dark-brown gravelly loam; very friable; weak medium granular structure; strongly acid.
7 to 14 inches, yellowish-brown gravelly fine sandy loam to loam; loose; weak medium granular structure; strongly acid.
14 to 17 inches, dark yellowish-brown gravelly loamy sand; loose; weak fine granular structure; strongly acid to medium acid.
17 to 19 inches, dark-brown cobbly loamy sand; loose; single grain (structureless); medium acid.
19 inches +, dark yellowish-brown cobbly loamy sand; loose; single grain (structureless); medium acid.

Below this layer are beds of sand, gravel, and slaty cobbles. Throughout the profile are many angular fragments of phyllite. At a depth of 26 inches, the decomposed rock fragments have a pH of 6.5. The surface soil and subsoil contain a moderate amount of gravel. Normally the depth to beds of sand and gravel is less than 20 inches. The erosion hazard is not great.

Use and management.—Most of this soil is in crops. The rest is in pasture, under forest, or is idle. Hay is the principal crop. Market vegetables, corn grown for silage, sweet corn, clover, alfalfa, potatoes, and small fruits are grown to a lesser extent.

Because this soil warms early in spring, it is a good soil for early vegetables. Lack of adequate moisture, however, generally lowers the yields of later crops. Crops on this soil respond well to fertilizer. If large amounts of commercial fertilizer, manure, and lime are used, fair to good yields are obtained. This soil needs simple erosion control methods if cultivated crops are grown. It can be tilled soon after rains. The mild slopes make it a good soil for mechanized farming. This soil is in capability class II, subclass IIe, and in management group 2.

Warwick gravelly loam, 0 to 3 percent slopes (Wd).—Except that it has milder slopes, this soil is similar to Warwick gravelly loam, 3 to 8 percent slopes. Erosion is not a problem on this soil. Under ordinary management it is suited to all the crops grown in the area. This soil is in capability class I and in management group 1.

Warwick gravelly loam, 8 to 15 percent slopes (Wg).—Except that it has stronger slopes, this soil is similar to Warwick gravelly loam, 3 to 8 percent slopes. It occurs in association with the other Warwick soils in the northeastern part of the county.

Use and management.—Most of this soil is used for crops. The rest is pastured, in forest, or idle. Erosion is a problem on this soil. This soil is in capability class III, subclass IIIe, and in management group 5.

Warwick gravelly loam, 3 to 15 percent slopes (We).—This soil is similar to Warwick gravelly loam, 3 to 8 percent slopes, or to Warwick gravelly loam, 8 to 15 percent slopes, depending on which soil is dominant in a given area. It is in the southern part of the county. This soil is in capability class III, subclass IIIe, and in management group 5.

Waterboro muck

Waterboro muck (Wh).—This organic soil occurs in depressions and on nearly level areas along streams. It is widely scattered throughout the county.

The soil is a mixture of very dark brown to black, well-decomposed organic matter and mineral matter. The mineral matter makes up as much as 50 percent of the soil material in some areas. The plant remains have disintegrated to the extent that individual fibers and the cell structure cannot be distinguished. In most places the mixed organic matter and mineral material extends to a depth of at least 3 feet.

In places there is brown organic matter in the lower part of the profile and the substratum is gray to light-gray glacial till of sand and gravel. This soil is very acid throughout.

Use and management.—Almost 90 percent of this soil is under forest. A few areas have been used as wild hay meadow, but they are now idle. This soil is not desirable for growing crops, however, because of the risk of floods and the frosts that occur in almost any month of the year. Sedges predominate in the pastures and meadows. On the forested areas there is a dense growth of alders, briers, red maples, and willows and a few hemlocks. This soil is in capability class VII, subclass VIIw, and in management group 13.

Waterboro muck, shallow (Wk).—This soil is similar to Waterboro muck except that the organic matter is less than 3 feet thick. Neither of these two soils is desirable for agriculture, but this soil is even less desirable than Waterboro muck. If this soil were drained, the muck layer would shrink so that it would be too shallow for agricultural use. Also, the height of the water table would be more difficult to control. This soil is in capability class VII, subclass VIIw, and in management group 13.

Whately series

The soils of the Whately series are level to nearly level. They have developed from sandy materials that overlie glaciolacustrine and marine silts and clays. The silts and clays are at depths of 18 to 40 inches.

These soils are the very poorly drained members of the catena that includes the well drained Melrose, the moderately well drained Elmwood, and the poorly drained Swanton soils. They occur in association with the other soils of the catena and with the Walpole, Scarboro, Scantic, and Biddeford soils. The Scarboro soils differ mainly as a result of having developed from glacial outwash, and the Biddeford soils, as a result of having developed entirely from silts and clays. These soils are in the Humic Gley great soil group. Only one soil of this series, Whately fine sandy loam, 0 to 3 percent slopes, occurs in the county.

Whately fine sandy loam, 0 to 3 percent slopes (Wm).—This soil is very poorly drained. It occurs in the eastern part of the county. On forested areas the trees are mainly yellow, black, and gray birches, red maples, and white pines. The undergrowth consists of water-tolerant shrubs and herbs.

Typical profile observed in a forested area:

1 to 0 inch, thin layer of leaves and twigs underlain by partly decomposed to well-decomposed leaves and other plant remains.
0 to 2 inches, very dark brown or black fine sandy loam that has a high content of organic matter and is mucky in places; coherent in place but loose if disturbed; fine granular structure; very strongly acid.
2 to 6 inches, dark brown to very dark brown fine sandy loam that is mottled in places; coherent in place but very friable if disturbed; weak very fine granular structure; very strongly acid.
6 to 18 inches, yellowish-brown or grayish-brown fine sandy loam mottled with light gray; coherent in place, but loose if disturbed; strongly acid.
18 inches +, olive-gray silty clay; plastic when wet; medium to thick platy structure; strongly acid to medium acid.

In some areas the surface layer is sandy loam, very fine sandy loam, or loamy sand. Surface runoff is very slow. The soil above the silty clay is rapidly permeable. In the wetter seasons, however, the water table is often within a few inches of the surface. In dry seasons the silty clay in the substratum retards the downward movement of water, and the water moves laterally along this layer. Water stands on the surface during wet seasons, and the subsoil is waterlogged most of the time. Roots penetrate to only shallow depths.

Use and management.—This soil is largely in forest. A few scattered areas have been cleared and are used for wild hay and pasture or are idle. If the soil is used for row crops, it must be drained. The pastures provide good grazing in summer. The commonest native pasture plants are Kentucky bluegrass, Colonial bentgrass, and whiteclover. Sedges predominate in the wetter spots. This soil is in capability class VI, subclass VIw, and in management group 11.

Whitman series

The soils of the Whitman series are level to gently sloping. They have developed on acid glacial till derived from granite, gneiss, and mica schist. The soils are the very poorly drained members of several catenas that include the well drained Gloucester, Charlton, Brookfield, and Paxton soils, the moderately well drained Acton, Scituate, Sutton, and Woodbridge soils, and the poorly drained Leicester and Ridgebury soils. In the Whitman series fine sandy loam is the dominant type, but some areas of sandy loam are mapped with the fine sandy loams. The stony Whitman soils are not mapped separately but are included in the Leicester, Ridgebury, and Whitman undifferentiated soil groups.

On forested areas of the Whitman soils, the trees are alder, gray birch, hemlock, soft maple, and other hardwoods, and sedges and rushes grow in places. The soils belong to the Humic Gley great soil group. The areas are scattered throughout the county. They occur in depressions in the uplands, and some are at the heads of streams.

Whitman fine sandy loam, 0 to 3 percent slopes (Wn).—This soil is level to nearly level and is very poorly drained. On forested areas the trees are mainly black ash, gray birch, hemlock, and red maple and a few red spruces and willows. Winterberry, speckled alder, white rod, and other small, water-tolerant shrubs also grow on this soil.

Typical profile:

4 to 0 inches, thin layer of loose leaves underlain, in places, by a thin layer of peat or muck; extremely acid.
0 to 8 inches, nearly black (light brownish gray or grayish brown when dry) fine sandy loam; contains many coarse particles of sand; has a high content of organic matter; firm to loose in place; fine granular structure; very strongly acid.
8 inches +, light-gray or pale-olive fine sandy loam; contains many fragments of stone; has faint mottles of yellowish brown; not very plastic or sticky when wet; very strongly acid.

The depth of the lighter colored material varies, depending on drainage. In areas that are drained, it is at shallower depths than in the wetter areas. The soil is covered by water during much of the year. Artificial drainage is seldom used, however, except where a small area of this soil is surrounded by well-drained soils.

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Use and management.—About 50 percent of this soil is in forest, less than 30 percent is in crops, and the rest is in pasture or idle. On areas that are not drained, hay is the principal crop. The carrying capacity of the pastures is low. Most of the pastures are covered by brush and weeds, and most of them are very wet during a large part of the grazing season. They need lime and fertilizer and must be drained to provide good pasture. In most places, however, the expense of draining the soil would not be justified. This soil is in capability class VI, subclass VIw, and in management group 11.

Whitman fine sandy loam, 3 to 8 percent slopes (Wo).—Except that it has stronger slopes, this soil is similar to Whitman fine sandy loam, 0 to 3 percent slopes, and its use and management are about the same. About 35 percent is used for crops, 35 percent is in forest, and the rest is in pasture or idle. This soil is in capability class VI, subclass VIw, and in management group 11.

Windsor series

The soils of the Windsor series are nearly level to strongly sloping. They have developed from sandy materials and occur on fairly smooth, low terraces. The sandy materials were derived mainly from granite and schist and are 6 to 10 feet thick. These soils differ from the Merrimac soils in that there is practically no gravel in the profile.

These well drained to excessively drained soils are in the same catena as the moderately well drained Sudbury soils, the poorly drained Walpole soils, and the very poorly drained Scarboro soils. They belong to the Brown Podzolic great soil group. The forests on these soils consist mainly of white pine, but there are a few gray birch trees and red maples. The soils are in the northwestern part of the town of Londonberry and in other small, scattered areas.

Windsor loamy sand, 3 to 8 percent slopes (Wr).—This soil is the most extensive of the Windsor loamy sands. Its drainage is excessive.

Typical profile:

A_p 0 to 8 inches, dark-brown loamy sand that contains many roots; soft when dry; weak very fine granular structure; strongly acid.

B_{21} 8 to 11 inches, yellowish-brown loamy sand in which roots are common; soft when dry; weak fine granular structure; strongly acid.

B_{22} 11 to 20 inches, brownish-yellow loamy sand in which roots are common; soft when dry; weak medium granular structure; strongly acid.

C_1 20 to 27 inches, pale-brown loamy sand that contains a few roots; soft when dry; single grain (structureless); strongly acid.

C_2 27 inches +, light brownish-gray very fine sand that contains a few roots; loose, single grain (structureless); strongly acid.

This soil is loose to friable throughout if disturbed.

In places the texture of the surface layer is fine sandy loam. In places pale-brown or pale-yellow loamy sand is at depths between 14 and 20 inches. In some places, at depths between 26 and 40 inches, the color of the soil is gray and the texture is loamy sand instead of very fine sand. A few mottles or streaks of yellow occur in some places at depths of 4 feet or more. Clay is at depths below 27 inches, but the depth to clay varies. In many places the clay is deep enough so that it can be seen only in sand pits.

Surface runoff is very slow and internal drainage is rapid. The water table is higher than in the Merrimac or Barnstead soils, but it is generally too low to provide adequate moisture for plants during dry periods. The plant nutrients and organic matter have leached out of the soil. Unprotected areas are slightly wind eroded.

Some areas of fine sandy loam and loamy fine sand have been mapped with this soil.

Use and management.—This soil is largely in forest, but small areas are cultivated, used for pasture, or are idle. Millet, corn grown for silage, and sweet corn are the principal crops. The crops and pastures need heavy applications of manure, commercial fertilizer, and lime, but if these are added they will leach out rapidly. The carrying capacity is generally low unless the pastures are fertilized. Most of the native pastures and idle areas contain broomsedge, poverty oatgrass, gray birch sprouts, cinquefoil, sweetfern, hairycapmoss, and common juniper. This soil is in capability class III, subclass IIIs, and in management group 6.

Windsor loamy sand, 0 to 3 percent slopes (Wp).—Except that it has milder slopes, this soil is similar to Windsor loamy sand, 3 to 8 percent slopes. It is more desirable for agriculture than the more strongly sloping soil. This soil is in capability class III, subclass IIIs, and in management group 6.

Windsor loamy sand, 8 to 25 percent slopes (Ws).—This soil occurs in small areas. Except that it has steeper slopes, it is similar to Windsor loamy sand, 3 to 8 percent slopes, with which it is associated. Some exposed areas have been slightly wind eroded, and some of the steeper exposed areas have been eroded by water, especially on terrace breaks that border drainageways.

Use and management.—This soil is mostly in forest. The trees are mainly white pines, but there are a few gray birches. Scattered areas are idle or are used for pasture. The native pasture plants are mainly blueberries, broomsedge, cinquefoil, moss, poverty oatgrass, and sweetfern. This soil is in capability class VII, subclass VIIs, and in management group 14.

Formation of Soils

The characteristics of any soil depend on (1) the physical and mineral composition of the parent material, (2) the climate under which the soil material has accumulated and existed since it accumulated, (3) the plant and animal life in and on the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of development have acted on the material.

Parent Materials

The soils in Rockingham County have developed largely from glacial till and glacial outwash. In addition, fairly large areas in the eastern part of the county have formed from marine or glaciolacustrine sediments; a few of the soils have developed from sediments deposited by streams; and a few have developed from organic material that has accumulated in depressions.

Glacial till consists of the mixed materials deposited by glaciers with little or no sorting by water. In this county the soils on glacial till occur mainly in the uplands. The till is of variable thickness. It was formed many years ago at the time the area was covered by glacial ice. As the glacier moved slowly along, it picked up rocks and ground them into particles the size of sand, silt, or clay. Some fragments of rock were not ground into fine particles but were carried along by the ice. When the climate became warmer, the ice melted and the mixed materials were then deposited by the glacier. Most of the glacial till in this county is stony except where the stones have been removed.

Glacial outwash, or water-sorted material, likewise was formed as a result of glacial action. As the glacier melted, torrents of water were released as streams that flowed from the melting ice. The streams picked up fine particles of soil, gravel, and small stones. These were carried varying distances by the water, the coarser particles settling out first, and were deposited as beds of sand and gravel, called glacial outwash.

The finer particles of silt and clay deposited by the water from the melting glacial ice remained suspended in the water. They were later deposited in glacial lakes or in the sea at the margin of the ice sheet. After the glacier melted the land rose and the silts and clays, called marine and glaciolacustrine lake sediments, were exposed. The soils formed from these materials occur mainly in the eastern part of the county.

Much of the glacial material was transported only a short distance, so the irregular contour of the underlying bedrock partly determined the distribution of the parent material from which the soils developed. The bedrock is made up of a wide variety of rocks, as granite, gneiss, granodiorite, phyllite, syenite, coarse crystalline gneiss, and schist. Some schist is calcareous, pyritiferous, or slightly micaceous. The geologic pattern is made even more complex because of the mixing of these materials dragged over the bedrock by glaciers.

The soils that are forming from recently deposited materials occur along streams. The streams in the nearly level areas often overflow. The sediments carried by the floodwaters are deposited on the low-lying areas near the stream. The level areas of stream deposits built up in this way are called flood plains.

Climate

The effect of climate on the soil depends on temperature, rainfall, and humidity, as well as on the relief and the physical characteristics of the soil itself. All these, in turn, influence drainage, aeration, runoff, erosion, and exposure to the sun and wind.

Rockingham County has a continental climate, but the eastern part borders or in places is only a few miles back from the Atlantic Ocean. This makes the climate slightly warmer in winter and cooler in summer than in the surrounding areas. The prevailing westerly wind, however, moderates the full effect of the ocean on the climate. The average annual temperature is 46.8° F., and the precipitation is about 39 inches.

Plant and Animal Life

Plants have had an important part in the development of the soils of Rockingham County. Animals have influenced the soils to a lesser extent. The county is in an area that is transitional between the central hardwood forest made up mainly of chestnut, oak, and pine and the northern forest that is mostly beech, hemlock, and maple. There is a large amount of white pine in the county. Originally, the forest consisted of a mixture of hardwoods and softwoods, mostly white ash, basswood, beech, yellow and gray birch, hemlock, hickory, red maple, and white and pitch pine.

The type of soil, drainage, and climate somewhat determine the distribution and dominance of the species of trees. Because the area is transitional, it has an unusually large number of different kinds of trees, and the trees include several species, as white ash, black cherry, red maple, hemlock, and white pine, that have a fairly wide range north and south.

In the original forest, white pine probably grew mostly in groups or singly among the hardwoods, and entire stands of pine grew as a permanent forest type on the sand plains only. Practically all the virgin timber has been cut, and the present cover consists largely of second- or third-growth trees. White pine grows in nearly pure stands on some of the uplands in this second- or third-growth timber apparently because the areas were once cleared and pastured. When the areas were pastured, most of the hardwoods were killed and the white pine grew with no competition.

Relief

The elevation ranges from fairly low to fairly high in Rockingham County. Near the coast the elevation ranges from sea level to about 300 feet. In the northwestern corner of the county, it is fairly high, ranging from 200 to 1,300 feet. The eastern part consists of fairly smooth outwash plains and areas of silty and clayey deposits of marine or lacustrine origin. These are interspersed with somewhat smooth, rounded glacial hills that are mostly gently sloping. The northern part of the county is a low plateau of smoothly rounded glacial hills interspersed with smooth to hummocky outwash plains. Most of the steep and rough land is in the northwestern part of the county. Here, the relief ranges from nearly level to steep and irregular.

Time

Time is a factor in soil development. If the parent material has been in place for only a short time, the climate and vegetation have not had an opportunity to act on the soils for a long enough time for horizons to develop, and the soils are said to be weakly developed. The soils of the Ondawa, Podunk, Rumney, and Saco series are examples of these soils. They are Alluvial soils that are forming from recently deposited sediments.

The Acton, Barnstead, and other soils of the Brown Podzolic great soil group are well-developed soils. Most of the material from which these soils were formed was deposited by glaciers.

The soils that have been in place long enough to have reached equilibrium with their environment are called mature, or old. Their profiles are well developed, whereas the young soils show little profile development. In this county it is thought that the development of recognizable horizons would take at least 500 to 1,000 years. During that time the soils would have to remain in place, and no fresh deposits would be added.

Classification of Soils

The lower categories of soil classification—phases, types, and series—are explained in the section, Soil Survey Methods and Definitions. Briefly, a soil type consists of one or more phases and a soil series of one or more soil types. Soil types or phases are the units shown on the detailed soil map.

Soil series are classified into a broader category, the great soil groups (*9, 10*). Each great soil group is made up of soils that have certain internal characteristics in common. In table 10 the soils are grouped in five great soil groups, the Alluvial, Bog, Brown Podzolic, Humic Gley, and Low-Humic Gley. A discussion of the soils of each of these great soil groups is given in the following pages. In addition there is a discussion of the Podzol great soil group. The Podzols have not been classified separately in this county because they generally occur as small, isolated areas surrounded by larger areas in which the layers of Podzols are absent.

Brown Podzolic Soils

Most of the well drained and moderately well drained soils of the county belong to the Brown Podzolic great soil group. On the surface they have an organic mat, 1 to 2 inches thick, that is made up of partly decomposed leaves or needles. The surface layer, or A_1 horizon, which is 1 to 3 inches thick, is dark grayish brown and is friable. Below this is a strong-brown, yellowish-brown, or olive-brown B horizon that is friable and in most places has a weak fine granular structure. Clay has not accumulated in the B horizon.

The Brown Podzolic soils are mature and have developed as a result of podzolization. They are generally only slightly influenced by a high water table, and they normally are made up of similar minerals. Most of the parent materials have been in place since the most recent glacier covered the area, so that climate and plants have been the major influences in the development of the soils.

The development of these soils probably took place in the following manner: Water percolated through the organic layer of leaves that covered the mineral soil on the forest floor and carried away the organic acids. These acids combined with iron and aluminum that were leached out of the mineral particles in the surface layer. These sesquioxide-humus compounds were moved only short distances, and then they precipitated out and adhered to the outside of the mineral particles in the B horizon. The compounds were a strong-red or yellow color, and thus they colored the mineral particles in the B horizon. The B horizon has a stronger color at the top because of the greater concentration of the coated particles there.

Most of the iron and aluminum apparently comes from the A_1 horizon. The leaching does not cause the A_1 horizon to become lighter colored, because only small amounts of iron and aluminum are leached out, and because many small animals, as ants, beetles, mice, spiders, and thrips, intermix the materials in the upper B horizon, the A_1 horizon, and the organic mat.

The lower part of the solum of the Brown Podzolic soils varies in texture, consistence, and structure. The soils that overlie gravel and sand or sandy till are generally finer textured in the upper part and become coarser textured with depth. The Brown Podzolic soils are very friable and have a weak fine granular structure in the upper part of the solum, but in some, the substratum has a loose consistence and is single grain (structureless).

The Brown Podzolic soils can be divided, according to texture, into the following five groups: (1) Soils that are coarser textured with increasing depth, (2) soils that have about the same texture throughout, (3) soils that are finer textured with increasing depth, (4) soils that have a very firm, brittle, platy layer, or fragipan, at depths between 21 and 24 inches, and (5) soils that are shallow over bedrock. A discussion of the soils in these various groups follows:

Soils that become coarser textured with depth.—The Merrimac soils are typical Brown Podzolic soils that become coarser textured with depth. They have developed on glaciofluvial deposits. The following profile of Merrimac sandy loam was observed in a forested area on a slope of 4 percent, 1 mile northeast of Auburn:

- A_0 ½ to 0 inch, partly decomposed organic matter from forest litter.
- A_1 0 to 5 inches, very dark grayish-brown (10YR 3/2) sandy loam that contains many roots; friable; weak fine granular structure; pH 5.0; lower boundary clear and wavy.
- 5 to 9 inches, dark-brown (7:5YR 4/4) gravelly sandy loam of which 30 percent is coarse pebbles; roots common; friable; weak medium granular structure; pH 5.2; lower boundary clear and wavy.
- B_{22} 9 to 14 inches, strong-brown (7.5YR 5/6) gravelly sandy of which 30 percent is coarse, partly decomposed limestone pebbles; roots common; friable; weak medium granular structure; pH 5.4; lower boundary clear and wavy.
- B_3 14 to 27 inches, yellowish-brown (10YR 5/8) gravelly sand of which 40 percent is coarse, partly decomposed limestone pebbles; contains few roots; very friable; weak fine granular structure; pH less than 5.0; lower boundary clear and wavy.
- C 27 inches +, white (10YR 8/2) sand that contains few roots; loose; single grain (structureless); pH less than 5.0.

A study of the Merrimac soils has been made in Connecticut, and publications that give detailed information about them can be obtained (*2, 8*).

The soils of the Barnstead series are similar in texture, structure, and consistence to the Merrimac soils. They have developed from glacial outwash that contains granite and also a rather high proportion of pyritiferous or easily weathered mica schist. Typically,

TABLE 10.—*Classification of the soil series by great soil groups and some of the factors that have contributed to their morphology*

Great soil group and series	Parent material	Drainage
Brown Podzolic:		
Acton	Gray, loose, sandy glacial till derived mainly from granite	Moderately good to somewhat poor.
Barnstead	Horizontally bedded, strong-brown, gravelly and sandy glacial outwash mainly from granite but with some weathered brown mica schist.	Good to excessive.
Brimfield	Shallow, strong-brown, loamy glacial till mainly from weathered brown mica schist.	Good.
Brookfield	Strong-brown, loose and friable, loamy glacial till mainly from weathered brown mica.	Good
Buxton	Marine or glaciolacustrine silts and clays from various kinds of rocks.	Moderately good to somewhat poor.
Charlton	Olive, loamy, firm glacial till mainly from schist	Good.
Elmwood	Shallow, sandy glacial outwash derived from various rocks and overlying marine or lacustrine clays.	Moderately good to somewhat poor.
Gloucester	Gray, loose, gritty and sandy glacial till mainly from granite	Good.
Hinckley	Grayish, coarse, crossbedded glacial outwash mainly from granite.	Excessive.
Hollis	Shallow, olive, loamy glacial till mainly from schist	Good.
Jaffrey	Strong-brown, coarse, crossbedded gravelly and sandy glacial outwash mainly from granite but with some weathered brown mica schist.	Excessive.
Melrose	Sandy glacial outwash from various kinds of rocks over marine or lacustrine clays.	Good.
Merrimac	Horizontally bedded, grayish, gravelly and sandy glacial outwash mainly from granite.	Good to excessive.
Paxton	Olive, compact, platy, loamy glacial till from granite and schist.	Good.
Scituate	Compact, platy, sandy glacial till mainly from granite	Moderately good to somewhat poor.
Shapleigh	Shallow, gray, sandy glacial till mainly from granite	Good.
Sudbury	Mainly horizontally bedded, grayish, gravelly and sandy glacial outwash mainly from granite.	Moderately good to somewhat poor.
Suffield	Marine or lacustrine silty and clayey glacial till from various kinds of rocks.	Good.
Sutton	Loose or compact, loamy glacial till mainly from schist	Moderately good to somewhat poor.
Warwick	Mainly horizontally bedded, grayish, gravelly and sandy glacial outwash with considerable phyllite; derived from gray mica schist, phyllite, and siliceous limestone.	Good to excessive.
Windsor	Deep, sandy glacial outwash mainly from granite and schist	Excessive.
Woodbridge	Olive, compact, platy, loamy glacial till mainly from schist	Moderately good to somewhat poor.
Humic Gley:		
Biddeford	Marine or glaciolacustrine silts and clays derived from various kinds of rocks.	Very poor.
Scarboro	Mainly horizontally bedded, grayish, gravelly and sandy glacial outwash largely from granite.	Very poor.
Whately	Shallow sandy outwash derived from various kinds of rocks and overlying marine or lacustrine clays.	Very poor.
Whitman	Gray or olive, sandy, loose or compact glacial till from granite or schist.	Very poor.
Low-Humic Gley:		
Leicester	Gray or olive, sandy, loose glacial till from granite and schist	Poor.
Ridgebury	Compact and platy, loamy glacial till largely from granite	Poor.
Scantic	Marine or lacustrine silts and clays derived from various kinds of rocks.	Poor.
Swanton	Shallow, sandy glacial outwash derived from various kinds of rocks, over marine or lacustrine clays.	Very poor.
Walpole	Horizontally bedded, grayish, gravelly and sandy glacial outwash mainly from granite.	Poor.
Alluvial:		
Ondawa	Horizontally bedded grayish sand mainly from granite and schist.	Good.
Podunk	Horizontally bedded grayish sand mainly from granite and schist.	Moderately good to somewhat poor.
Rumney	Horizontally bedded grayish sand mainly from granite and schist.	Poor.
Saco	Horizontally bedded grayish sand mainly from granite and schist.	Very poor.
Bog:		
Balch and Littlefield peats	Acid, slightly to partly decomposed organic remains; little or no organic matter.	Very poor.
Waterboro muck	Acid, well-decomposed organic remains; considerable mineral matter.	Very poor.

the Barnstead soils have a brown surface layer and a reddish-brown or strong-brown subsoil.

The Warwick soils are finer textured than the Merrimac soils, and unlike those soils, were derived mostly from phyllite and schist. The phyllite in the Warwick soils once contained lime, but the lime has leached out so that even traces of it are hard to find.

The following profile of Warwick gravelly loam was observed in a gravel pit in the town of Stratham:

- A_p 0 to 7 inches, dark-brown (10YR 4/3) gravelly loam that contains many roots; very friable; weak medium granular structure; pH 5.4; lower boundary clear and wavy.
- B_2 7 to 14 inches, yellowish-brown (10YR 5/6) gravelly sandy loam in which roots are common; loose; weak medium granular structure; pH 5.1; lower boundary clear and wavy.
- C_2 14 to 17 inches, dark yellowish-brown (10YR 4/4) gravelly sandy loam in which roots are common; loose; weak fine granular structure; pH 5.5; lower boundary clear and wavy.
- D_1 17 to 19 inches, dark-brown (10YR 4/3) cobbly coarse sand containing few roots; loose; single grain (structureless); pH 6.2; lower boundary clear and wavy.
- D_2 19 inches +, dark yellowish-brown (10YR 4/4) cobbly loamy sand; contains few roots; loose; single grain (structureless); pH 6.0. Below this layer are beds of sand, gravel, and cobbles, mostly of phyllite and schist.

The Hinckley and Jaffrey soils, which are similar to the Merrimac and Barnstead soils except for coarser texture, for the most part have developed on areas of hummocky or uneven relief. The Windsor soils are also similar to the Merrimac, except that there is little or no gravel in the profile or parent material and in places clay occurs at depths of 8 to 10 feet.

The Gloucester soils are typical of the Brown Podzolic soils that have developed on sandy till derived from granite. The following profile of Gloucester sandy loam was observed on a slope of 5 percent in a forested area of mixed hardwoods and conifers. The area was near a road on the northern slope of Mount Misery in the town of Auburn:

- A_{00} 2 to 1 inches, recently deposited leaves, twigs, and other organic matter.
- A_0 1 to 0 inch, partly decomposed organic materials.
- A_1 0 to 3½ inches, dark grayish-brown (10YR 4/2) sandy loam that contains many roots; friable; weak medium granular structure; pH 5.4; lower boundary clear and wavy.
- B_{21} 3½ to 6 inches, strong-brown (7.5YR 5/8) sandy loam in which roots are common; friable; weak fine granular structure; pH 5.3; lower boundary clear and wavy.
- B_{22} 6 to 17 inches, yellowish-brown (10YR 5/8) sandy loam in which roots are common; friable; weak fine granular structure; pH 5.2; lower boundary clear and wavy.
- B_3 17 to 21 inches, yellowish-brown (10YR 5/4) stony gravelly loamy sand in which roots are common; 5 percent coarse, partly decomposed pebbles; weak fine granular structure; pH 5.2; lower boundary clear and wavy.
- C 21 inches +, white (10YR 8/2) stony gravelly sand containing a few roots; friable; weak medium granular structure, but massive (structureless) in places; pH less than 5.0.

This soil has developed from glacial till. It contains boulders of granite, and small rock fragments are on the surface and throughout the profile. The mechanical analysis of a sample of Gloucester sandy loam indicated that there had been little or no transfer of material within the profile. The colloidal content did not vary significantly in this sample, but chemical analysis shows that much iron and aluminum had been transferred or eluviated.

Soils that have about the same texture throughout.—The Charlton, Brookfield, and Sutton soils have about the same texture throughout the profile. The soils have a very friable solum in which the structure is weak fine granular. Their parent material is firm and has a granular or platy structure.

The Charlton soils, which have developed from schistose glacial till, are typical of this group. The following is a description of a profile of Charlton loam on a slope of 6 percent observed in a wooded area of mixed hardwoods and conifers. The profile observed was near Saddleback Mountain, northwest of Lucas Pond, in the town of Northwood:

- A_{00} 1 to 0 inch, (forest floor) layer of fairly recent leaves, needles, and twigs.
- A_1 0 to 7 inches, very dark grayish-brown (10YR 3/2) loam that contains many roots; friable; weak medium granular structure; pH 5.1; lower boundary clear and wavy.
- B_{21} 7 to 13 inches, yellowish-brown (10YR 5/8) loam that contains many roots; friable; weak medium granular structure; pH 5.3; lower boundary clear and wavy.
- B_{22} 13 to 24 inches, dark yellowish-brown (10YR 4/4) loam in which roots are common; friable; weak medium granular structure; pH 5.4; lower boundary clear and wavy.
- C 24 inches +, yellowish-brown (10YR 5/4) to light olive-brown (2.5Y 5/4) loam containing a few roots; about 5 percent partly decomposed limestone pebbles; firm in place, but friable if disturbed; moderate medium platy structure; pH 5.4.

This soil probably was once under cultivation, and the thickness of the present A_1 horizon is the same as the thickness of the original plow layer.

The Brookfield soils have developed from till that was made up mainly of pyritiferous mica schist. They have a rust-colored, brown or strong yellowish-brown color throughout. These well-drained soils have a rolling relief. The following is a description of a profile of Brookfield sandy loam, observed one-fourth mile northwest of Long Pond on Browns Hill in the town of Northwood:

- A_0 2 to 0 inches, litter of decomposed grasses and roots.
- A_1 0 to 4 inches, dark yellowish-brown (10YR 4/4) sandy loam that contains many roots; friable; weak fine granular structure; pH 5.0; lower boundary clear and wavy.
- B_{21} 4 to 10 inches, yellowish-red (5YR 4/6) fine sandy loam that contains many roots; friable; weak medium granular structure if undisturbed, but weak fine granular structure if crushed; pH 5.3; lower boundary clear and wavy.
- B_{22} 10 to 18 inches, strong-brown (7.5YR 5/8) fine sandy loam in which roots are common; friable; weak medium granular structure if undisturbed, but weak fine granular structure if crushed; pH 5.3; lower boundary clear and wavy.
- B_3 18 to 23 inches, yellowish-brown (10YR 5/8) fine sandy loam in which roots are common; friable; medium granular structure if undisturbed, but weak fine granular structure if crushed; pH 5.4; lower boundary clear and wavy.
- C_2 23 inches +, yellowish-brown (10YR 5/6) very fine sandy loam to loam that contains few roots; firm; weak medium granular structure; pH 6.0.

The Sutton soils are moderately well drained and are in the same catena as the Charlton and Brookfield soils. They are associated with the Acton, Scituate, and Wood-

bridge soils. Typically, they have a brown surface layer that overlies a mottled brown subsoil.

Soils that become finer textured with depth.—Examples of the Brown Podzolic soils that become finer textured with depth are those of the Suffield, Buxton, Melrose, and Elmwood series. These soils have formed from marine or lacustrine silts and clays. The solum of the Suffield and Buxton soils is silty, whereas that of the Melrose and Elmwood soils is sandy and overlies silts and clays.

A profile description of Suffield silt loam, which is typical of these soils, follows:

- A_p 0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam that contains some roots; very friable; moderate fine granular structure, but more granular in upper 3 inches than in lower part of horizon; pH 6.2; lower boundary abrupt and wavy.
- B_2 9 to 12 inches, olive-brown (2.5Y 4/4) silt loam containing a few roots; very friable; moderate medium subangular blocky structure; pH 6.0; lower boundary clear and wavy. (In a few places this horizon is lacking.)
- B_3 12 to 17 inches, light olive-brown (2.5Y 5/4) silt loam that contains a few roots; has a few, fine, faint brownish mottles; very friable; moderate medium subangular blocky structure; pH 6.0; lower boundary abrupt and wavy.
- B'_{21g} 17 to 22 inches, silt loam that has many distinct and medium mottles of olive gray (5Y 5/2) and light olive brown (2.5Y 5/4); friable; moderate medium subangular blocky structure; pH 5.6; lower boundary clear and wavy.
- B_{22g} 22 to 30 inches; olive-gray (5Y 4/2) silty clay loam that has common, medium, distinct mottles of brown (10YR 4/3); firm; moderate coarse subangular blocky structure, but tends to break to plates that are about 5 millimeters thick; pH 5.8.
- C 30 inches +, varved very fine sands and silts that are mottled distinctly.

The Suffield and Buxton soils of this group have blocky lower B horizons resembling the B horizons of Gray-Brown Podzolic soils in structure. More study of the Suffield and Buxton soils will be necessary before their genesis can be described with certainty.

Soils that have a very firm, brittle, platy layer, or fragipan, at depths between 21 and 24 inches.—In this group of Brown Podzolic soils are the Paxton soils, which contain a fragipan. There are several theories to explain the origin of the fragipan in these soils. One of these is that the fragipan was formed of glacial till that had been made compact and very firm or brittle by the weight of the glacial ice at the time the material was deposited. The soils that contain fragipans are on or near drumlins that are of glacial origin, a fact that supports this theory.

A second theory is that the fragipan developed as a result of the processes of soil development.[5] This theory is based on the fact that some soils that contain a fragipan occur in areas that were not covered by glaciers. It is not known how much the processes of soil development may have been responsible for the formation of the fragipan in these soils. In support of the soil-development theory, however, is the fact that the hard, platy fragipan layer is fairly thin in most of the moderately well drained soils. Below this is friable, unmodified parent material. In most drumlins, on the other hand, the characteristic platy structure of the fragipan occurs only in the uppermost 5 or 6 feet. Below this the material is massive and is compact and very firm or brittle to great depths.

Another theory is that the hard, brittle fragipan layer may be a relic of the permafrost from the immediate postglacial period (*4*).

The following profile of Paxton loam is representative of the Brown Podzolic soils that have fragipans:

- A_p 0 to 9 inches, dark-brown (10YR 4/3) loam that contains many roots; friable; weak fine granular structure; pH 5.4; lower boundary clear and wavy.
- B_2 9 to 15 inches, light olive-brown (2.5Y 5/4) loam that contains many roots; friable; weak fine granular structure; pH 5.4; lower boundary clear and wavy.
- B_{22} 15 to 21 inches, olive (5Y 5/3) fine sandy loam that is 10 percent coarse skeleton; contains a few roots; friable; mostly weak fine granular structure, but faint indication of plates; pH less than 5.0; lower boundary clear and wavy.
- B_{23m} 21 inches +, olive (5Y 5/3) fine sandy loam that is 5 percent coarse skeleton; contains a few roots; brittle; friable if disturbed; moderate medium platy structure; pH less than 5.0.

Soils that are shallow over bedrock.—Fairly large areas of Brown Podzolic soils are shallow over bedrock. Some of these shallow soils are the Hollis, Brimfield, and Shapleigh in which bedrock occurs at depths of 12 to 24 inches. These shallow soils have developed normally. The upper horizons are as thick as those in the deeper soils developed from the same kind of parent material, but the lower horizons that occur in the deeper soils are missing from these soils.

Normally, these soils have developed from glacial till, but in some places a large proportion of angular fragments of stones and gravel occur in the lower part of the subsoil. These fragments have been cracked from the bedrock by frost action. The granitic bedrock was made smooth by the glaciers and has remained smooth. Much of the phyllitic bedrock, however, is now shattered. In many places the shattered phyllitic bedrock is like a deep, very gravelly or very stony soil material through which water, roots, and air penetrate readily.

Humic Gley Soils

The Humic Gley soils occur in wetter areas than the Low-Humic Gley soils. Even though the water table fluctuates, the Humic Gley soils are saturated except during the middle of the growing season or during unusually dry periods. They differ from the Low-Humic Gley soils principally in the type of surface layer. Commonly they have a mucky surface layer, 2 to 10 inches thick, that has a fairly high content of organic matter. These soils generally support sedges and rushes as well as trees and brush, such as alder.

The Humic Gley soils in Rockingham County belong to the Whitman, Biddeford, Scarboro, and Whately series. Generally these soils do not have a fragipan, but a fragipan occurs in some of the sloping Whitman soils that are subject to lateral seepage of ground water.

[5] CARLISLE, F. J., JR. CHARACTERISTICS OF SOILS WITH FRAGIPAN IN A PODZOL REGION. 1954. [Unpublished PhD thesis. Copy on file Cornell University Library, Ithaca, N. Y.],

A profile of Whitman fine sandy loam, 0 to 3 percent slopes, observed in a forested area, follows:

A_{00} 4 to 0 inches, (forest floor) thin layer of loose leaves underlain in places by a thin layer of peat or muck; extremely acid.

A_1 0 to 8 inches, nearly black fine sandy loam that is light brownish gray or grayish brown when dry; contains many coarse particles of sand and many stones of granite and schist; very high content of organic matter; firm to loose in place; fine granular structure; very strongly acid; layer commonly saturated.

C_g 8 inches +, light-gray or pale-olive fine sandy loam indistinctly mottled with yellowish brown; contains many stone fragments; not very plastic or sticky when wet; very strongly acid; layer commonly saturated.

Though it does not appear in the profile just described, Whitman soils in many places have a light-gray, faintly mottled A_{2g} horizon similar to that in Low-Humic Gley soils. Also, a distinctly mottled B_{2g} horizon occurs just below the A_2 horizon.

Low-Humic Gley Soils

Most of the poorly drained mineral soils of this county belong to the Low-Humic Gley great soil group. These soils have developed under the influence of a fluctuating water table, which accounts for the gray surface layer and the distinct, gray, yellowish, or strong-brown mottling in the lower horizons. The layer of organic matter on the surface is thin, and generally most of it disappears just before the leaves fall. The organic matter is broken down in many places by the fairly numerous earthworms.

The Low-Humic Gley soils vary in texture, consistence, and structure. Some of the fine-textured soils have a fragipan, and some do not. The Ridgebury soils, for example, have a fragipan, but the fragipan is absent in the Swanton and Scantic soils. A description of a profile of Ridgebury stony fine sandy loam, observed in the town of Nottingham, follows:

A_{00} 2 to 0 inches, (forest floor) layer made up mostly of white pine needles.

A_1 0 to 3 inches, very dark brown (10YR 2/2) stony fine sandy loam that contains many roots; very friable; moderate medium granular structure; earthworm activity apparent.

A_{2g} 3 to 7 inches, grayish-brown (2.5Y 5/3) stony fine sandy loam with common distinct coarse grayish-brown (2.5Y 5/3) and dark grayish-brown (2.5Y 4/2) mottles and some that are dark brown (7.5YR 4/4); layer is cloddy but so wet that structure is difficult to determine.

B_{21} 7 to 14 inches, dark grayish-brown (2.5Y 4/3) gravelly sandy loam, mottled with grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6); friable to firm in place, and friable if disturbed; weak fine granular structure; water seeps along this horizon.

B_{22gm} 14 to 24 inches, olive-brown (2.5Y 4/4) gravelly sandy loams; common, distinct, coarse mottles of yellowish brown (10YR 5/6) and grayish brown (10YR 5/2); very firm and brittle in place but fraible if disturbed; moderate medium platy structure; fewer stones in this layer than in A_1 and A_{2g} horizons.

B_{3gm} 24 to 40 inches +, olive-brown (2.5Y 4/4) sandy loam that has many coarse prominent mottles of grayish brown (2.5Y 5/2) and dark brown (7.5Y 4/4); color becomes lighter with depth and is olive brown (2.5Y 4/4) at depths of about 30 inches; very firm in place, and friable if removed; less firm at depths of about 30 inches, but still difficult to dig; weak thick platy structure; slightly brittle; vertical cracks indicate that some large polygons are present.

A description of a profile of Scantic silt loam, on a slope of 3 percent, observed in the town of Durham, follows:

A_{00} 2 to 1½ inches, layer of pine needles of current year.

A_{01} to A_{02} 1½ to 0 inches, partly decomposed needles; some earthworm casts.

A_p 0 to 7 inches, grayish-brown (2.5Y 5/2, dry) heavy silt loam that contains many roots; very friable; moderate fine granular structure; much earthworm activity apparent.

B_{2g} 7 to 20 inches, silty clay loam that contains many roots; friable; coarse moderate to strong subangular blocky structure, but peds not vertically alined one over the other; outsides of peds olive gray (5Y 5/2), and insides have common, coarse, distinct, olive-colored (5Y 4/4) mottles and some mottles of olive brown (2.5Y 4/4).

C_{1g} 20 to 32 inches, clay; very firm; weak coarse prismatic structure, but breaks to thick medium plates and finally to aggregates that have coarse angular and strong blocky structure; vertical faces of the prisms are gray (2.5Y 5/1); about 60 percent of the mottles inside the prisms are olive brown (2.5Y 4/4), and the rest are olive (5Y 4/3 to 4/4).

C_{2g} 32 to 36 inches, silty clay loam; very firm in place, but friable if disturbed; strong moderate to coarse angular blocky structure; outside of peds mostly gray (2.5Y 5/1), but a few dark-brown (10YR 3/3) stains of manganese dioxide; inside of peds has common, coarse, distinct mottles of olive (5Y 4/3 to 4/4) and some olive-brown (2.5Y 4/4) mottles.

The soils that have developed on sandy deposits generally have a friable or loose consistence throughout but become coarser textured with depth.

The Walpole and Leicester soils are typical of this group. The following is a profile description of Leicester fine sandy loam:

A_{00} 2 to 1 inches, litter of pine needles and leaves.

A_0 1 to 0 inch, layer of humus.

A_1 0 to 3 inches, very dark gray (7.5YR 3/0) fine sandy loam that contains many roots; friable if disturbed; weak fine granular structure; pH 5.0; lower boundary clear and wavy.

B_{2g} 3 to 8 inches, light brownish-gray (2.5Y 6/2) fine sandy loam in which roots are common; friable if disturbed; weak medium granular structure; pH 5.2; lower boundary clear and wavy.

B_{3g} 8 to 10 inches, dark grayish-brown (10YR 4/2) sandy loam that contains a few roots; friable if disturbed; weak medium granular structure; pH 5.3; lower boundary clear and wavy.

C_g 10 inches +, light olive-brown sandy loam that contains a few roots; has yellowish-brown (10YR 5/8), common, fine, distinct mottles; friable if disturbed; weak fine granular structure; pH 5.3.

Although absent in this profile, the A_1 horizon of the Walpole and Leicester soils is frequently underlain by a light-gray, friable, faintly mottled A_{2g} horizon that is 4 to 8 inches thick.

The process that has led to the development of the Low-Humic Gley and Humic Gley soils is gleization. Gleying takes place as follows: Leaves, needles, and other organic matter fall on the surface layer and are incorporated into the nearly black A_1 horizon by the action of small animals. During most of the year the high water table saturates the soil almost to the surface so that oxygen becomes deficient. The small amount of oxygen in the soil is used by the bacteria that are in the surface layer.

The gray color of the soil results when the highly colored (reddish) ferric iron compounds in the soil are reduced. The color then changes to the grayish or greenish color of ferrous compounds.

Reduction is greatest just below the surface layer. Here the bacteria are more numerous, because this part of the soil is near their food supply. The bacteria obtain their food from the organic matter in the A_1 horizon or from the soluble products of the organic matter. Reduction is less intense in the B_{2g} horizon and is localized. Distinct mottling results when the outside parts of the soil peds or clods are strongly affected by reduction. The outsides of the peds then have a gray color, and the insides are less strongly affected.

Organic matter or its soluble products apparently are needed for gleying to take place. In many soils the organic matter is used up in the upper part of the soil. The lower part of the soil retains the original color of the parent material, even though it is saturated completely for long periods.

Because the water table is high except during the growing season, water does not percolate downward through the Low-Humic Gley soils and therefore leaching has not been extensive. For this reason and also because the ground water generally flows outward, or laterally, the Low-Humic Gley soils commonly have a slightly higher base saturation than the associated Brown Podzolic soils. This is noticeable especially in areas where the parent materials contain some carbonates. Generally the wetter soils of a catena are considerably less acid throughout than the nearby Brown Podzolic soils that have been subjected to leaching by the downward movement of water.

Alluvial Soils

The soils of the Alluvial great soil group are well drained to very poorly drained and occur on flood plains. They are composed of recently deposited sediments and therefore have little or no horizon development. They frequently receive fresh sediments as a result of flooding. This recently added material prevents horizons from developing, and as a result the soils are immature, or young.

The soils in the Ondawa catena—the Ondawa, Podunk, Rumney, and Saco—belong to the Alluvial great soil group. The Rumney and Saco soils have poorer drainage than the Ondawa and Podunk soils, and their horizons show more development. In addition they have fairly distinct mottles. These characteristics are not strong enough, however, to classify the Rumney and Saco soils in the Low-Humic Gley or Humic Gley great soil group.

Bog Soils

The Bog soils in this county are the Balch and Littlefield peats and Waterboro muck. These soils are composed of organic matter from plant remains, which have accumulated in depressions that are always wet. The plant remains consist mainly of sedges, rushes, mosses, and trees and shrubs that grew at or near the surface of small ponds or potholes and eventually died and sank to the bottom. To some extent the plant remains were preserved from oxidation and decay by the water.

Through the years, thick layers of plant remains gradually built up until they filled the depressions in which the plants grew. Balch and Littlefield peats, which have undergone little decomposition, were formed in this way. The plant remains that make up Waterboro muck are decomposed, however, so that the original plant cannot be recognized, and in places this soil has a high content of mineral matter. In this county Waterboro muck is the only soil in which the plant remains are decomposed to this extent.

The Bog soils are not used for agriculture. On most of them are poor stands of red maple, black spruce, alders and other shrubs, and mosses, rushes, and sedges. All of these soils are acid.

Tidal marsh and Fresh water marsh resemble the Bog soils, but they contain a considerable amount of mineral matter mixed with the organic matter. Because they are flooded at times, they also have some characteristics of Alluvial soils.

Podzols

The Podzols have developed as the result of severe leaching. No extensive areas of Podzols occur in this county, but they occur in adjacent counties at high elevations or on areas of coarse sand that are at low elevations. At high elevations the climate becomes cooler and the vegetation changes to include more conifers under which leaching is more thorough. Also at higher elevations there are fewer small animals to disturb the soil. As a result a light-gray horizon, the A_2 horizon, or bleicherde, replaces the A_1 horizon. The color of the upper part of the B horizon is reddish brown and is called an orterde. If the bleicherde and orterde layers become so thick that they are apparent even after the soil has been plowed, the soils are called Podzols.

Weakly developed Podzols that have 1 to 2 inches of bleicherde and 2 to 3 inches of orterde are fairly common in some areas of Rockingham County. They occur as small isolated areas surrounded by larger areas that have no gray layer or the layer is only as much as one-half inch thick. Generally the thin gray layer is visible under fairly old stands of hemlock or beech in any part of the county. Apparently the small animals do not mix the layers under these conditions, or the sesquioxide-humus complexes are formed more rapidly than the layers are mixed.

Miscellaneous Land Types

Miscellaneous land types are areas not classified as soils. The land types mapped in Rockingham County are Coastal beach and dune sand, Fresh water marsh, Tidal marsh, and Urban and made land. The mapping unit, Coastal beach and dune sand, resembles the soils of the Regosol great soil group because it has no soil horizons and consists of unconsolidated sands. It is also similar to the Alluvial soils except that fresh material is not added as a result of flooding.

Additional Facts About the County

In the following pages are discussions of physiography, relief, drainage, geology, climate, and vegetation. Also included in this section are discussions of the industries and agriculture in the county and other general information.

Physiography, Relief, and Drainage

Rockingham County lies within two physiographic sections—the Seaboard Lowland and the New England Upland. Elevations are generally between 100 and 500 feet but range from sea level to 1,300 feet on a hill near the county line in the northwestern corner of the county.

The lowland in the eastern part of the county is made up of fairly smooth plains interspersed with smooth, rounded hills that generally have mild slopes. The uplands in the eastern part of the county consist of a low-lying plateau on which there are smooth, rounded hills, interspersed with smooth or hummocky plains. Most of the steep, rough land occurs in scattered areas in the northwestern part of the county. Except in the western part of the county, drainage is generally towards the south and southeast. The largest streams are the Exeter, Lamprey, Piscataqua, and the Squamscott. All of these streams except the Piscataqua rise within the county. Except in the low, swampy areas, they flow fairly rapidly.

Geology

The bedrock that underlies Rockingham County is mainly granite and mica schist interspersed with other materials. Along the coast the mica schist is finer textured than elsewhere and is similar to phyllite in characteristics.

The area was once covered by a glacier of Wisconsin age. When the glacier receded it left two main types of deposits—nonstratified, unsorted glacial till and stratified, water-sorted, gravelly glacial outwash. Hilly, stratified deposits, known as kames, occupy a much smaller area than the till and glacial outwash.

The till is generally stony and has characteristics similar to those of the underlying rock. It varies in depth, but in most places it is 4 to 5 feet deep. In a large part of the area, the till is shallow and outcrops are common.

The glacial outwash is less extensive than the till. It was deposited by the waters from the melting ice of the glacier.

As the glacier melted, deposits of marine clay were laid down along the coastal areas. The land was depressed by the weight of the ice so that several miles inland from the coast the deposits of marine clay were interfingered with deposits of till and glacial outwash. This caused the soil pattern to be complex.

Water Supplies[6]

Ground water occurs in both the consolidated and unconsolidated rocks in Rockingham County. In the consolidated rocks, or bedrock formations, it occurs only in the cracks or fissures. In the unconsolidated deposits, as glacial drift, marine sediments, and glaciolacustrine and glaciofluvial deposits, ground water is in the voids or pore spaces between the individual particles making up the deposits.

The supply of ground water is normally abundant in the unconsolidated deposits that underlie the soils on sandy and gravelly glacial outwash. In these areas wells with fairly large, constant yields may be obtained by digging or drilling into the saturated deposits. In some areas ground water occurs in deposits of stratified medium- or coarse-grained sand, and driven well points may be used to obtain a moderate supply of water.

Water can also be obtained from wells dug in glacial till and in fine-grained, stratified deposits. In these areas the water table fluctuates considerably because of differences in precipitation and conditions of natural discharge. Consequently, some wells in these areas become dry during prolonged dry spells.

In areas underlain by a thin mantle of glacial till or by marine, glaciolacustrine, or glaciofluvial silts and clays, it has often been necessary to drill into the bedrock, which is consolidated rock, to obtain an adequate supply of water. In some places, however, sand and gravel lie beneath the silt and clay and adequate supplies of water can be obtained by drilling or digging through the silt and clay without drilling into the bedrock.

Some cities and towns in the county, notably Portsmouth, Exeter, Hampton, Epping, and Seabrook, draw substantial amounts of ground water for municipal use from gravel-pack wells driven into glacial deposits of sand and gravel. The yield of these wells ranges from about 150 to 600 gallons per minute.

The gravel-pack wells in some parts of New Hampshire are generally between 40 and 100 feet deep. The casing is of steel and is generally 1 or 2 feet in diameter with a 10- to 20-foot screen at the bottom.

Wells drilled into the bedrock formation—locally called artesian wells although they are not free flowing—generally have a 6- or 8-inch steel casing that penetrates the unconsolidated deposits overlying the bedrock. A hole is drilled in the bedrock, but the casing does not extend down into this hole.

The artesian wells range from about 50 to 200 feet in depth, but many of them are about 121 feet in depth (*6*).

Dug wells are commonly between 7 and 45 feet in depth and range in diameter from 2 to about 20 feet. As a rule the older dug wells are lined with stones or bricks, but the more recent ones are lined with 2- or 3-foot pipe of concrete or tile.

In many parts of the county, coarse-textured, porous materials overlie nearly impervious, unconsolidated

[6] BRADLEY, EDWARD. GROUNDWATER RESOURCES IN PART OF THE SEACOAST REGION OF NEW HAMPSHIRE AND ADJACENT AREAS. U. S. Geol. Survey Water Supply Paper. [In press.]

deposits. Springs are common where these two kinds of materials come in contact if the point of intersection is near the surface. In rather low areas where the bedrock is covered with only a thin layer of soil or unconsolidated material, springs sometimes issue from cracks in the bedrock. Some of the springs supply water for livestock or farm homes.

Climate

Table 11, compiled from records at the United States Weather Bureau station at Manchester in Hillsboro County, gives monthly, seasonal, and annual temperatures and precipitation typical for Rockingham County. The records of this weather station were used because complete weather information was not available at any station in the county.

The county has a continental climate. The prevailing winds are from the west. Winds from the Atlantic Ocean modify the temperatures in the eastern part of the county, however, causing the winters to be milder and the summers to be cooler than in the western part of the county. The winters are long and cold, and the summers are short and cool with few excessively hot days. Temperatures below zero are common during the winter, and readings above 100°F. have been recorded during the summer.

The precipitation is well distributed throughout the year, but the largest amount of rainfall generally comes in summer. As a rule crops receive enough moisture to grow well, but occasional droughts or rainy spells in summer sometimes damage them. The climate is favorable for growing forage crops, market vegetables, and fruit trees, and for raising poultry and dairy cattle.

TABLE 11.—*Temperature and precipitation at Manchester, Hillsboro County, N. H.*
[Elevation, 171 feet]

Month	Temperature[1]			Precipitation[2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1894)	Wettest year (1951)	Average snowfall
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	27.4	61	−28	3.25	2.08	5.01	9.2
January	24.1	60	−18	3.29	2.34	3.78	21.4
February	23.9	59	−29	2.96	2.49	6.35	16.2
Winter	25.1	61	−29	9.50	6.91	15.14	46.8
March	32.6	76	−18	3.61	1.19	5.52	10.2
April	43.6	86	17	3.19	2.11	3.42	2.9
May	56.4	96	28	3.10	4.63	3.88	.1
Spring	44.2	96	−18	9.90	7.93	12.82	13.2
June	65.8	97	40	3.20	.41	3.33	[3]
July	70.3	100	44	3.43	2.47	5.45	0
August	68.8	98	41	3.39	.89	4.53	0
Summer	68.3	100	40	10.02	3.77	13.31	[3]
September	60.5	92	30	3.38	3.11	2.91	0
October	49.0	82	18	3.02	2.71	4.51	.1
November	38.9	77	4	3.33	2.24	8.19	3.1
Fall	49.5	92	4	9.73	8.06	15.61	3.2
Year	46.8	100	−29	39.15	26.67	56.88	63.2

[1] Average temperature based on a 34-year record, through 1955; highest and lowest temperatures on a 22-year record, through 1952.
[2] Average precipitation based on an 80-year record, through 1955; wettest and driest years based on an 80-year record, in the period 1875–1955; snowfall based on a 19-year record, through 1952.
[3] Trace.

Vegetation

Most of Rockingham County is in the white pine region of New England—a belt along the Atlantic seaboard that includes southwestern Maine, southern New Hampshire, southeastern Vermont, eastern and central Massachusetts, and the northeastern corner of Connecticut.

When the first white men arrived, the area that is now Rockingham County was probably covered by a forest of mixed hardwoods and conifers (*3*). On the lower plateau the most common deciduous trees were beech, yellow birch, chestnut, elm, sugar maple, red maple, and northern red oak. There were some shagbark and bitternut hickories and a few white ash trees. White pine was the most common conifer. On some of the sandy plains in the valleys and on the dry ridgetops, there were almost pure stands of white pine. Pitch pine and red pine also grew on the dry sandy plains, and hemlock trees were an important part of all the mixed stands. At the higher elevations there were more hemlocks in the stand, as well as paper birch and some red spruce trees.

Before the middle of the 19th century, much of the original forest had been cut and the areas used for pasture or crops. Most of the areas that were farmed, especially those on rough land, were later abandoned and again grew up to forest. The abandoned fields reseeded naturally to white pine, and many of them became covered by pure stands. In some places, however, aspen, pin cherry, and gray birch became established and were later replaced by other hardwoods or by mixed stands of hardwoods and white pine.

Organization and Population

One of the first permanent settlements in New Hampshire was in the town of Newington in Rockingham County. The county was 1 of the 5 original counties in the State. It was established on March 15, 1771, and was named for the Marquis of Rockingham.

The population of the county is somewhat higher in summer than in winter because of the influx of summer residents. In 1950 the county had a total population of 70,059, of which 29,001 was urban and 41,058 was rural. This was an increase of almost one-third from 1930, when the population was 53,750. The rural population is distributed over the southern and western parts of the county.

Exeter, the county seat, had a population of 5,664 in 1950, and Portsmouth had a population of 18,830. Derry, Salem, Hampton, and Newmarket, all important manufacturing, recreational, or trading centers, had populations of 5,826, 4,805, 2,847, and 2,709, respectively.

Transportation and Markets

The county has good transportation facilities. One line of the Boston and Maine Railroad runs parallel to the coast and passes through the towns of Seabrook, Hampton Falls, Hampton, North Hampton, and Greenland. Another line of the same railroad passes through Atkinson, Plaistow, Newton, Kingston, East Kingston, Exeter, Newfields, and Newmarket. Still another branch connects Portsmouth with Manchester, running through Auburn, Candia, Raymond, Epping, Newfields, Stratham, and Greenland, and another passes through the towns of Salem, Windham, Derry, and Londonderry.

All communities have hard-surfaced or gravel roads that are well maintained. In winter the roads are kept open by snowplows, and icy places on the main roads are sanded. The good transportation facilities are important in making accessible the resort areas at the mountains, lakes, and seashore.

Portsmouth, the only seaport in the State, has harbor and river facilities for local and foreign shipping. Coal, oil, gas, and gypsum ore are all shipped by water.

Except for poultry products and milk, most of the farm products are marketed in Portsmouth and in other trading centers within the county. The poultry products are shipped to Boston and New York, and milk is shipped to nearby Manchester and Boston. Most of the farm products are carried to market by truck. During the summer and fall, a large amount of farm produce is sold at roadside stands along the main roads.

Industries

The principal industries in Rockingham County are the manufacture of shoes, fiber products, wire cable, bricks, wallboard, and shingles and other various wood products. Shipbuilding has been an important industry in Portsmouth for many years. Portsmouth is the leading industrial center in the county, but Exeter, Derry, and Newmarket are also important.

Schools and Churches

Schools and churches are well distributed throughout the county. Many of the small, 1-room schools have been closed, and the pupils now attend large, centrally located schools. In the rural areas school buses provide transportation for the elementary school children. High schools are located in the larger towns. Each town also has a town hall that is used for the official and social meetings of the community.

Agriculture

In Rockingham County agriculture is less important than manufacturing. Agriculture has declined gradually since about 1850. Farmland is still being abandoned and allowed to grow up in forest. Forests cover more than 74 percent of the county.

The agriculture of this county is based largely on the raising of dairy cattle and poultry. Apples, forage crops, potatoes, market vegetables, and small fruits are the principal crops. On the following pages the more outstanding features of this agriculture are pointed out. The statistics used are from reports published by the United States Bureau of the Census.

Agricultural History

In the early agriculture of the county, clearing the soils of trees and stones was a slow and difficult process and crops were grown primarily for home use. The principal crops were corn, flax, oats, potatoes, wheat, and vegetables. Because of the poor transportation facilities, it was difficult to market the farm produce, but some settlements near the coast exported other products, as furs, fish, and lumber. Agriculture continued to develop, however, in spite of the poor transportation facilities, especially in the eastern part of the county. It reached its peak about 1850.

The raising of cattle and sheep became the leading farm enterprises after 1850. Then it was found that the level, fertile soils of the West were more suitable for raising cattle and sheep than the soils of this county, so poultry raising and dairying became the chief enterprises. At first, cheese and butter were the principal dairy products shipped to market, but later, fluid milk was sold.

Land Use

In 1954, about 33.2 percent of the county, or 146,820 acres, was in farms. Of this, approximately 33.4 percent was cropland, 52.4 percent was woodland, 7.5 percent was other pasture that was neither cropland nor woodland, and 6.7 percent was other land. The acreage of land in farms, by use, is listed as follows:

	Acres
Cropland (total)	49,074
Harvested	30,646
Used only for pasture	11,104
Not harvested nor pastured	7,324
Woodland (total)	76,991
Pastured	13,338
Not pastured	63,653
Other pasture (not cropland and not woodland)	10,949
Other land (house lots, roads, wasteland, etc.)	9,806

Types and Sizes of Farms

In 1954, 51.2 percent of the farms in the county were miscellaneous and unclassified. The rest are listed by type of farm as follows:

	Number
Dairy	342
Field crops	6
Fruit and nut crops	5
General	25
Livestock other than dairy and poultry	20
Poultry	391
Vegetable	25

Most of the fruit farms and dairy farms are on rolling upland soils. The truck farms are mainly on

nearly level terraces and glacial outwash plains. The poultry farms are on all types of soil, but the coarse-textured soils are the most desirable for this purpose because it is easier to control poultry diseases on these soils.

The farms are not large. In 1954, only 153 of the 1,678 farms were larger than 220 acres. The average-sized farm was 87.5 acres. This is a slight increase over 1950, when the average-sized farm was 83.4 acres.

Farm Tenure

In 1954, owners operated 1,345 of the 1,678 farms in the county. Part owners operated 279 farms, tenants operated 36, and managers operated 18.

Crops

Many different crops are grown in this county. Table 12 shows the acreage of the principal crops and the number of fruit trees in the county for specified years.

Hay.—In 1954, hay was grown on approximately 52 percent of the cropland in the county. The hay listed as "Other hay" in table 12 has generally been cut from old fields on abandoned farms or on farms that have been purchased as summer residences. Many of the old fields have not been reseeded for more than 20 years; the grasses originally seeded have been replaced by Kentucky bluegrass, poverty oatgrass, redtop, sweet vernalgrass, and other volunteer grasses. The hay is of poor quality and the yield is usually low. On many of the old fields, the grasses are cut for hay only when there is a shortage of hay grown elsewhere.

Corn.—Most of the corn is grown for silage. Field corn is not grown extensively, chiefly because the season is too short for standard dent corn to mature. Recently developed varieties of hybrid dent corn mature satisfactorily, however.

Oats.—Oats are the only important cereal crop grown in the county. They are grown on only a small acreage and are generally seeded as a spring nurse crop. Later, the crop is cut for hay or is pastured.

Apples and peaches.—Apples are the most important tree fruit, but peaches are also important. Much of the fruit is grown in large commercial orchards. MacIntosh apples of high quality are grown on many farms. Most of the commercial orchards are in the towns of Derry, Greenland, Hampton Falls, Londonderry, Salem, and Stratham. The orchards are at rather high elevations where there is enough air movement to prevent damage from frost.

Other crops.—Potatoes, market vegetables, and strawberries are grown commercially on a fairly large acreage, but most farms have only a few acres of these crops. Sweet corn is an important truck crop. It is sold locally or is marketed in Boston.

Pastures

In Rockingham County, 35,391 acres of farmland was pastured in 1954. Many of the permanent pastures and woodland pastures are on rough, rocky, or wet land unsuited to tilled crops. Juniper, various hardhacks, Canadian thistle, and other weeds have grown up on these pastures. Because of the poor quality of the forage, the areas are being pastured less than formerly. On the permanent pastures the most common plants are Kentucky bluegrass, white Dutch clover, redtop, sweet vernalgrass, and various sedges.

Many farmers now manage their pastures as carefully as they do their cropland. The better managed pastures are plowed, disked, limed, and fertilized and are seeded to pasture mixtures that include bromegrass and Ladino clover. The pastures that are well managed produce more abundant forage of better quality than that produced on the unimproved pastures, and the grazing season is extended for 2 or more weeks each year. Any surplus grasses are cut for silage.

Until recently, the pastures were commonly not plowable and the large areas used to grow hay and pasture were kept separate. A practice that is now commonly used is to seed a mixture that is suitable for either hay or pasture on soils that can be plowed. The areas are then used for rotational pastures.

A suitable mixture for seeding the rotational pastures consists of high-yielding tall grasses, as timothy, smooth bromegrass, and Ladino clover, which are more desir-

TABLE 12.—*Acreage of principal crops and number of bearing fruit trees*

Crop	1939	1949	1954
	Acres	*Acres*	*Acres*
Corn for all purposes	2,275	1,247	1,139
For silage	1,383	1,057	1,053
Harvested for grain	480	113	52
Grazed or cut for fodder	412	77	34
Oats, harvested	18	70	75
All hay	56,670	31,976	25,585
Alfalfa	754	908	2,535
Clover and timothy, alone or mixed	12,811	17,361	15,187
Small grains cut for hay	663	503	229
Other hay	42,442	12,995	6,434
Silage from grass or hay crops	(1)	209	1,200
Irish potatoes	941	[2] 667	[3] 364
Vegetables for home use and for sale:			
Sweet corn	292	380	391
Beans, snap	97	57	60
Cabbage	51	96	76
Carrots	67	8	9
Asparagus	14	4	11
Cucumbers	32	47	55
Lettuce	25	18	24
Green peas	36	18	32
Squash	157	212	95
Tomatoes	63	70	66
Other vegetables	26	59	61
Small fruits harvested:			
Strawberries	61	46	24
Raspberries, tame	23	11	10
Blueberries, tame or wild	161	129	68
	Number[4]	*Number*[4]	*Number*
Apple trees	96,433	79,043	49,142
Peach trees	5,775	6,367	5,137
Pear trees	3,177	2,944	1,097

[1] Not reported.
[2] Does not include acreage for farms with less than 15 bushels harvested.
[3] Does not include acreage for farms with less than 20 bushels harvested.
[4] One year later than year at head of column.

able than the low-growing wild whiteclover and Kentucky bluegrass. Usually the first cutting is harvested for grass silage or for hay, depending mainly on the weather. The new seeding is grazed more heavily during the first and second year until the ratio of clover to grass decreases and the hay becomes easier to dry. Thereafter, the fields are pastured, or a second crop of hay may be harvested, depending on the amount of forage needed and on the weather.

The areas that are pastured are generally divided into three or more small units, and each is grazed in succession for about a week or 10 days. This allows the grazed areas time to recover, so that a higher yield of forage is obtained. The permanent pastures are grazed in spring, early in summer, and late in fall. The rotational pastures and supplementary pastures provide grazing during the summer and early fall.

The more productive parts of the permanent pastures are often improved by applying a topdressing of lime and commercial fertilizer and by clipping to control the weeds. Supplementary crops, as sudangrass, Japanese millet, Hungarian millet, and soybeans, are grown to provide grazing during the late summer and early fall. Rye and winter wheat can be grazed late in fall and early in spring and will provide a winter cover. Barley is a good crop to supply grazing late in fall.

Livestock and Livestock Products

Poultry and dairy cattle are the most important kinds of livestock in this county. There were 13,031 head of cattle in the county in 1954 of which 7,073 were milk cows. Some of the cattle are purebred, as Ayrshire, Guernsey, Jersey, and Holstein-Friesian breeds, and a few herds are entirely purebred stock. Many of the dairy herds are made up of grade cattle that have a large percentage of Holstein-Friesian blood. The dairy farms are scattered throughout the county. Some of the dairy products are sold locally, and some are marketed in Portsmouth, Manchester, Nashua, and Boston.

Poultry farms are scattered throughout the county. The number of chickens over 4 months old increased from 499,818 in 1950 to 737,058 in 1954. Many poultrymen have crossed white Plymouth Rocks with other breeds that have a white color to produce an exceptionally vigorous, fast-growing, rapid-feathering bird that produces consistent profits on the broiler market. Eggs and live poultry are marketed in Manchester, Derry, and Boston, and much of the live poultry is reshipped to New York.

Farm Improvements and Equipment

Many of the farm buildings are large and substantial and are kept in good repair. The barns were once attached to the houses, so that it was unnecessary to go outside to go from one to the other. Although this arrangement was convenient during heavy snows, it increased the danger of fire. In 1954, telephones were reported in 1,369 farm dwellings, electricity in 1,644, and piped running water in 1,534. Television sets were reported on 1,114 farms, and home freezers on 613.

When the land was first cleared, the fences on many farms were made of fieldstones piled in rows. These stone fences are easily kept in repair, but they furnish refuge for many insects and rodents. They are also difficult to clear of brush, briers, and creeping vines, especially poison-ivy. Another disadvantage of these fences is that they are difficult and expensive to move if the farmer wishes to change the size and shape of a field. Fences of barbed wire or temporary electric fences are now commonly used. Many of the stone fences have been removed to enlarge the fields so that heavy farm machinery can be used.

In 1954, milking machines were reported on 343 farms, grain combines on 10 farms, pick-up balers on 100 farms, field forage harvesters on 53 farms, motor trucks on 1,009 farms, tractors on 934 farms, and automobiles on 1,339 farms. Other equipment commonly used on the farms in the county are hydraulically operated plows, mowing machines, disk harrows, side-delivery rakes, hay loaders, and manure spreaders.

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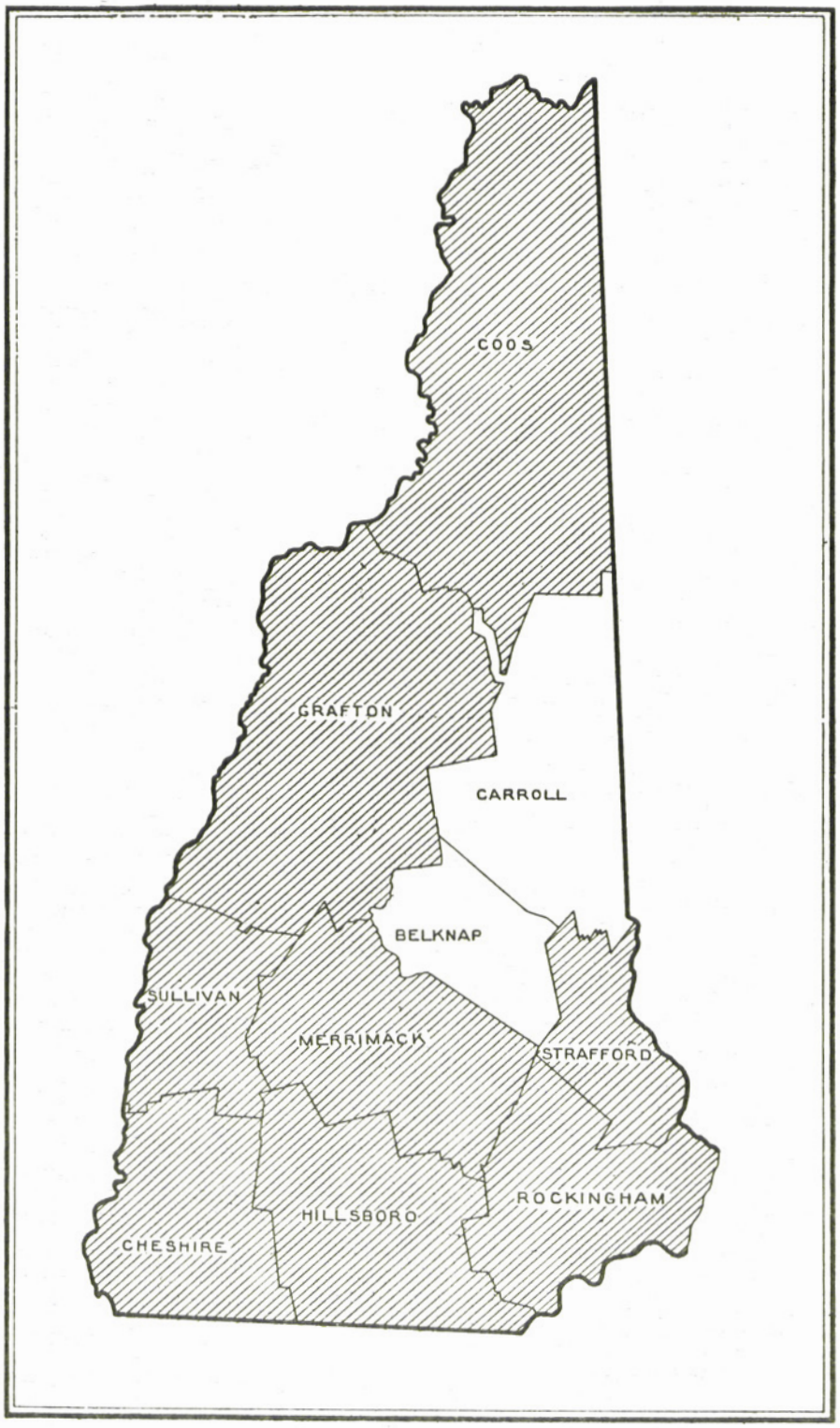

Areas surveyed in New Hampshire shown by shading.

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