SOIL SURVEY

Broome County, New York

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1958 through 1964. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1967. This survey was made cooperatively by the Soil Conservation Service and Cornell University Agricultural Experiment Station; it is part of the technical assistance furnished to the Broome County Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

Other classifications can be developed by using the map and information in the text to group soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

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

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

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

Community planners and others concerned with suburban development can read about the soil properties that affect the choice of homesites, industrial sites, and recreation areas in the section "Nonfarm Uses of the Soils."

Engineers and builders can find, under "Engineering Applications," tables that give facts about engineering properties of the soils and that name soil features that affect engineering practices and structures.

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

Newcomers in Broome County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover picture: View toward the northeast from Binghamton. The Chenango River at left; the Susquehanna River at right. The city has expanded and taken in areas of the well-drained, gravelly Chenango soils of the river valleys and of Lordstown, Mardin, and Volusia soils on uplands.

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Contents

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SOIL SURVEY OF BROOME COUNTY, NEW YORK

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

BROOME COUNTY, in the south-central part of New York (fig. 1), has a total area of 454,400 acres. Binghamton is the county seat.

Binghamton, Endicott, and Johnson City—known as the triple cities—make up one of the most important industrial complexes in the State. This industrial development and the accompanying urban sprawl continue to make sizable inroads in agricultural areas.

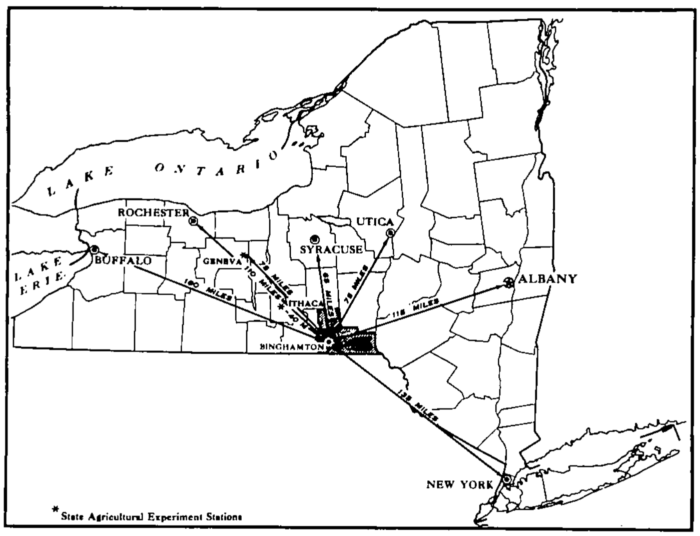

Figure 1.—**Location of Broome County in New York.**

As in the rest of New York State, the trend is toward a decrease in the farm acreage and an increase in the average size of farms. The 1964 Census of Agriculture shows that 46 percent of the total land area in Broome County was in farms. This figure is 7 percent less than that in 1959.

Dairying is the main type of farming in Broome County. The chief crops are those grown to feed dairy cattle. Among them are corn for silage, oats, and hay crops. A few farmers specialize in raising potatoes, apples, and garden crops. There are also a few poultry farms.

About 53 percent of this county is woodland or forest (*13*)[1]. Although woodland is not a major source of income, it does provide farmers and others with supplemental funds.

[1] Italic numbers in parentheses refer to Literature Cited, page 93.

State and county parks cover about 2,000 acres of this county. Federal, State, and county governments have combined funds for development of recreational facilities at the Whitney Point Dam. Private funds also are being made available for development of public recreational areas.

How This Survey Was Made

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

The soil scientists made comparisons among the profiles they studied and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this soil survey efficiently, it is necessary to know the kinds of groupings used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Chenango and Lordstown, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural, undisturbed landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Within a series, all the soils having a surface layer of the same texture belong to one soil type. In this survey area, each of the series recognized is represented by only one type.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Lordstown channery silt loam, 5 to 15 percent slopes, is one of three phases of Lordstown channery silt loam, a soil type that has a slope range of 0 to 25 percent.

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

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

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. They show such a mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Mardin-Chenango channery silt loams, 5 to 15 percent slopes.

Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that occur together without regularity in pattern or relative proportion. The individual tracts of the component soils could be shown separately on the map, but the differences between the soils are not enough to merit separation for the objectives of the soil survey. An example is Chenango and Howard gravelly loams, 5 to 15 percent slopes.

Most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units, but they are given descriptive names, such as Alluvial land or Made land, and are called land types.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of readers, among them farmers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil surveys. On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. The groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

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

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

The six soil associations in Broome County are each discussed in the following paragraphs. The terms for texture used in the title for several of the associations apply to the surface layer. For example, in the title for association 1, the words "gravelly" or "silty" refer to texture of the surface layer. More detailed information about the soils is given in the section "Descriptions of the Soils."

1. Chenango-Howard-Unadilla association

Deep, well-drained, gravelly or silty soils on terraces

This association occupies gravelly outwash terraces or kames and silty stream terraces, above the normal flood plain along the major streams in the county. The soils range from nearly level on terrace benches to steeply sloping or rolling on terrace escarpments and kames.

This association covers about 6 percent of the county. Chenango and Howard soils occupy about 65 percent of its acreage. These are deep, well-drained soils that formed in stratified, water-sorted sand and gravel. They commonly occur together along the Chenango River and its tributaries or along the Susquehanna River below its confluence with the Chenango River. They are similar in many characteristics, but Howard soils formed in material that contained more limestone gravel and have a subsoil of finer texture than that of the Chenango soils. These limestone fragments favor growth of deep-rooted plants, but cementing is likely to occur in the gravelly strata.

Deep, silty, well-drained Unadilla soils occupy about 15 percent of the association. In a few places Unadilla soils are adjacent to Chenango and Howard soils, but in most places they are on lower terraces. When streams are extremely high, some of these areas are flooded.

Minor soils, making up about 20 percent of the association, are Scio and Wallington in depressions, Mardin and Canaseraga on the lower valley walls that fringe the terraces, and Tioga, Middlebury, and Wayland on flood plains.

Extensive areas of this association are occupied by the cities and larger villages in the county. Chenango and Howard soils are well suited to most urban uses. They are well drained, and they have a rapidly permeable substratum. Although they formed in water-deposited material, they generally have adequate bearing strength for most structures. If heavy structures are contemplated, onsite investigation is necessary. The slope may impose some limitations for certain urban uses. Flooding is a hazard on Tioga, Middlebury, and Wayland soils.

This association includes some of the best soils in the county for farming. The dominant soils are deep and well drained. They generally have favorable relief, and they respond to good management. Dairying is the principal type of farming, but market garden crops are also important.

Chenango and Howard soils are the principal source of sand and gravel in the county. Soils that occur along the smaller streams are also a source of sand and gravel, but this material commonly is dirty and high in content of shale. Tioga, Middlebury, and Wayland soils are a good source of topsoil.

The dominant soils, for the most part, are well suited to many recreational uses. Slope and the gravelly texture of their surface layer may limit to some extent their use for athletic fields. Except for some steep slopes, these soils have few or no limitations for use as parks, picnic areas, golf courses, riding trails, and campsites.

2. *Tioga-Chenango-Howard association*

Deep, well-drained, silty soils on bottom lands and gravelly soils on terraces

This association occupies flood plains and adjacent gravelly and silty glacial outwash terraces along the major streams in the county. It also includes a large number of alluvial fans that have formed where small streams enter the large valleys. These fans occur mainly along Nanticoke Creek, in the western part of the county, and along Oquaga Creek, in the eastern part.

This association covers about 5 percent of the county. Tioga soils make up about 55 percent of its acreage, and Chenango and Howard soils about 25 percent. Tioga soils occur on the flood plains of the major streams. They are deep, well drained, and silty. Chenango and Howard soils occupy the nearly level terraces and rolling kames that are above the normal flood level of streams. They are deep, well drained, and gravelly.

Minor soils make up about 20 percent of the association. Among them are Unadilla soils, which are on lower terraces adjacent to the flood plains, and Middlebury and Wayland soils, which are closely associated with Tioga soils on the flood plains.

The hazard of flooding and the presence of a high water table limit the use of the soils as sites for residential or industrial developments. In the vicinity of the triple cities, Binghamton, Endicott, and Johnson City, much of the flood plain has been protected by dikes. These areas are now used for urban development.

A large part of this association is farmed. Dairying is the main type of farming. Silage corn, grain corn, oats, and hay are grown on the better drained soils. The wetter soils are used mainly for hay and permanent pasture. A small acreage in the vicinity of the cities is used intensively for vegetables and nursery stock.

Recreational development is confined largely to summer cottages along the major rivers. Golf courses and picnic areas can be developed in areas where flooding is not a hazard during seasons of use. This association is well suited to forestry and to some types of wildlife habitat developments, but it generally is not put to such uses.

Chenango and Howard soils are a good source of sand and gravel. The soils on flood plains are an excellent source of topsoil.

3. *Canaseraga-Dalton association*

Deep, well-drained to somewhat poorly drained, gently sloping to moderately sloping, silty soils that have a compact, impervious subsoil; on valley sides

This association consists of scattered areas of gently sloping and moderately sloping soils on lower valley walls along the Susquehanna River, mainly near Harpursville, Ouaquaga, Conklin, and Johnson City. Included is a lake near Whitney Point in the northern part of the county.

This association makes up about 1 percent of the county. Canaseraga soils, which are moderately well drained to well drained, occupy about 50 percent of its acreage, and Dalton soils, which are somewhat poorly drained, occupy about 30 percent. These soils formed in contrasting deposits of silty or very fine sandy material, 18 inches or more thick over compact glacial till. A slowly permeable fragipan occurs at a depth of 18 to 30 inches in the Canaseraga soils and at a depth of less than 20 inches in the Dalton soils. Canaseraga soils occur in convex areas that receive little runoff. Dalton soils are mainly in concave areas or on the lower part of slopes that receive considerable runoff from associated soils.

Minor soils make up about 20 percent of the association. They consist of the closely associated Mardin and Volusia soils along the valley walls and Unadilla, Chenango, and Howard soils on glacial outwash and stream terraces that fringe the valley walls.

Much of the acreage along the Susquehanna River, in the vicinity of the triple cities, is used for residential purposes, or it is idle. Seasonal wetness, a slowly permeable fragipan, and to a lesser extent slope and the hazard of erosion, are the main limitations for most nonfarm uses. These factors must be considered in the design of septic-tank systems. The silty mantle that covers much of this association is readily eroded and has poor bearing strength. Thus, these factors should be considered if extensive development or a heavy structure is contemplated. The underlying glacial till generally has adequate bearing strength for most foundations.

Dairying is the main farming enterprise. Corn, oats, and hay are the principal crops. Canaseraga and Dalton soils are readily eroded and require careful management if used intensively for crops.

This association can be developed for some recreational uses, such as golf courses, parks, riding trails, and picnic areas. Such uses may be restricted to some extent because of the slope and the hazard of erosion. Seasonal wetness is a limiting factor on Dalton and Volusia soils.

Topsoil can be obtained from the dominant soils, but the supply is limited. Except for the minor Chenango and Howard soils, the soils of this association are a poor source of sand and gravel.

4. Volusia-Mardin association

Deep, somewhat poorly drained to well-drained, gently sloping to very steep soils that have an impervious subsoil; on uplands

This is the most extensive soil association in the county. It occurs primarily on uplands in all parts of the county except the southeastern part. The slopes extend from the valleys to the hilltops and range from gently sloping to very steep (fig. 2).

This association makes up about 65 percent of the county. Volusia soils occupy about 45 percent of its acreage, and Mardin soils about 30 percent. Volusia soils are somewhat poorly drained. They commonly occur on foot slopes that receive considerable runoff from adjacent soils or in the more nearly level areas where runoff is slow. They consist of deep, channery, medium-textured soils that formed in strongly acid glacial till derived mainly from local sandstone and shale. Their most characteristic feature is a very dense, slowly permeable fragipan at a depth of 15 to 18 inches. This pan confines the movement of air and water to the soil above the pan, and it retards the growth of roots. Mardin soils are moderately well drained to well drained. They occupy the more convex areas and the upper part of the slopes where water generally does not accumulate. Mardin soils have a slowly permeable fragipan at a depth of 18 to 22 inches.

Figure 2.—Typical view of Volusia-Mardin soil association from a point 3 miles southeast of Sanitaria Springs.

Minor soils make up about 25 percent of the association. They are Lordstown, Chippewa, Alden, Arnot, and Tuller soils and alluvial soils. Traces of shallow Arnot and Tuller soils are on some of the more nearly level ridgetops. Lordstown soils are gently sloping to steep, and they are underlain by sandstone or shale at a depth of 20 to 40 inches. Outcrops of rock are common on the steeper slopes. Chippewa and Alden soils are in depressions and seeps, and the alluvial soils are on fans and along small streams.

Seasonal wetness, a slowly permeable fragipan, depth to bedrock, and, in many places slope, are features that must be considered if the dominant soils are used for residential or industrial developments. Most of the soils have good bearing properties, and several areas in the vicinity of the triple cities have been used for residential developments. Many scenic sites within easy commuting distance from business districts are considered desirable for rural residences despite their limitations.

Farming is decreasing in much of this association. The few remaining farms are mostly dairy farms. Low fertility, seasonal wetness, a shallow rooting zone, and slope limit the use of these soils for crops. Very careful management is needed if the soils are cultivated.

This association is suitable for many kinds of recreational developments, among which are campsites, picnic areas, hiking trails, and riding trails. It is also suitable for both openland and woodland wildlife habitat. Volusia and Mardin soils have a slowly permeable subsoil and substratum. Thus, they provide suitable sites for water impoundments. Reforestation with suitable species generally is satisfactory, but there is also a fair amount of natural forest.

The major soils in this association are a poor source of sand, gravel, and topsoil.

5. Lordstown-Volusia-Mardin association

Moderately deep, well-drained soils, and deep, well-drained to somewhat poorly drained soils that have an impervious subsoil; on uplands

This association occupies gently sloping to moderately sloping hilltops and the steep, upper part of slopes, on the uplands. The hilltops, though slightly dissected, are remnants of an old peneplain, and viewed from a distance they characteristically show an even skyline. The largest area of this association covers most of the towns of Binghamton and Conklin, south of the Susquehanna River in the vicinity of the city of Binghamton. Other extensive areas occur on both sides of the Susquehanna River, in the town of Windsor.

This association covers about 13 percent of the county. Lordstown soils make up about 40 percent of its acreage, Volusia soils 30 percent, and Mardin soils 20 percent. Lordstown soils are well drained, medium textured, and strongly acid. They are gently sloping to very steep and are underlain by sandstone or shale at a depth of 20 to 40 inches. Outcrops of rock are common on the steeper slopes. The deeper, somewhat poorly drained Volusia soils and well drained to moderately well drained Mardin soils are interspersed among Lordstown soils. These soils formed in compact glacial till. A very dense, slowly permeable fragipan occurs at a depth of about 15 inches in the Volusia soils and at a depth of 18 to 22 inches in the Mardin soils. Both soils are gently sloping to moderately steep, but Volusia soils occur mainly in concave areas where runoff is slow or on foot slopes that receive runoff from adjacent areas. Mardin soils occur mainly in convex areas or on the upper part of slopes where little water accumulates.

Minor soils make up about 10 percent of the association. They are Arnot, Tuller, Chippewa, and Alden soils and alluvial soils. Arnot and Tuller soils are closely associated with Lordstown soils. They occur mainly on flat ridgetops and are shallow to bedrock. The deeper, poorly drained and very poorly drained Chippewa and Alden soils are in depressions or seeps. Traces of alluvial soils are along small streams.

Urban developments are not extensive in this association, although some residences have been constructed in scenic areas near the triple cities. Shallowness to bedrock, a slowly permeable fragipan, seasonal wetness, and in many places slope, are the major limitations for such uses.

Farming is decreasing, and much of the acreage is abandoned farmland and native forest, or it is idle. Dairy farming is the principal type of farming. Silage corn, oats, and hay are the crops commonly grown. Low fertility, shallow rooting depth, and in places stoniness, climate, seasonal wetness, and slope, are limitations that need to be considered if these soils are farmed.

This association is suited to a wide variety of recreational uses, among which are summer camps, trails, picnic areas, and campsites. Much of the acreage is suitable for the development of openland and woodland wildlife habitat. The deeper soils can be used as sites for ponds. There is an extensive acreage in native forest, and most trees available for reforesting will grow here. For best results, care should be taken to select trees that are well suited to the soils.

The soils of this association are generally a poor source of sand, gravel, and topsoil.

6. Cattaraugus-Oquaga-Morris-Culvers association

Deep, well-drained to somewhat poorly drained and moderately deep, well-drained, moderately sloping to steep soils on uplands

This association is in the southeastern corner of the county, where the underlying bedrock is mainly red sandstone and shale. This area is the most rugged and stony part of the county. Narrow, steep-walled valleys merge with moderately sloping uplands that extend to the ridgetops (fig. 3). The elevation along the Delaware County line exceeds 2,000 feet.

This association makes up about 10 percent of the county. Cattaraugus soils occupy about 40 percent of its acreage, and Oquaga soils about 25 percent. Both are medium-textured, well-drained soils that formed in glacial till derived primarily from local red sandstone and shale. They vary in degree of stoniness. Cattaraugus soils are deep, and they have a well-expressed, slowly permeable fragipan. Slopes are moderate to steep, and little water accumulates. Oquaga soils are moderately deep. They are underlain by sandstone and shale at a depth of 20 to 40 inches. Slopes are also moderate to steep, and there are many outcrops of rocks on the steeper slopes.

Figure 3.—**Typical view of Cattaraugus-Oquaga-Morris-Culvers soil association, looking northward from a point about 3 miles southwest of Deposit. The terrain in the southeastern part of the county is much more rugged than in most areas in the western part. Oquaga soils occupy some of the highest and steepest parts of this association.**

Other soils in this association are somewhat poorly drained Morris soils, which occupy about 20 percent of the association, and moderately well drained Culvers soils, which occupy about 15 percent. These are deep soils, and they have a slowly permeable fragipan. Morris soils are on foot slopes or in concave areas where considerable runoff accumulates. Culvers soils have moderate to moderately steep slopes on which some runoff accumulates. Also in this association are traces of shallow Arnot soils, poorly drained Chippewa soils, and some alluvial soils.

This association is a considerable distance from manufacturing areas. Thus, the population is sparse, and there is little urban or industrial development. Although the soils could be used for this purpose, the narrow valleys and steep slopes are a deterrent.

Dairying is the main farming enterprise. Crops commonly are grown in a rotation consisting of silage corn, oats, and hay. Drainage generally is good, but low fertility, high elevation, stoniness, and in places slope or a dense fragipan, are limitations if these soils are farmed. The average precipitation is higher in this association than in the western part of the county, and there is a cool growing season. These factors are favorable for the growth of grasses.

Soil features and the scenic landscape are favorable for the development of a variety of recreational developments, among which are hiking trails, riding trails, campsites, ski resorts, and picnic areas. A part of this association fringes a popular recreation and vacation area, and a number of summer camps and hotels are in this association.

More than half of this association is forested. Trees available for reforestation do well on soils that are suited to them. All the soils are suitable for wildlife habitat developments, and many are suitable for water impoundments.

The dominant soils of this association are a poor source of sand, gravel, and topsoil.

Use and Management of the Soils

In this section, the general management practices applicable to the soils of the county are discussed. The soils are grouped into capability classes to show their relative suitability for farming, and suggestions for the use and management of the soils in each capability unit are given. Included in this section is a table showing estimated average acre yields obtained from each of the soils at different levels of management. In addition, soils are grouped according to their suitability for use as woodland, and soil interpretations for wildlife habitat are discussed. The last part of this section presents information about soil properties that are important to engineers and builders and rates the soils for selected nonfarm uses.

Use of Soils for Crops and Pasture [2]

This section explains characteristics of soils that affect their suitability for crops and pasture. It is designed to help farmers, those who advise farmers, and students to choose soil and crop management practices that are suitable for wise and economic use of the soils on a farm and that are appropriate for the conditions prevailing at the time the choices are made. Before making his choices, the user of this survey should consider the latest information on soil and crop management.[3]

Subsoil characteristics that affect root growth

In choosing a crop to be grown on a given soil, the characteristics of the subsoil or underlying material of that soil need to be considered. These characteristics are given for each soil in the section "Descriptions of the Soils."

In some soils, such as the Chenango and Tioga, the subsoil is loose and easily penetrated to a great depth by roots. In other soils, such as Cattaraugus, dense glacial till at a depth of 24 to 30 inches restricts root penetration. In the Culvers, Volusia, and Morris soils, a fragipan at a depth of about 10 to 24 inches restricts drainage and root penetration. The Arnot and Tuller soils are underlain by bedrock at a depth of 20 inches or less.

In areas where the movement of air and water is restricted by a claypan, fragipan, or other dense material, the growth of roots is also restricted. Figure 4 shows typical root zones for well drained, moderately well drained, somewhat poorly drained, and poorly drained soils.

[2] This section was prepared by E. L. McPherron, agronomist, Soil Conservation Service, from material furnished by Reeshon Feuer, associate professor of agronomy, Cornell University. Unless otherwise noted, the material is based on the results of research studies performed on the Aurora and the Mount Pleasant Research Farms by staff members and associates of the New York State College of Agriculture at Cornell University.

[3] New research findings are reported currently in annually revised editions of "Cornell Recommends for Field Crops" and "Cornell Recommends for Vegetable Crops," both prepared by the staff of the New York State College of Agriculture at Cornell University. Cornell Miscellaneous Bulletin Number 47 and current editions of other applicable publications on soil and crop management should also be consulted. Constantly revised information is available upon request from the local office of the Soil Conservation Service and of the Cooperative Extension Service.

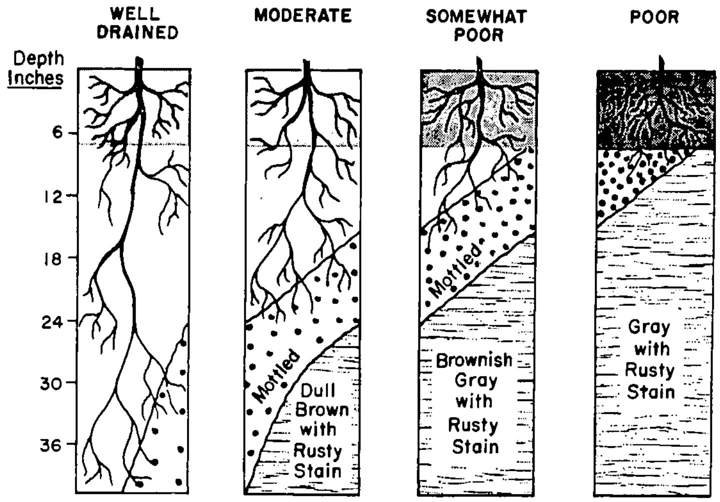

Figure 4.—**Effect of soil drainage on root growth.**

Acidity relationships of the soils

The natural lime content of Broome County soils ranges from medium to very low. Figure 5 illustrates the relationship of the different lime levels to a depth of 60 inches in four different profiles.

Medium-lime soils, such as the Howard and Wayland, are acid to a depth of more than 12 inches, but they become less acid below that depth. They generally have free lime at a depth of 36 to 48 inches. Low-lime soils, such as the Mardin and Volusia, are strongly acid to a depth of more than 24 inches, but in some places they have neutral material deep in the substratum, commonly beyond the reach of plant roots.

Lime moves downward in a silt loam, which is the most common surface-soil texture in this county, at an average rate of half an inch each year. Crops also deplete the lime. Therefore, to maintain the desired pH in the plow layer, it is necessary to apply lime periodically, usually once each rotation sequence.

Nitrogen relationships of the soils

The average organic-matter content of the surface layer of soils on uplands in this county is 4 percent. This percentage was obtained from soil tests. Nitrogen is released from this organic matter at the rate of 40 to about 160 pounds per acre each year. Poorly drained soils that warm up slowly benefit from additional nitrogen in spring.

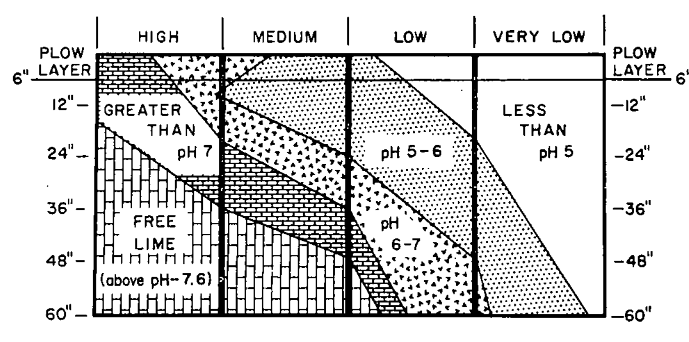

Figure 5.—**Lime level of different soil profiles in Broome County.**

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Phosphorus relationships of the soils

Most soils in this county are medium in ability to supply phosphorus. This means that they can release the equivalent of 10 pounds of phosphate [4] per acre each year. The addition of appropriate amounts of phosphate in the form of commercial fertilizer is essential for good crop growth.

Potassium relationships of the soils

The soils in Broome County are medium or low in ability to supply potassium. Those that have medium ability release about 70 pounds of potash [5] per acre each year. Those that have low ability generally supply less than 70 pounds. Medium-textured soils, such as the Chenango and Lordstown, have medium ability to supply potassium.

Capability Grouping

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

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

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

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

Class I. Soils have few limitations that restrict their use.

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

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

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

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[4] To convert phosphorus (P) to phosphate (P_2O_5), multiply by 2.3; to convert phosphate to phosphorus, multiply by 0.43.

[5] To convert potash (K_2O) to potassium (K), multiply by 0.83; to convert potassium to potash, multiply by 1.2.

Class V. Soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

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

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

Class VIII. Soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (No soils in Broome County are in class VIII.)

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

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

CAPABILITY UNITS are soil groups within the subclasses. All the soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to be similar in productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within the subclass.

Management by capability units

In the following pages each of the capability units in Broome County is described, and suggestions for the use and management of the soils in each unit are given. The names of soil series represented are mentioned in the description of each group, but this does not mean that all the soils of a given series are in the group. The "Guide to Mapping Units" shows which group each individual soil is in.

CAPABILITY UNIT I-1

This unit consists of loamy soils of the Chenango, Howard, and Unadilla series. These are deep, nearly level, well-drained soils in areas of glacial outwash and on stream terraces. The root zone, 30 to 40 inches or more thick, is capable of supplying a moderate to large amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium.

These soils are easy to work. They are suited to all the crops commonly grown in the county (fig. 6), but prolonged dry periods affect crop growth. They release plant nutrients readily and respond to management. Cultivated crops can be grown frequently if the soils are limed and fertilized, crop residue is returned occasionally, and surface structure is maintained.

CAPABILITY UNIT I-2

Tioga silt loam is the only soil in this unit. It is a deep, nearly level, well-drained soil on flood plains. The root zone, 40 inches or more thick, is capable of supplying a large amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium. Streambank erosion and channel gouging are limitations along parts of some streams. Flooding generally is not a hazard during the growing season.

This soil is well suited to all the crops grown here (fig. 7). There are few restrictions to intensive cultivation if the soil is limed and fertilized according to crop needs. Dikes and measures that protect streambanks are needed along parts of some streams.

CAPABILITY UNIT IIe-1

Tioga gravelly silt loam, fan, is the only soil in this unit. It is a deep, gently sloping, well-drained soil on alluvial fans. The root zone, 30 to 40 inches or more thick, is capable of supplying a moderate to large amount of moisture. Reaction is medium acid, and the capacity to supply both potassium and phosphorus is medium. Occasional flooding is a hazard, and water erosion is a hazard in the more sloping areas.

This soil is similar to the Tioga soil in capability unit I-2, but it is more sloping and consequently is susceptible to greater loss of soil material and moisture. It is suited to all crops grown in the county. Contour farming is needed, however, to conserve moisture and control erosion. In some places rock fragments interfere slightly with the use of precision machinery for special crops.

CAPABILITY UNIT IIe-2

This unit consists of loamy soils of the Culvers and Mardin series. Most of the acreage consists of deep, gently sloping, moderately well drained soils with a well-expressed fragipan, but one of the Mardin soils is moderately shallow. The root zone, 18 to 24 inches thick, is capable of supplying only a moderate amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium. Erosion is a moderate hazard.

These soils are suited to all the crops commonly grown in the county. The fragipan causes both wetness early in the year and a shortage of moisture in summer. A high level of management, consisting chiefly of contour farming, stripcropping, and diversion ditches, helps to divert runoff and to conserve water. If the soils are cul-

Figure 6.—**Vegetable crops on Unadilla, Chenango, and Howard soils, near Johnson City. These soils are in capability unit I-1. Areas near population centers are rapidly being used for urban developments.**

tivated intensively, sod crops should be grown part of the time and measures should be used to control erosion. Stone fragments interfere with tillage in some places.

CAPABILITY UNIT IIe-3

Canaseraga silt loam, 3 to 8 percent slopes, is the only soil in this unit. It is a deep, moderately well drained soil with a well-expressed fragipan. The root zone, confined to the 18 to 30 inches of soil above the fragipan, is capable of supplying a moderate to large amount of moisture. Reaction is strongly acid, the capacity to supply phosphorus is medium, and the capacity to supply potassium is low. Erosion is a severe hazard.

This soil is well suited to most crops grown in the county, but prolonged intensive cultivation results in severe loss of soil material. Sod crops should be grown frequently. Crop residue should be utilized to reduce surface crusting, and erosion control measures, to curb runoff. Tillage should be kept to a minimum, and traffic should be avoided when the soil is wet. Repeated applications of lime and fertilizer are needed.

CAPABILITY UNIT IIw-1

This unit consists of loamy soils of the Braceville and Scio series. These are deep, nearly level, moderately well drained soils in areas of glacial outwash and on stream terraces. The water table restricts the root zone mainly to the topmost 18 to 24 inches. The root zone is capable of supplying a moderate to large amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium.

These soils have few limitations for use as cropland, and their potential justifies intensive management. The main limitations are wetness in spring, which delays planting in some places, and the high water table, which limits the choice of crops. These limitations can be overcome by drainage, minimum tillage, and the use of cover crops, sod crops, and crops that tolerate some degree of wetness. Ample amounts of lime and fertilizer are needed.

CAPABILITY UNIT IIw-2

Middlebury silt loam is the only soil in this unit. It is a deep, nearly level, moderately well drained silty soil on flood plains. The root zone, 24 to 36 inches thick, is capable of supplying a large amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium. Occasional flooding is a hazard, and wetness briefly delays planting in spring.

This soil is well suited to those legumes and other

Figure 7.—**Garden crops on Tioga silt loam, near Chenango Bridge. Although subject to flooding early in spring, this soil is excellent for garden crops. It is in capability unit I–2.**

common crops that tolerate short periods of wetness. Dikes and measures that protect streambanks are needed along some parts of streams. Lime and fertilizer are needed for most crops; the amounts should be determined by soil tests, the kind of crop grown, and the level of production desired.

CAPABILITY UNIT IIs–1

Lordstown channery silt loam, 0 to 5 percent slopes, is the only soil in this unit. It is a moderately deep, well-drained soil on uplands. The root zone is restricted by bedrock to the topmost 20 to 40 inches. It is capable of supplying a moderate to large amount of moisture. Reaction is strongly acid, and the capacity to supply both potassium and phosphorus is medium.

This soil is well suited to crops, but the restricted root zone slightly reduces crop growth. Measures are needed to increase infiltration, especially during the growing season. Loss of soil and water can be reduced by contour farming, minimum tillage, and the use of crop residue. Lime is needed for most crops, and especially for legumes. The amount of fertilizer applied should be determined by soil tests. The response to fertilizer is good.

CAPABILITY UNIT IIIe–1

This unit consists of loamy soils of the Cattaraugus, Lordstown, and Oquaga series. These soils are deep to moderately deep, moderately sloping, and well drained. Either a well-expressed fragipan or bedrock restricts the root zone to the topmost 20 to 40 inches. The root zone is capable of supplying a moderate to large amount of moisture. Reaction is strongly acid, and the capacity to supply both potassium and phosphorus is medium. Runoff and erosion are hazards and may restrict use for crops in the more sloping areas.

These soils are suited to all crops commonly grown in the county, but they may be short of moisture in summer. Early cultivation is possible, and a high level of management is justified. Measures that reduce runoff and conserve soil and moisture are needed. Among these are contour farming, stripcropping, minimum tillage, and crop-residue management. Full stands of deep-rooted crops help to protect the soils. Sod crops should be made part of the cropping system. Diversion ditches are needed in many places, but their construction could be limited by the depth to bedrock. Deep placement of lime encourages deeper root growth. Fertilizer is needed for all crops.

CAPABILITY UNIT IIIe-2

This unit consists of loamy soils of the Chenango, Howard, and Mardin series. These are deep, moderately sloping and rolling, well-drained soils on outwash terraces and moraines. The root zone, 24 to 40 inches or more thick, is capable of supplying a moderate to large amount of moisture. Reaction generally is medium to strongly acid in the root zone, and the capacity to supply both potassium and phosphorus is medium. Howard soils are strongly acid in the surface layer but contain lime at a depth of 36 to 60 inches. Erosion is a moderate or severe hazard. Complex slopes are common.

These soils are suited to all crops grown in the county. Early grazing or tillage is possible. Stripcropping, minimum tillage, and crop-residue management help to control erosion. Where contour farming is not practical because of the complex slopes, the long-term use of sod crops is more profitable. Lime and fertilizer help to maintain good crop growth.

CAPABILITY UNIT IIIe-3

Unadilla silt loam, 5 to 15 percent slopes, is the only soil in this unit. It is a deep, rolling, well-drained soil on dissected stream terraces. The root zone, 30 to 40 inches or more thick, is capable of supplying a large amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium. Erosion is a severe hazard. The slopes are complex.

This soil is suited to all crops grown in the county. It must be worked carefully, however, or a surface crust forms and a plowpan develops. Minimum tillage and the use of cover crops and crop residue help to maintain good structure. Because of the complex slopes, contour farming generally is not practical and the use for cultivated crops should be kept to a minimum to help control erosion. Both lime and fertilizer are required.

CAPABILITY UNIT IIIe-4

This unit consists of loamy soils of the Culvers and Mardin series. These are deep, moderately sloping, moderately well drained or well drained soils with a well-expressed fragipan. The root zone, only 18 to 24 inches thick over the fragipan, is capable of supplying only a moderate amount of moisture. Reaction is strongly acid, and the capacity to supply both potassium and phosphorus is medium. Erosion is a hazard.

These soils are suited to all crops grown in the county. Slope and the thinness of the root zone are limitations. Needed are measures that safely remove excess surface water and conserve moisture for summer crops. Under a high level of management, such measures consist of stripcropping, diversion ditches, minimum tillage, contour farming, crop-residue management, and the use of sod crops in the cropping system. Deep placement of lime encourages deeper root growth. Fertilizer should be added in amounts adequate for the crop grown.

CAPABILITY UNIT IIIe-5

Canaseraga silt loam, 8 to 15 percent slopes, is the only soil in this unit. It is a deep, moderately well drained and well drained soil with a well-expressed fragipan. The root zone, 18 to 30 inches thick, is capable of supplying a moderate to large amount of moisture. Reaction is strongly acid, the capacity to supply phosphorus is medium, and the capacity to supply potassium is low. Erosion is a severe hazard.

This soil is suited to all crops grown in the county, but prolonged intensive cultivation results in severe loss of soil material. Areas in cultivation must be protected by measures that control runoff and conserve soil and water. Suitable measures consist of stripcropping, diversion ditches, contour farming, minimum tillage, crop-residue management, and the use of sod crops in the cropping system. Machines should be used little when the soil is wet. Lime and fertilizer should be added in amounts adequate for the crop grown.

CAPABILITY UNIT IIIe-6

This unit consists of loamy soils of the Morris and Volusia series. These are deep, moderately sloping, somewhat poorly drained soils with a well-expressed fragipan. The root zone, only 12 to 18 inches thick, is capable of supplying only a small amount of moisture. Reaction is strongly acid, and the capacity to supply both potassium and phosphorus is medium. Runoff is rapid, and erosion is a hazard. Overcoming extremes of wetness and droughtiness are problems.

These soils are suited to many of the crops grown in the county but are better suited to sod crops than to row crops. The slope and the shallowness to the fragipan result in wetness early in spring and droughtiness in summer. Diversion ditches help to remove the excess water and permit early cultivation and plant growth. A more serious problem is overcoming lack of moisture in summer. Contour farming, minimum tillage, and the use of sod crops help to keep the soils open. Moisture stored in winter encourages early growth of sod crops, and if the soils are well fertilized and limed, the yields of first cuttings are increased.

CAPABILITY UNIT IIIe-7

Dalton silt loam, 8 to 15 percent slopes, is the only soil in this unit. It is a deep, somewhat poorly drained soil with a well-expressed fragipan. The root zone, only about 20 inches thick, is capable of supplying only a small amount of moisture. Reaction is strongly acid, the capacity to supply potassium is low, and the capacity to supply phosphorus is medium. Erosion is a severe hazard.

Crop production on this soil is limited by wetness in spring and droughtiness in summer, both conditions resulting from the shallowness to the fragipan. Early sod crops that are tolerant of wetness are the most dependable crops. Success with cultivated crops depends on the control of erosion and the management of water. Measures that help to control erosion consist of contour stripcropping, diversion ditches, and sod waterways. Both lime and fertilizer are needed.

CAPABILITY UNIT IIIw-1

This unit consists of loamy soils of the Volusia and Wallington series. These are deep, nearly level, somewhat poorly drained soils with a well-expressed fragipan. The root zone, only 15 to 18 inches thick, is capable of supplying only a small amount of moisture. Reaction is strongly acid, the capacity to supply potassium is low to medium, and the capacity to supply phosphorus is medium. Excess water is the main limitation.

These soils are not suited to intensive cultivation. If they are worked when wet, a plowpan forms and the surface crusts readily. Seasonal wetness delays planting and affects crop growth. Droughtiness is a hazard in summer or when rainfall is unevenly distributed. Row crops can be grown, but sod crops and legumes that are tolerant of wetness are the most dependable crops. Early removal of wetness improves crop production by allowing plants to start growth earlier in spring. Shallow surface ditches or diversion terraces are feasible in some places. Both lime and fertilizer are needed on these soils.

CAPABILITY UNIT IIIw-2

This unit consists of loamy soils of the Morris and Volusia series. These are deep, gently sloping, somewhat poorly drained soils with a well-expressed fragipan. The root zone, only 15 to 18 inches thick over the fragipan, is capable of supplying only a small amount of moisture. Reaction is strongly acid, and the capacity to supply both potassium and phosphorus is medium. Wetness is the main limitation. Erosion is a hazard.

These soils can be cultivated but must be managed carefully. Diversion terraces and contour farming help to improve drainage and control erosion. If these measures are not used, sod crops and legumes that are tolerant of wetness are more dependable than row crops (fig. 8). Both lime and fertilizer are needed.

CAPABILITY UNIT IIIw-3

Dalton silt loam, 2 to 8 percent slopes, is the only soil in this unit. It is a deep, somewhat poorly drained soil with a well-expressed fragipan. The root zone, only about 20 inches thick, is capable of supplying only a small amount of moisture. Reaction is strongly acid, the capacity to supply phosphorus is medium, and the capacity to supply potassium is low. Seasonal wetness is a limitation. Erosion is a severe hazard.

This soil generally has limited use for cultivated crops unless it can be drained and planted early. If cultivated crops are grown, erosion must be kept to a minimum. Sod crops that tolerate wetness are dependable forage crops if the soil is well limed and topdressed annually with high-nitrogen fertilizer. Suitable conservation measures consist of contour farming or stripcropping coupled with the use of diversion ditches and sod waterways.

Figure 8.—Hay crops on Volusia soils, near Belden. Lordstown soils are on some of the steep, forested slopes in background.

CAPABILITY UNIT IVe-1

This unit consists of loamy soils of the Cattaraugus, Culvers, Lordstown, Mardin, and Oquaga series. These are deep and moderately deep, moderately steep, moderately well drained and well drained soils. Either a well-defined fragipan or bedrock restricts the root zone to the topmost 18 to 40 inches. The root zone is capable of supplying a moderate to large amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium. Erosion, resulting from the slope and excess runoff, is the main hazard.

These soils are suited to all the crops commonly grown in the county, but they are better suited to sod crops because of the slope and the hazard of erosion. Sod crops can be managed and utilized for pasture. Cultivated crops can be grown infrequently on short slopes and on slopes protected by diversion ditches. Contour farming and crop-residue management help to curb erosion. The operation of large machinery is hazardous and generally impractical. All the soils need to be limed. Fertilizer should be added in amounts determined by soil tests.

CAPABILITY UNIT IVe-2

This unit consists of loamy soils of the Chenango, Howard, and Mardin series. These are deep, moderately steep or hilly, well drained and moderately well drained soils on outwash terraces and moraines. The root zone, 18 to 40 inches thick, is capable of supplying a moderate to large amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium. Runoff is rapid, and erosion is a severe hazard. The slopes are complex.

These soils are suited to all the crops commonly grown in the county, but they are better suited to sod crops because of the slope and hazard of erosion. They can be planted and grazed early in the season. Deep-rooted crops are preferred because they withstand dry periods better than shallow-rooted crops. Cultivated crops can be grown infrequently in a rotation with sod crops. Minimum tillage helps to conserve moisture. Because of the complex slopes, the use of contour farming is limited. The operation of large machinery is extremely hazardous. Both lime and fertilizer are needed. Grass sod should be fertilized with nitrogen in spring. Row crops should be sidedressed. Fertilizer should be added more than once each growing season to offset loss of nutrients through leaching.

CAPABILITY UNIT IVe-3

Volusia channery silt loam, 15 to 25 percent slopes, is the only soil in this unit. It is a deep, somewhat poorly drained soil with a well-expressed fragipan. The root zone, only 15 to 18 inches thick, is capable of supplying only a small amount of moisture. Reaction is strongly acid, and the capacity to supply both potassium and phosphorus is medium. Erosion is a severe hazard.

This soil is severely restricted for use as cropland. Grassland or woodland is a more dependable use. The fragipan results in wetness early in spring and droughtiness during dry periods. The slope makes diversion ditches impractical. The need for lime and fertilizer is high. The production of hay and pasture can be improved if the grasses used are tolerant of wetness and the soil is topdressed early in spring with high nitrogen fertilizer.

CAPABILITY UNIT IVe-4

Volusia channery silt loam, 8 to 15 percent slopes, eroded, is the only soil in this unit. It is a deep, somewhat poorly drained soil with a well-expressed fragipan. The root zone, only 8 to 10 inches thick, is capable of supplying only a small amount of moisture. Reaction is strongly acid, the capacity to supply potassium is medium, and the capacity to supply phosphorus is low. The hazard of further erosion is severe.

This soil is similar to the soils in capability unit IIIe-6, but it has been severely damaged by erosion. Erosion has thinned the surface layer and has depleted the natural organic-matter content. Wetness is a limitation in spring, and droughtiness in summer. Cultivated crops can be grown in small areas that are within fields containing other soils that are cultivated, but these areas need to have organic matter added and fertility improved. Sod crops generally are more dependable than cultivated crops. Large amounts of lime and fertilizer are needed for whatever crop is grown.

CAPABILITY UNIT IVw-1

Wayland silt loam is the only soil in this unit. It is a deep, nearly level, poorly drained and somewhat poorly drained soil of flood plains. Undrained, the root zone is only about 12 inches thick over the water table, and plants do not lack moisture. Reaction is variable, and the capacity to supply both potassium and phosphorus is medium. Wetness and flooding are the main limitations.

This soil is suited to cultivated crops only if it is drained and protected from flooding during the growing season. It should not be worked when wet. Sod crops that are tolerant of wetness show good response to high-nitrogen fertilizer. Lime should be added in amounts determined by soil tests.

CAPABILITY UNIT IVw-2

This unit consists of loamy soils of the Alden and Chippewa series. These are deep, nearly level and gently sloping, poorly drained and very poorly drained soils on uplands. Chippewa soils have a fragipan. Their root zone is only 10 to 18 inches thick, but plants are rarely affected by lack of moisture. Reaction is strongly acid to slightly acid, and the capacity to supply both potassium and phosphorus is medium. Wetness is the main limitation.

These soils are suited to cultivated crops only if they are drained. Control of surface water is needed to protect the gently sloping soils from erosion. If cultivated crops are grown, they should be planted on the contour and sod waterways and surface drains should be provided for safe, quick removal of excess water. The removal of surface water also permits management for selected sod crops that tolerate wetness. Both lime and fertilizer are needed for all crops. The sod crops benefit from nitrogen fertilizer.

CAPABILITY UNIT IVw-3

Tuller channery silt loam, 0 to 25 percent slopes, is the only soil in this unit. It is a somewhat poorly drained and poorly drained soil on uplands. Bedrock is near the surface. The root zone, 12 to 20 inches thick, is capable of supplying only a small amount of moisture. Reaction is moderately acid, and the capacity to supply both potassium and phosphorus is medium. Wetness is the main limitation, but droughtiness is a limitation during dry periods and erosion is a moderate to severe hazard in the more sloping areas.

This soil is poor for crops. Its wetness is difficult to correct and delays planting, and its droughtiness causes plants to lack moisture. The less sloping areas can be cropped if water is diverted from the adjoining areas. Contour measures are needed if the more sloping areas are cultivated. Both lime and fertilizer are needed for all crops. A complete high-nitrogen fertilizer applied to sod crops early in spring helps to increase production of first cuttings of hay or pasture.

CAPABILITY UNIT IVs-1

Arnot channery silt loam, 0 to 25 percent slopes, is the only soil in this unit. It is well drained and moderately well drained. The root zone, 12 to 20 inches thick over bedrock, is capable of supplying only a small amount of moisture. Reaction is strongly acid, and the capacity to supply both potassium and phosphorus is medium. Erosion is a moderate to severe hazard in the more sloping areas.

This soil is better suited to sod crops than to cultivated crops. Scattered rock outcrops and bedrock near the surface interfere with tillage. Plants need large amounts of lime and yearly applications of fertilizer if they are to be maintained. Sod crops respond to early applications of nitrogen fertilizer and furnish early grazing. If cultivated crops are grown, contour measures are needed to control erosion and conserve moisture.

CAPABILITY UNIT Vw-1

Alluvial land makes up this unit. It is flooded frequently and is poorly drained to excessively drained. The thickness of the root zone, the reaction, and the capacity to supply plant nutrients are variable.

Small areas would be suited to cultivated crops only if the stream courses were altered. Permanent vegetation is a more suitable use. Only long-lived plants that tolerate both wetness and droughtiness should be selected for management. Lime and fertilizer should be added in amounts determined by crop needs and the productivity desired.

CAPABILITY UNIT VIe-1

This unit consists of loamy soils of the Cattaraugus, Chenango, Howard, Lordstown, Mardin, and Oquaga series. The soils are deep and moderately deep, steep, and chiefly well drained. The deep soils have a moderately well expressed fragipan that restricts the root zone and the movement of air and water to the topmost 18 to 30 inches. In the moderately deep soils, bedrock of sandstone or shale restricts the root zone to the topmost 20 to 40 inches. The root zone of all the soils is capable of supplying a moderate to large amount of moisture, but runoff is so rapid that little moisture soaks in. Reaction is chiefly strongly acid, and the capacity to supply plant nutrients is medium. Erosion is a severe hazard. There are scattered rock outcrops.

These soils are too steep for cultivation and should be kept in permanent vegetation. Topdressing an established sod annually helps to produce a fair amount of pasture in spring and early in summer. Grazing management should maintain a protective plant cover.

CAPABILITY UNIT VIIw-1

Peat and Muck makes up this unit. These are nearly level, very poorly drained, organic soils. They vary in thickness and are saturated with water most of the year. Reaction and the capacity to supply plant nutrients are variable.

Areas of Peat and Muck normally are not used for cultivated crops and are mainly in forest consisting of water-tolerant trees or in bog-type vegetation. Onsite inspection is needed to determine if areas can be drained and managed for specialty crops.

CAPABILITY UNIT VIIs-1

This unit consists mainly of very stony or rocky, nearly level to very steep soils of the Cattaraugus, Lordstown, Mardin, Morris, Oquaga, and Tuller series. The thickness of the root zone, the capacity to supply moisture, the acidity, and the capacity to supply plant nutrients all are highly variable.

These soils are not suited to cultivated crops and are difficult to manage for pasture. Some areas provide grazing early in spring. Management for woodland or recreation generally is preferable.

Estimated Yields

Table 1 lists, for each soil in the county, the estimated yields per acre of corn, oats, forage mixtures, and grass meadow, under two levels of management.

The figures in columns A represent yields to be expected under average management. Under the A level of management, practices that conserve soil and water and the elements of crop management are less than those suggested in "Cornell Recommends." Applications of lime maintain a reaction of pH 6.0 or less; fertilization of sod crops generally is not sufficient to meet crop needs; only spot drainage is used, and summer rainfall is wasted because erosion control practices are lacking; rotations are haphazard, and the best suited crops are seldom planted; field operations generally are not timely; and the control of weeds, insects, and plant diseases is not consistent. Nevertheless, the estimates shown in columns A are a little above the average yields obtained by farmers in the county in the early 1960's.

The figures in columns B represent yields that can be expected under improved management. This management consists of using suitable crop rotations; applying lime and fertilizer in kinds and amounts indicated by soil tests; providing adequate drainage and irrigation, where needed; using contour farming, stripcropping, sodded waterways, or other measures to conserve soil and water; controlling weeds and insects; and tilling at the right time and in the right way. Yields are now increasing at the rate of about 2 percent each year and can be expected to increase further as new varieties of crops are developed and management is improved.

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

[Yields in columns A are those obtained under ordinary management; those in columns B are yields to be expected under improved management. Absence of figure indicates that crop is not commonly grown on the specified soil]

Mapping unit	Corn for silage		Corn for grain		Oats		Forage mixtures (hay): Alfalfa-grass (2- to 5-year stands)		Forage mixtures (hay): Alfalfa-birdsfoot trefoil-grass (3- to 5-year stands)		Forage mixtures (hay): Birdsfoot trefoil-grass (3- to 10-year stands)		Grass meadow (hay)	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Alden and Chippewa soils, 0 to 3 percent slopes	----	13	----	65	----	55	----	----	----	----	1.0	2.5	1.0	2.0
Alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Arnot channery silt loam, 0 to 25 percent slopes	----	----	----	----	30	55	2.0	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Braceville gravelly silt loam	11	20	55	100	35	75	2.0	3.5	2.5	3.5	2.0	3.0	1.5	2.5
Canaseraga silt loam, 3 to 8 percent slopes	9	16	45	80	35	65	2.0	3.5	2.0	3.5	2.0	3.0	1.5	2.5
Canaseraga silt loam, 8 to 15 percent slopes	8	15	40	75	35	65	2.0	3.5	2.0	3.5	2.0	3.0	1.5	2.5
Cattaraugus channery silt loam, 5 to 15 percent slopes	10	18	50	90	40	75	2.0	3.5	2.5	3.5	2.0	3.0	1.5	2.5
Cattaraugus channery silt loam, 15 to 25 percent slopes	8	16	40	80	35	65	2.0	3.0	2.0	3.0	1.5	2.5	1.5	2.5
Cattaraugus channery silt loam, 25 to 35 percent slopes	----	----	----	----	----	----	----	----	----	----	1.0	2.0	----	1.5
Chenango and Howard gravelly loams, 0 to 5 percent slopes	12	20	60	100	50	80	3.5	4.5	3.0	4.0	3.0	4.0	1.5	2.5
Chenango and Howard gravelly loams, 5 to 15 percent slopes	11	18	55	90	45	70	3.5	4.5	2.5	3.5	2.5	3.5	1.5	2.5
Chenango and Howard gravelly loams, 15 to 25 percent slopes	9	16	45	80	40	65	2.5	3.5	2.0	3.0	1.5	2.5	1.0	2.0
Chenango and Howard gravelly loams, 25 to 40 percent slopes	----	----	----	----	30	45	1.5	2.5	1.0	2.0	1.0	2.0	----	1.0
Chippewa channery silt loam, 3 to 8 percent slopes	8	12	40	60	35	50	2.0	3.0	2.0	3.5	2.0	3.0	1.5	2.5
Culvers channery silt loam, 2 to 8 percent slopes	10	16	50	80	40	65	2.0	3.0	2.0	3.0	1.5	2.5	1.0	1.5
Culvers channery silt loam, 8 to 15 percent slopes	10	15	50	75	40	60	2.0	3.0	2.0	3.0	1.5	2.5	1.0	1.5
Culvers channery silt loam, 15 to 25 percent slopes	8	14	40	70	35	60	----	----	1.5	2.5	1.0	2.0	1.0	1.5
Cut and fill lands, gravelly materials	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cut and fill lands, loamy materials	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cut and fill lands, silty materials	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Dalton silt loam, 2 to 8 percent slopes	8	14	40	70	30	60	2.0	3.0	2.0	3.5	2.0	3.0	1.5	2.5
Dalton silt loam, 8 to 15 percent slopes	9	12	45	60	35	55	2.0	3.0	2.0	3.5	2.0	3.0	1.5	2.5
Lordstown channery silt loam, 0 to 5 percent slopes	9	15	45	75	45	70	2.5	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Lordstown channery silt loam, 5 to 15 percent slopes	9	15	45	75	45	65	2.5	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Lordstown channery silt loam, 15 to 25 percent slopes	8	14	40	70	40	60	2.0	3.0	2.0	2.5	1.5	2.5	1.0	1.5
Lordstown and Oquaga channery silt loams, 25 to 35 percent slopes	----	----	----	----	35	55	1.5	2.5	1.5	2.5	1.0	1.5	1.0	1.5
Lordstown and Oquaga soils, 35 to 60 percent slopes	----	----	----	----	----	----	----	----	----	----	----	1.0	----	1.0
Lordstown and Oquaga extremely stony and rocky soils, 0 to 35 percent slopes	----	----	----	----	----	----	----	----	----	----	----	1.0	----	1.0
Made land, sanitary land fill	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Mardin channery silt loam, 2 to 8 percent slopes	9	16	45	80	40	65	2.0	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Mardin channery silt loam, 8 to 15 percent slopes	9	15	45	75	40	60	2.0	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Mardin channery silt loam, 15 to 25 percent slopes	8	14	40	70	40	60	2.0	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Mardin channery silt loam, 25 to 35 percent slopes	----	----	----	----	30	55	1.5	2.5	1.5	2.5	1.5	2.5	1.0	1.5

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

Mapping unit	Corn for silage		Corn for grain		Oats		Forage mixtures (hay): Alfalfa-grass (2- to 5-year stands)		Forage mixtures (hay): Alfalfa-birdsfoot trefoil-grass (3- to 5-year stands)		Forage mixtures (hay): Birdsfoot trefoil-grass (3- to 10-year stands)		Grass meadow (hay)	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Mardin channery silt loam, moderately shallow variant, 2 to 8 percent slopes	8	16	40	80	40	65	2.0	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Mardin-Chenango channery silt loams, 5 to 15 percent slopes	9	16	45	80	45	65	2.5	4.0	2.5	4.0	2.0	3.0	1.5	2.5
Mardin-Chenango channery silt loams, 15 to 25 percent slopes	----	----	----	----	40	65	1.5	2.5	2.0	3.0	1.5	2.5	1.0	2.0
Mardin and Cattaraugus soils, 35 to 60 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	1.0
Middlebury silt loam	10	22	50	110	35	80	1.5	2.5	2.0	3.0	1.5	2.5	1.5	2.5
Morris channery silt loam, 2 to 8 percent slopes	6	14	30	70	35	60	----	2.5	1.5	2.5	1.5	2.5	1.0	1.5
Morris channery silt loam, 8 to 15 slopes	6	12	30	60	35	55	----	2.5	1.5	2.5	1.5	2.5	1.0	1.5
Morris and Tuller very stony soils, 3 to 25 percent slopes	----	12	----	60	----	55	1.5	2.5	1.5	3.0	----	1.0	----	1.0
Oquaga channery silt loam, 5 to 15 percent slopes	8	15	40	75	45	70	2.5	3.5	2.0	3.5	1.5	2.5	1.0	2.0
Oquaga channery silt loam, 15 to 25 percent slopes	8	14	40	70	40	65	1.5	2.5	1.5	2.5	1.0	2.0	1.0	1.5
Peat and Muck	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Scio silt loam	10	20	50	100	35	75	1.5	2.5	2.0	3.0	1.5	2.5	1.5	2.5
Tioga silt loam	12	20	60	115	50	80	2.5	4.5	2.5	4.0	2.0	3.0	1.5	2.5
Tioga gravelly silt loam, fan	13	22	65	110	50	80	2.5	4.0	2.5	4.0	2.0	3.0	1.5	2.5
Tuller channery silt loam, 0 to 25 percent slopes	----	14	----	70	25	50	1.5	2.5	1.5	2.5	1.0	2.0	1.0	1.5
Unadilla silt loam, 0 to 5 percent slopes	13	23	65	115	50	80	2.5	4.0	2.5	4.0	2.0	3.0	1.5	2.5
Unadilla silt loam, 5 to 15 percent slopes	13	23	65	115	50	80	2.5	4.0	2.5	4.0	2.0	3.0	1.5	2.5
Volusia channery silt loam, 0 to 3 percent slopes	6	14	30	70	25	60	1.0	2.0	1.0	2.0	1.0	2.0	1.0	1.5
Volusia channery silt loam, 3 to 8 percent slopes	6	14	30	70	35	60	1.5	2.5	1.5	2.5	1.5	2.5	1.0	1.5
Volusia channery silt loam, 8 to 15 percent slopes	6	13	30	65	35	55	1.5	2.5	1.5	2.5	1.5	2.5	1.0	1.5
Volusia channery silt loam, 8 to 15 percent slopes, eroded	5	12	25	60	30	55	1.0	2.0	1.5	2.5	1.0	1.5	1.0	1.5
Volusia channery silt loam, 15 to 25 percent slopes	5	12	25	60	30	55	1.0	2.0	1.5	2.5	1.0	1.5	1.0	1.5
Wallington silt loam	7	16	35	80	40	60	----	----	1.5	2.5	1.5	2.5	1.0	1.5
Wayland silt loam	----	18	----	90	----	60	----	2.5	----	2.5	1.0	2.0	1.0	2.0

The annually revised editions of "Cornell Recommends for Field Crops" and "Cornell Recommends for Vegetable Crops" can be used as a guide for the management needed to obtain the yields shown in columns B.

Woodland [6]

Originally, forest covered all of Broome County. Early settlers cleared much of the land for farming (*5*). Now, 9,300 acres of forest is under public ownership and 81,900 is owned by farmers. The largest forested areas, totaling 149,600 acres, are privately owned. These areas are on the rugged terrain in the eastern part of the county (*13*).

In 1958, it was estimated that about 36 percent of the county was woodland (*20*). Farm woodlots in the 16 towns ranged in size from the average of 8 acres in the town of Dickinson to 77 acres in the town of Sanford. A more recent estimate indicates that now about 53 percent of the county is woodland (*13*).

There are five major forest types in the county—northern-hardwood, oak, hemlock-hardwood, white-pine, and bottom land-hardwood.

The northern-hardwood type is the most important and occurs throughout the county. This type consists principally of sugar maple (fig. 9), beech, and red maple,

[6] This section prepared by MEREDITH A. PETERS, woodland conservationist, Soil Conservation Service, in consultation with personnel from the New York State College of Forestry, Syracuse; Department of Forest Soils, Cornell University; and the New York State Conservation Department.

Figure 9.—Native vegetation on Volusia and Mardin soils, near West Colesville. The trees are largely sugar maple. These soils have many favorable features for recreation areas, wildlife habitat, and residential developments.

but it has some black birch, yellow birch, basswood, white ash, aspen, red oak, black cherry, hickory, American elm, and hemlock (*19*).

The oak type occurs on steep slopes along rivers and on some southern and western slopes in the southern part of the county. It consists chiefly of red oak, white oak, chestnut oak, black oak, and red maple.

The hemlock-hardwood type is most prevalent in the northern towns. Hemlock makes up about a quarter of the stands. Various other hardwoods make up the rest.

The white-pine type is in nearly all sections of the county. It occurs as isolated, small, almost pure stands or as a mixture of white pine and various hardwoods.

The bottom land-hardwood type occurs along streams, on soils that are likely to be flooded. This type consists of elm, sycamore, willow, and associated minor species.

The softwood growing stock totals 39.7 million cubic feet. The species that make up most of this total are hemlock 18.1, white pine 10.7, and red pine 8.1 (*13*).

The hardwood growing stock totals 135.5 million cubic feet. The species that make up most of this total are soft maple 35.2, sugar maple 32.1, red oak 12.8, and white ash 10.1.

The softwood sawtimber totals 71.3 million board feet. The species that make up most of this total are hemlock 36.8, white pine 19.3, and red pine 11.9.

The hardwood sawtimber totals 201.0 million board feet. The species that make up most of this total are sugar maple 50.7, soft maple 37.3, red oak 26.2, white ash 16.1, basswood 14.8, and beech 14.1.

Plantations make up an important part of the acreage in forest (fig. 10). Red pine, white pine, and Norway spruce make up about 75 percent of the early plantings. During the past 25 years, the proportion of red pine plantings has increased. White pine has not been planted, because of the likelihood of extensive damage by the white-pine weevil. An early planting of white pine in the vicinity of Sky Lake, however, appears to have outgrown extensive weevil damage.

Woodland suitability groups

The soils of Broome County have been placed in nine woodland suitability groups. Each group is made up of soils that are similar in potential productivity, are suited to similar trees, and require similar management. Table 2 describes the woodland groups in the county

Figure 10.—**Pine plantation on Volusia, Mardin, and Lordstown soils along State Highway 17, near Deer Lake. These soils are well suited to reforestation.**

and lists the map symbols of the soils in each group. This table gives ratings of productivity and evaluates the hazards and limitations that affect management. The species suitable for planting and to favor in existing stands are listed (*25*).

The potential productivity of the soils in each group is expressed in relative terms: good, fair, or poor. Each rating indicates the capacity of the soils to produce wood crops. A rating of poor indicates that tree planting generally is not recommended except for erosion control or to provide food and cover for wildlife.

Seedling mortality refers to the expected degree of mortality of naturally occurring or planted seedlings as influenced by soil texture, depth, drainage, flooding, height of the water table, and degree of erosion. Normal rainfall, good planting stock, and proper planting are assumed. The mortality is *slight* if the expected loss of seedlings is less than 25 percent; *moderate* if the loss is between 25 and 50 percent; and *severe* if it is more than 50 percent.

Plant competition refers to the invasion or growth of unwanted trees, shrubs, vines, or other plants when openings are made in the canopy. The competition is *slight* if it does not hinder the establishment of a desirable stand of trees. It is *moderate* if competing plants delay the establishment of a desirable stand. Competition is *severe* if it prevents the establishment of a desirable stand unless intensive cultural measures are applied. Among the soil properties that affect plant competition are available moisture capacity, degree of erosion, and drainage.

Equipment limitation indicates the degree to which factors such as slope, drainage, stoniness, and soil texture restrict the use of equipment commonly used in woods operations. The limitation is *slight* if there is little or no restriction on the type of equipment that can be used or the time of year that equipment can be used. It is *moderate* if the use of equipment is seasonally limited or if modified equipment or methods of harvesting are needed. The limitation is *severe* if special equipment is needed or if the use of such equipment is severely restricted by one or more unfavorable soil characteristics.

Erosion hazard is rated according to the risk of erosion on woodland where normal practices are used in managing and harvesting trees. It is *slight* if erosion control is not an important consideration. The hazard is *moderate* if some attention must be given to check soil losses. It is *severe* if special treatment or special methods of operations are needed to control erosion.

Windthrow hazard depends on the development of roots and the capacity of the soils to hold trees firmly. The hazard is *slight* if windthrow is not an important concern. It is *moderate* if roots hold the trees firmly, except when the soil is excessively wet or when the wind is strongest. The hazard is *severe* if many trees are expected to be blown over because their roots do not provide enough stability.

Wildlife [7]

Wildlife is an important natural resource in Broome County. There are populations of white-tailed deer, ruffed grouse, gray squirrels, cottontail rabbits, ring-necked pheasants, woodcocks, and wild turkeys.

The kinds and amounts of wildlife that live in a given area are closely related to land use; to the resulting kinds, amounts, and patterns of vegetation; and to the supply and distribution of water. These, in turn, are generally related to the kinds of soils (fig.11).

In table 3, soils are rated for eight elements of wildlife habitat: (1) grain and seed crops, (2) grasses and legumes, (3) wild herbaceous upland plants, (4) hardwood plants, (5) coniferous wildlife habitat, (6) wetland food and cover plants (7) shallow diked impoundments, and (8) shallow excavated impoundments and for three classes of wildlife: (1) openland, (2) woodland, and (3) wetland (*1*).

[7] This section was prepared by ROBERT E. MYERS, wildlife biologist, Soil Conservation Service, Syracuse, N. Y.

A rating of 1 indicates that the soil is well suited with few limitations; 2, that it is suited with moderate limitations; 3, that it is poorly suited because of severe limitations; and 4, that it is not suited.

Wildlife habitat elements

Each soil is rated in table 3 according to its suitability for various kinds of plants and water developments that make up a wildlife habitat element. These ratings can be used as an aid in (1) selecting the best soils for creating, improving, or maintaining specific wildlife habitat elements; (2) determining the relative intensity of management required for individual habitat elements; and (3) avoiding sites that would be difficult or not feasible to manage. Following is a discussion of the eight habitat elements selected for rating in table 3.

GRAIN AND SEED CROPS.—Among these crops are seed-producing annuals, such as corn, sorghum, wheat, barley, oats, millet, buckwheat, and sunflower. Soils well suited to these plants are deep, nearly level or very gently sloping, medium textured, well drained, and free or nearly free of stones. They also have a high moisture-holding capacity and are not subject to frequent flooding. These soils can be safely planted to a wide variety of grain crops each year. Soils that are not so well suited require more intensive management and are suited to fewer crops.

Figure 11.—**Changing pattern of land use on Mardin and Volusia soils. Many areas are reverting to brush. For desirable wildlife habitat, it is essential that open areas be maintained.**

TABLE 2.—*Suitability of*

Woodland suitability groups	Productivity	Seedling mortality	Plant competition
Group 1. Deep, well drained and moderately well drained, medium-textured soils that formed in gravelly glacial outwash, in silty material on stream terraces, or in alluvial deposits. There are few or no restrictions to the rooting depth. The Howard soil becomes calcareous at a depth of 3½ to 6 feet. Otherwise, these soils range from very strongly acid to slightly acid. Tioga and Middlebury soils are subject to flooding. Slopes of 0 to 25 percent. Braceville (Br); Chenango and Howard (ChA, ChC, ChD); Middlebury (Ms); Scio (Sc); Tioga (Ta, Tg); Unadilla (UnB, UnC).	Good	Slight	Moderate
Group 2. Well drained and moderately well drained, medium-textured, strongly acid, upland soils. A well-expressed fragipan or bedrock at a depth of 20 to 40 inches limits the depth of the rooting zone and restricts the movement of air and water. Slopes of 0 to 25 percent. Canaseraga (CaB, CaC); Cattaraugus (CcC, CcD); Culvers (CuB, CuC, CuD); Lordstown (LdB, LdC, LdD); Mardin (MhB, MhC, MhD, MmB); Mardin-Chenango (MnC, MnD); Oquaga (OuC, OuD).	Good	Slight	Moderate
Group 3. Well-drained, steep, medium-textured soils. Except for Chenango and Howard gravelly loams, these are strongly acid or very strongly acid, upland soils that have a well-expressed fragipan or that are 20 to 40 inches in depth to bedrock. The fragipan or bedrock restricts the growth of roots and the movement of air and water. Runoff is rapid on the steep slopes. Lack of moisture becomes critical during dry periods. Slopes of 25 to 40 percent. Cattaraugus (CcE); Chenango and Howard (ChE); Lordstown and Oquaga (LoE); Mardin (MhE).	Good	Moderate	Moderate
Group 4. Well-drained, medium-textured, strongly acid or very strongly acid, very steep soils. These soils generally are very stony or rocky. A fragipan or bedrock at a depth of 20 to 40 inches limits the depth of the rooting zone and restricts the movement of air and water. Runoff is rapid on these steep slopes. Lack of moisture becomes critical during dry periods. Slopes of 35 to 60 percent. Lordstown and Oquaga (LrF); Mardin and Cattaraugus (MrF).	Fair	Slight	Moderate
Group 5. Somewhat poorly drained, acid, medium-textured soils, mainly on uplands. Wallington silt loam is on stream terraces. A well-expressed fragipan or bedrock at a depth of 12 to 20 inches seriously limits the depth of the rooting zone and restricts the movement of air and water. Slopes of 0 to 25 percent. Dalton (DaB, DaC); Morris (MtB, MtC); Morris and Tuller (MuD); Tuller (TuD); Volusia (VoA, VoB, VoC, VoC3, VoD); Wallington (Wa).	Fair	Moderate	Moderate
Group 6. Well drained to moderately well drained, medium-textured, strongly acid soils that are 12 to 20 inches thick over bedrock. A shallow rooting zone and droughtiness are the major limitations for most woodland uses. Slopes of 0 to 25 percent. Arnot (ArD).	Fair	Moderate	Moderate
Group 7. Very stony or rocky, well drained and moderately well drained, medium-textured, strongly acid soils on uplands. A well-expressed fragipan or bedrock at a depth of 20 to 40 inches limits the depth of the rooting zone and restricts the movement of air and water. Slopes of 0 to 35 percent. Lordstown and Oquaga (LsE).	Fair	Moderate	Slight
Group 8. Poorly drained and very poorly drained, strongly acid to slightly acid soils on uplands. A strongly expressed fragipan at a depth of 12 to 18 inches in the Chippewa soils and a prolonged high water table in the Alden soils limit the depth of the rooting zone and restrict the movement of air and water. Some areas of these soils are very stony. Slopes of 0 to 8 percent. Alden and Chippewa (AcA); Chippewa (CpB).	Poor	Moderate	Slight
Group 9. Wet soils on flood plains, peat and muck, and miscellaneous land types that generally are not suitable for use as commercial woodland sites. Plantings for special use may be successful on some sites, but careful examination is needed to select suitable sites. Alluvial land (Ad); Cut and fill lands (Cv, Cw, Cy); Made land (Mf); Peat and Muck (Pm); Wayland (Wd).			

the soils for woodland

Equipment limitation	Erosion hazard	Windthrow hazard	Species suitability	
			For planting	To favor in existing stands
Slight	Slight	Slight	Scotch pine, white pine, red pine, European larch, Japanese larch, Norway spruce, white spruce. Limited suitability: Whitecedar, redcedar.	Sugar maple, red maple, beech, black cherry, red oak, white ash, basswood, hemlock.
Slight	Slight	Slight	Scotch pine, white pine, red pine, European larch, Japanese larch, Norway spruce, white spruce. Limited suitability: Whitecedar, redcedar.	Sugar maple, red maple, red oak, white ash, white oak, beech, black cherry, basswood, black birch, hemlock, white pine.
Moderate	Slight	Slight	Scotch pine, red pine, white pine, European larch, Japanese larch. Limited suitability: Norway spruce, white spruce, whitecedar, redcedar.	Sugar maple, red maple, beech, white ash, black cherry, basswood, red oak, white oak, hemlock.
Severe	Moderate	Slight	Scotch pine, red pine, European larch. Limited suitability: White pine, Japanese larch, Norway spruce, white spruce, redcedar.	Sugar maple, red maple, red oak, white oak, hickory, black birch, beech, ash, black cherry, basswood, hemlock.
Moderate	Slight to moderate.	Moderate	White pine, white spruce. Limited suitability: Scotch pine, European larch, Japanese larch, Norway spruce.	Sugar maple, red maple, black cherry, black birch, yellow birch, hemlock.
Slight	Slight	Moderate	Limited suitability: Scotch pine, red pine, white pine, European larch.	Red oak, hickory, white oak, white pine, sugar maple.
Moderate to severe.	Slight	Slight	Scotch pine, white pine, red pine, European larch. Limited suitability: Japanese larch, Norway spruce, white spruce, redcedar.	Sugar maple, red maple, white ash, black cherry, black birch, beech, hemlock, white pine.
Severe	Slight	Severe	Limited suitability: White spruce.	Black birch, hickory, white pine, hemlock, red maple, yellow birch.

TABLE 3.—*Rating of soils for wildlife habitat elements and classes of wildlife*

[A rating of 1 indicates that the soil is well suited; 2, the soil is suited; 3, poorly suited; and 4, unsuited. Not rated are Alluvial land, Cut and fill lands, and Made land]

Soil name	Wildlife habitat elements								Classes of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood plants	Coniferous wildlife habitat	Wetland food and cover plants	Shallow diked impoundments [1]	Shallow excavated impoundments [1]	Openland	Woodland	Wetland
Alden and Chippewa soils, 0 to 3 percent slopes:											
Alden	4	3	3	2	1	1	2	1	3	2	1
Chippewa	4	3	3	2	2	2	1	1	3	2	1
Arnot channery silt loam, 0 to 25 percent slopes	3	3	2	2	3	4	4	4	3	3	4
Braceville gravelly silt loam	2	1	1	2	2	4	4	4	1	2	4
Canaseraga silt loam, 3 to 8 percent slopes	2	1	1	2	2	4	3	3	1	2	4
Canaseraga silt loam, 8 to 15 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Cattaraugus channery silt loam, 5 to 15 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Cattaraugus channery silt loam, 15 to 25 percent slopes	3	2	1	2	2	4	4	4	2	2	4
Cattaraugus channery silt loam, 25 to 35 percent slopes	4	3	1	2	2	4	4	4	3	2	4
Chenango and Howard gravelly loams, 0 to 5 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Chenango and Howard gravelly loams, 5 to 15 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Chenango and Howard gravelly loams, 15 to 25 percent slopes	3	2	2	2	2	4	4	4	2	2	4
Chenango and Howard gravelly loams, 25 to 40 percent slopes	4	3	2	2	2	4	4	4	3	2	4
Chippewa channery silt loam, 3 to 8 percent slopes	4	3	3	2	2	3	4	4	3	2	4
Culvers channery silt loam, 2 to 8 percent slopes	3	2	2	2	1	4	4	4	2	2	4
Culvers channery silt loam, 8 to 15 percent slopes	3	2	2	2	1	4	4	4	2	2	4
Culvers channery silt loam, 15 to 25 percent slopes	3	2	2	2	1	4	4	4	2	2	4
Dalton silt loam, 2 to 8 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Dalton silt loam, 8 to 15 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Lordstown channery silt loam, 0 to 5 percent slopes	2	2	1	2	2	4	4	4	2	2	4
Lordstown channery silt loam, 5 to 15 percent slopes	2	2	1	2	2	4	4	4	2	2	4
Lordstown channery silt loam, 15 to 25 percent slopes	3	2	1	2	2	4	4	4	2	2	4
Lordstown and Oquaga channery silt loams, 25 to 35 percent slopes	4	3	1	2	2	4	4	4	3	2	4
Lordstown and Oquaga soils, 35 to 60 percent slopes	4	4	1	2	2	4	4	4	4	2	4
Lordstown and Oquaga extremely stony and rocky soils, 0 to 35 percent slopes	4	4	1	2	2	4	4	4	4	2	4
Mardin channery silt loam, 2 to 8 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Mardin channery silt loam, 8 to 15 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Mardin channery silt loam, 15 to 25 percent slopes	3	2	1	2	2	4	4	4	2	2	4
Mardin channery silt loam, 25 to 35 percent slopes	4	3	1	2	2	4	4	4	3	2	4

See footnote at end of table.

TABLE 3.—*Rating of soils for wildlife habitat elements and classes of wildlife*—Continued

Soil name	Wildlife habitat elements								Classes of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood plants	Coniferous wildlife habitat	Wetland food and cover plants	Shallow diked impoundments [1]	Shallow excavated impoundments [1]	Openland	Woodland	Wetland
Mardin channery silt loam, moderately shallow variant, 2 to 8 percent slopes	2	1	1	2	2	4	4	4	1	2	4
Mardin-Chenango channery silt loams, 5 to 15 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Mardin-Chenango channery silt loams, 15 to 25 percent slopes	3	2	2	2	2	4	4	4	2	2	4
Mardin and Cattaraugus soils, 35 to 60 percent slopes	4	4	2	2	2	4	4	4	4	2	4
Middlebury silt loam	2	1	1	1	3	4	4	4	1	1	4
Morris channery silt loam, 2 to 8 percent slopes	2	2	2	2	2	3	4	4	2	2	4
Morris channery silt loam, 8 to 15 percent slopes	2	2	2	2	2	4	4	4	2	2	4
Morris and Tuller very stony soils, 3 to 25 percent slopes	4	3	2	2	2	4	4	4	3	2	4
Oquaga channery silt loam, 5 to 15 percent slopes	2	2	1	2	2	4	4	4	2	2	4
Oquaga channery silt loam, 15 to 25 percent slopes	3	2	1	2	2	4	4	4	2	2	4
Peat and Muck	4	3	3	2	2	1	4	2	3	3	3
Scio silt loam	2	1	1	1	3	4	4	4	1	1	4
Tioga silt loam	2	1	1	1	3	4	4	4	1	1	4
Tioga gravelly silt loam, fan	2	1	1	1	3	4	4	4	1	1	4
Tuller channery silt loam, 0 to 25 percent slopes	3	2	2	2	1	4	4	4	2	2	4
Unadilla silt loam, 0 to 5 percent slopes	1	1	1	1	3	4	4	4	1	1	4
Unadilla silt loam, 5 to 15 percent slopes	2	1	1	1	3	4	4	4	1	1	4
Volusia channery silt loam, 0 to 3 percent slopes	3	2	2	2	2	3	2	2	2	2	2
Volusia channery silt loam, 3 to 8 percent slopes	3	2	2	2	2	3	4	4	2	2	4
Volusia channery silt loam, 8 to 15 percent slopes	3	2	2	2	2	4	4	4	2	2	4
Volusia channery silt loam, 8 to 15 percent slopes, eroded	4	2	2	2	2	4	4	4	2	2	4
Volusia channery silt loam, 15 to 25 percent slopes	3	2	2	2	2	4	4	4	2	2	4
Wallington silt loam	2	2	1	2	2	3	4	4	2	2	4
Wayland silt loam	4	3	3	2	2	2	3	3	3	2	3

[1] Detailed investigation is needed at the site of a proposed shallow diked impoundment or a shallow excavated impoundment to determine feasibility. Table 6 in the section "Engineering Applications" lists the soil features that affect the construction of the reservoir area and embankment of farm ponds.

GRASSES AND LEGUMES.—In this group are domestic grasses and legumes that are established by planting. Among these are alfalfa, trefoil, clover, bluegrass, switchgrass, fescue, bromegrass, timothy, orchardgrass, and reed canarygrass. Soils that are rated well suited have slopes of 0 to 15 percent, are well drained or moderately well drained, and have moderately high or high moisture-holding capacity. An adequate stand of many kinds of plants can be easily maintained on these soils for at least 10 years without renovation. Occasional flooding and surface stones are not of serious concern, because the soils are seldom tilled.

WILD HERBACEOUS UPLAND PLANTS.—In this group are perennial grasses and weeds that generally are established naturally. They are bluestem, quackgrass, panicgrass, goldenrod, wild carrot, nightshade, and dandelion. Soils that are well suited to these plants vary widely in texture, drainage, and slope. Drainage ranges between well drained and somewhat poorly drained. Slope is not a limiting factor. Stoniness and occasional flooding are not of serious concern.

HARDWOOD PLANTS.—These plants are nonconiferous trees, shrubs, and woody vines that produce nuts or other fruits, buds, catkins, twigs, or foliage that wildlife eat.

They generally are established naturally but can be planted. Among the native kinds are oak, beech, cherry, maple, birch, poplar, apple, hawthorn, dogwood, viburnum, grape, and briers. Soils that are well suited to these plants are deep or moderately deep, medium textured or moderately fine textured, and well drained to somewhat poorly drained. Slopes and surface stoniness are of little significance.

Also in this group are several varieties of fruiting shrubs that are raised commercially for planting. Among those that can be grown on soils rated well suited are autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crabapple, multiflora rose (fig. 12), highbush cranberry, and silky dogwood. In addition, highbush cranberry, silky dogwood, and other shrubs with similar site requirements can be planted on soils that have a rating of suited. Hardwoods that are not available commercially can commonly be transplanted successfully.

CONIFEROUS WILDLIFE HABITAT.—This element consists of cone-bearing, evergreen trees and shrubs used by wildlife primarily for cover, though some provide browse and seeds. Among these are Norway spruce, white pine, whitecedar, and hemlock. It is important that living branches be maintained close to the ground so that food and cover are readily available to rabbits, pheasants, and other small animals. The lower branches die if trees are allowed to form a dense canopy that shuts out the light.

Soils rated as well suited are those on which conifers grow slowly. These soils either have an effective rooting depth of less than 10 inches or are very poorly drained or excessively drained. It may be difficult to establish a stand of conifers on these soils because seedling mortality is high. Once established, however, a pure conifer habitat is fairly easy to maintain as there is little competition from hardwoods.

Soils rated as poorly suited are those on which conifers grow at a faster rate. These are the deeper soils that are either well drained, moderately well drained, or somewhat poorly drained. If seedlings are planted, the spacing should be 14 feet or more. Maintaining a pure stand of conifers is difficult because hardwoods readily invade the site.

WETLAND FOOD AND COVER PLANTS.—These are wild, herbaceous, annual and perennial plants that grow on moist to wet sites. Among them are smartweed, wild millet, rushes, spikerush, sedges, rice cutgrass, mannagrass, and cattails.

Soils that have a rating of well suited are nearly level and are very poorly drained. Soils that have a rating of suited are nearly level and are poorly drained. Depth, stoniness, and texture of the surface layer are of little concern.

SHALLOW DIKED IMPOUNDMENTS.—The soils are rated on the basis of their suitability for the construction of a

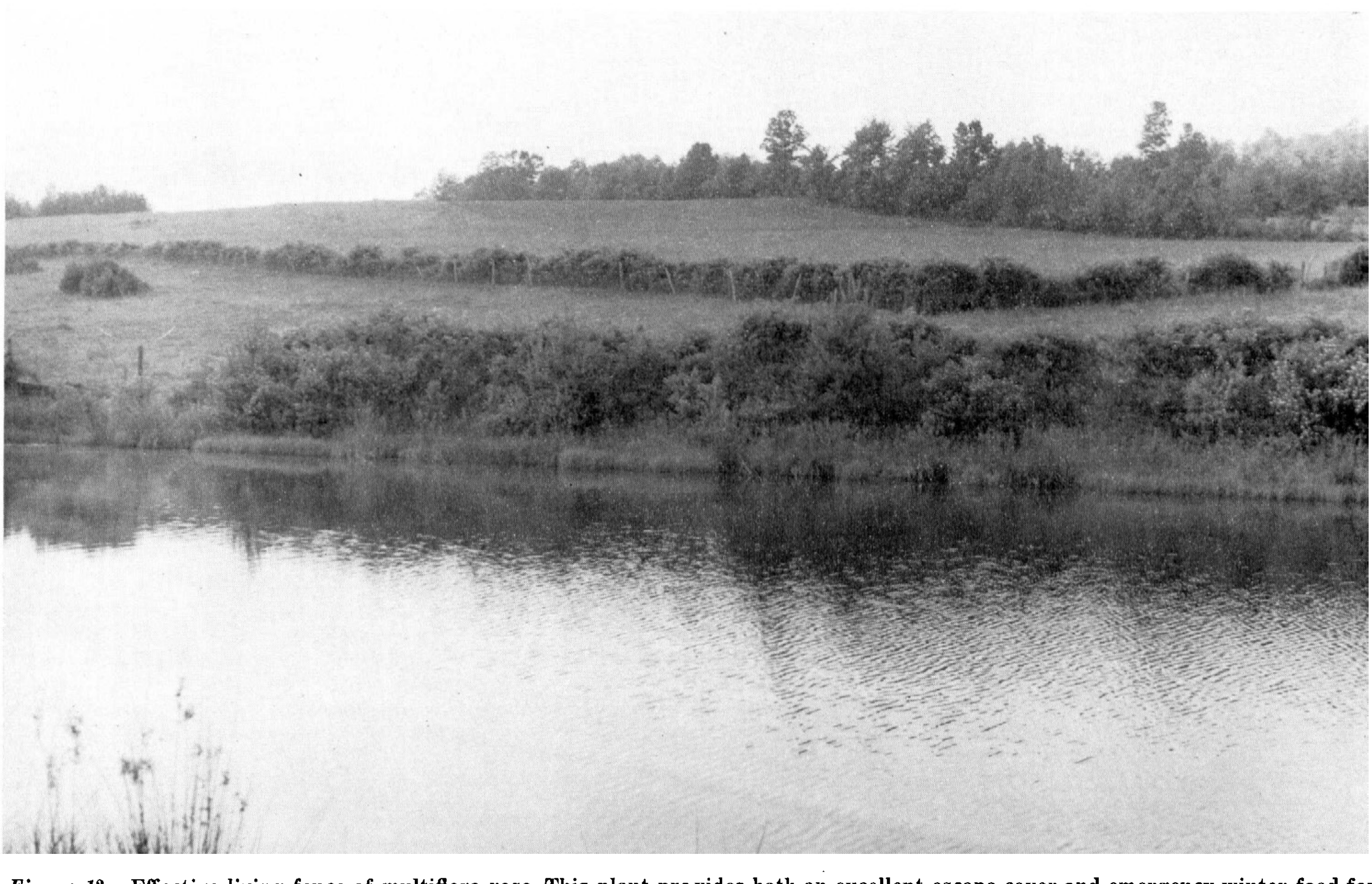

***Figure 12.*—Effective living fence of multiflora rose. This plant provides both an excellent escape cover and emergency winter food for wildlife.**

Figure 13.—**Marshes provide a favorable habitat for waterfowl.**

low dike to impound a shallow body of water. In this wildlife element are marshes (fig. 13), which receive surface runoff; flooded duck fields or dry shallow impoundments, in which domestic grains are grown and then flooded in fall with up to 18 inches of water from adjacent ponds or streams; and shallow ponds developed as watering facilities for wildlife. Fishponds are not included.

Detailed field investigations of the soils and sites are necessary to determine the feasibility for water developments. Soil limitations for reservoir areas and embankments for ponds are shown in table 6 in the section "Engineering Applications."

Soils that are rated as well suited are level or nearly level, more than 6 feet deep to bedrock, and poorly drained or very poorly drained. The subsoil must be slowly or very slowly permeable and deep enough that 2 feet of material can be left in place over limestone, sandstone, and other hard bedrock to prevent seepage through cracks in the rock.

Shallow excavated impoundments.—These are level ditches and potholes constructed to create areas of open water, primarily for waterfowl. Fishponds are not included in this habitat element. Detailed field investigations of the soils and sites are necessary to determine the feasibility for water developments. Soil limitations for reservoir areas and embankments for ponds are shown in table 6 in the section "Engineering Applications."

Soils rated as well suited are nearly level, more than 6 feet deep to bedrock, and poorly drained or very poorly drained. A seasonal water table is within 6 inches of the surface. The subsoil must be slowly or very slowly permeable and deep enough that at least 2 feet of material can be left in place over limestone, sandstone, or other hard bedrock to prevent seepage through cracks in the rock.

Classes of wildlife

Each soil is rated in table 3 according to its suitability for three classes of wildlife. These ratings can be used as an aid in (1) planning the broad use of land for wildlife refuge, nature-study areas, or other developments for wildlife and (2) determining areas that are suitable for acquisition for wildlife developments.

The ratings for openland wildlife are based on the ratings for grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood plants, and coniferous wildlife habitat. The ratings for woodland wildlife are based on the ratings shown for wetland food and cover plants, shallow diked impoundments, and shallow excavated impoundments.

Openland wildlife.—Examples of openland wildlife are pheasants, meadowlarks, field sparrows, doves, cottontail rabbits, red foxes, and woodchucks. These birds and mammals normally make their home in areas of cropland, pasture, meadow, and lawns and in areas overgrown with grasses, shrubs, and herbs.

WOODLAND WILDLIFE.—Among the birds and mammals that prefer woodlands are ruffed grouse, woodcocks, thrushes, vireos, scarlet tanagers, gray and red squirrels, gray foxes, white-tailed deer, and raccoons.

WETLAND WILDLIFE.—Ducks, geese, rails, herons, shore birds, redwing blackbirds, minks, muskrats, and beavers are familiar examples of birds and mammals that normally make their home in ponds, marshes, swamps, and other wet areas.

Engineering Applications [8]

This soil survey for Broome County, New York, although made primarily for farm use, has considerable value for other uses. Some soil properties are of special interest to engineers because they affect the design, construction, and maintenance of roads, airports, pipelines, building foundations, and sewage disposal systems. Among the properties most important to the engineer are permeability to water, shear strength, grain size, compaction characteristics, soil drainage, plasticity, pH, relief, depth to the water table, depth to bedrock, and kind of bedrock.

Information in this survey can be used to—

1. Make studies that will aid in selecting and developing sites for industrial, commercial, residential, and recreational purposes.
2. Make preliminary estimates of soil properties that are significant in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables, and in planning detailed investigations of the selected locations.
4. Locate probable sources of granular and other kinds of material for use in construction.
5. Correlate performance of engineering structures with soils and thus gain information that will be useful in planning the designs and in maintaining the structures.
6. Determine the suitability of the soils for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and from aerial photographs for the purpose of making maps and reports that can be used readily by engineers and others.

With the use of the soil map for identification, the engineering interpretations in this section can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and excavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful in planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Tables 4, 5, and 6 give significant information and interpretations for many purposes.

Additional information about the soils can be found in other sections of the survey, particularly the sections "Descriptions of the Soils" and "Formation, Morphology, and Classification of the Soils."

Terminology

Some of the special terms used by soil scientists may not be familiar to the engineer, and some common terms —for example, clay, silt, and sand—may have special meaning in soil science. These terms and others are defined in the Glossary. Following are definitions of several terms used in this section of the survey.

BEARING CAPACITY.—The unit load that can be placed on a soil without detrimental deformation to the structure that is supported. It is generally expressed in tons or pounds per square foot. In this survey the adjective ratings given for bearing capacity are estimated and should not be used to assign specific values of bearing capacity.

COMPRESSIBILITY.—The capability of a soil to be compressed by a superimposed load.

LIQUID LIMIT.—The moisture content at which the soil material passes from a plastic to a viscous, semiliquid state.

MOISTURE CONTENT.—The ratio of the weight of water contained in the soil to the dry weight of the soil. It is generally expressed as a percentage.

MOISTURE-DENSITY RELATIONS.—If a soil material is compacted at a successively higher moisture content, 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. The moisture-density relationship is important in earthwork, for as a rule, optimum stability is obtained for any given compactive effort if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

PLASTIC LIMIT.—The moisture content at which the soil material passes from a semisolid to a plastic state.

PLASTICITY INDEX.—The numerical difference between the liquid limit and the plastic limit. The plasticity index indicates the range of moisture content within which a soil material is plastic.

SHRINKAGE LIMIT.—The moisture content of soil material at which no further shrinkage occurs.

SHRINK-SWELL POTENTIAL.—An indication of the volume change to be expected of the soil material with changes in moisture content.

Engineering classification systems

In this section, soil texture is described according to the system used by the American Association of State

[8] This section was prepared by JOHN B. FLECKENSTEIN, senior agronomist, EDWARD A. FERNAU, assistant soils engineer, and JOHN DRAGONETTI, assistant engineering geologist, New York State Department of Transportation, Bureau of Soil Mechanics, and by WALTER S. ATKINSON, State conservation engineer, Soil Conservation Service.

Highway Officials (AASHO) (*2*); the Unified system developed by the Corps of Engineers, U.S. Army (*26*); and the classification system used by the U.S. Department of Agriculture.

The AASHO system is based on the field performance of highways in relation to the gradation of particle size, liquid limit, and plasticity index of soil materials. The soils having about the same general load-carrying capacity are placed together in seven basic groups, though the range in load-carrying capacity within each group is wide, and there is an overlapping of load-carrying capacity from one group to another. The groups range from A–1 (gravelly soils of high bearing capacity, the best soils for subgrade) to A–7 (clayey soils having low bearing capacity when wet, the poorest soils for subgrade). Within each group, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest.

The Unified soil classification system is based on identification of soils according to their texture and plasticity and on their performance as engineering construction materials. In this system two letters are used to designate each of 15 possible classes. The letters G, S, C, M, and O stand for gravel, sand, clay, silt, and organic soils, respectively. The letters W, P, L, and H refer to well graded, poorly graded, low liquid limit, and high liquid limit, respectively. In this system, SM and GM are sands and gravels that include fines of silt; ML and CL are silts and clays that have a liquid limit below 50; and MH and CH are silts and clays that have a liquid limit above 50. If the soils are on the borderline between two classifications, a joint classification is used, for example, GM–GC.

In the system used by scientists of the U.S. Department of Agriculture, the texture of the soil horizon depends on the proportional amounts of the different sized mineral particles. The percentage of soil material smaller than 2.0 millimeters (classified as clay, silt, and sand) determines the textural classification.

Soil data and interpretations

Table 4 presents data obtained by laboratory tests on samples of nine soils that are extensive in the county. The soils were sampled at one or more locations. These soils formed in highly variable glacial till and water-deposited materials, which range considerably in grain size, or texture. Although the engineering soil classification given in table 4 may not apply to all parts of the mapped soil unit, it does apply to the soil as it occurs throughout most of its acreage in Broome County. Most of the samples were obtained at a depth of less than 6 feet, and consequently the data may not be adequate for estimating soil properties in deeper cuts. In establishing the engineering soil classification, particles larger than 3 inches were not considered.

Table 5 lists estimated properties of the soils that are significant to engineers. The estimates in table 5 are based on test data shown in table 4, on information taken from the soil survey, and on knowledge gained through experience in using the soils for engineering construction.

Table 6 lists some appraisals of the suitability of the soils as a source of topsoil, granular material, and fill material. Also, it shows characteristics that affect use of the soils in highways and embankment and building foundations, as well as in the installation of conservation engineering practices.

Engineering properties of geologic deposits and bedrock

The following geologic deposits occur in Broome County: glacial till, glacial outwash, lacustrine sediments, alluvium, and muck or peat. In addition, part of the county was mapped as Cut and fill lands and as Made land, sanitary land fill.

Each geologic unit has engineering significance that differs from that of other geologic units. Each unit is described in the following paragraphs, and the broad engineering significance is given.

Thick Glacial Till

Thick glacial till occurs on the uplands, mostly where the topography is sloping or hilly. Ordinarily, the deposits are more than 3½ feet thick over bedrock. Compactness of the material in place varies, depending on whether the till was overridden by the ice or was left in place when the ice melted. Glacial till generally is unstratified, although in places pockets of sand, gravel, silt, or clay have formed within the soil mass as a result of some local sorting (fig. 14).

Figure 14.—**Soil profile showing complex nature of some glacial deposits, along State Highway No. 17 near Willow Point. This spot has several feet of gravelly till over mixed strata of outwash gravel, sand, and silt.**

TABLE 4.—*Engineering*

[Tests performed by New York State Department of Transportation, Bureau of Soil Mechanics, in

Soil name and location	Parent material	SCS report No. S62NY-4	Horizon	Depth	Moisture-density data[1] Maximum dry density	Moisture-density data[1] Optimum moisture	In place dry density	In place moisture content
				In.	*Lb. per cu. ft.*	*Pct.*	*Lb. per cu. ft.*	*Pct.*
Braceville gravelly silt loam: Town of Windsor, 5 mi. S. of Ouaquaga, on E. side of Susquehanna River, in pasture 100 yds. E. of road. (Modal.)	Gravelly and sandy glacial outwash derived mainly from sandstone and shale.	21–1	Ap	0–5	101	18	--------	--------
		21–2	B21	5–13	115	14	--------	--------
		21–5	IIB′x1	18–26	119	12	--------	--------
		21–8	IIIC2	41–48	120	12	--------	--------
Town of Windsor, 2.2 mi. N. of Windsor, 75 yds. W. of State Route 79, in pit in pasture. (Till subsoil variant; included because of small extent.)	Gravelly and sandy glacial outwash over congeliturbate till; both materials derived mainly from gray sandstone and shale.	5–1	Ap	0–7	98	21	--------	--------
		5–2	B2	7–14	107	17	--------	--------
		5–5	IIIB′x1	19–52	126	11	--------	--------
Canaseraga silt loam: Town of Windsor 3.6 mi. N. of Windsor on Seward Rd., in pit in idle field on E. side of road. (Modal.)	Presumably about 30 inches of eolian very fine sand and silt over firm glacial till derived mainly from sandstone and shale. A fragipan has developed in each deposit.	4–1&2	Ap	0–10	96	21	75	15
		4–3	B21	10–18	109	15	91	12
		4–4	B22	18–28	109	13	--------	--------
		4–7	IIB′x3	36–48	122	12	123	11
		4–8	IICx	48–53	131	10	129	9
Town of Vestal, ⅛ mi. W. of Johnson City bridge, in borrow pit behind Howard Johnson's Motel and Restaurant. (Variable subsoil and substratum.)	Presumably about 30 inches of eolian very fine sand and silt over multiple deposits of till or congeliturbate till derived mainly from gray siltstone, sandstone, and shale.	23–1	Ap	0–8	104	17	--------	--------
		23–2	B2	8–19	116	13	--------	--------
		23–3	IIB′x1	19–31	115	13	--------	--------
		23–6	VC2x	52–66	130	9	--------	--------
Town of Kirkwood, 1.4 mi. E. of Binghamton, in pit in abandoned orchard on State hospital farm. (Thin mantle.)	Presumably about 24 inches of eolian silt and very fine sand over glacial till or congeliturbate till derived mainly from gray siltstone, shale, and sandstone.	24–1	Ap	0–8	94	23	--------	--------
		24–2	B21	8–15	107	16	92	19
		24–3	B22	15–22	114	14	--------	--------
		24–5	IIB′x1	24–39	126	9	114	13
		24–6	IIB′x2	39–64	132	7	128	10
		24–7	IICx	64–72	132	9	--------	--------
Chenango gravelly loam: Town of Windsor, 0.5 mi. S. of Ouaquaga, on E. side of Susquehanna River, fresh cut made in gravel pit W. of road. (Modal.)	Glacial outwash derived mainly from sandstone and shale.	20–1	Ap	0–5	107	16	--------	--------
		20–2	B21	5–17	122	11	93	9
		20–4	IIC1	29–42	131	11	--------	--------
		20–6	IVC3	76–88	137	8	110	4
Town of Windsor, 2.9 mi. S. of Windsor, on State Route 79, in field of alfalfa 50 yds. W. of road. (Fine gravelly inclusion.)	Glacial outwash derived mainly from sandstone and shale.	9–1	Ap	0–10	115	14	--------	--------
		9–2	B2	10–20	129	10	--------	--------
		9–3	IIC1	20–68	117	13	--------	--------
		9–4	IIIC2	68	118	14	--------	--------
Culvers channery silt loam: Town of Sanford, 4 mi. SW. of Deposit, near Blueberry Lake, in pit in old meadow. (Modal.)	Glacial till derived mainly from red sandstone and shale.	14–1	Ap	0–7	90	25	86	14
		14–2	B21	7–13	110	16	--------	--------
		14–5	B′x1	20–27	125	11	--------	--------
		14–6	B′x2	27–55	127	10	120	10
		14–7	Cx	55–91	126	11	120	10

See footnotes at end of table.

test data

accordance with standard procedures of the American Association of State Highway Officials (AASHO)]

Lineal shrinkage	Estimated percentage >3 inches discarded	Mechanical analysis [2]: Percentage passing sieve—: 3-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Percentage smaller than [3]—: 0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.	Liquid limit	Plasticity index	Classification: AASHO	Unified [4]
Pct.												*Pct.*			
4	--------	92	75	65	62	56	41	------	------	------	------	------	[5] NP	A-4(2)	GM
4	--------	97	69	53	48	41	29	------	------	------	------	33	11	A-2-6(0)	GC
1	--------	100	99	95	91	82	66	54	29	11	8	19	6	A-4(6)	ML-CL
3	--------	96	91	87	85	81	72	58	30	12	9	21	6	A-4(8)	ML-CL
5	--------	94	59	51	48	46	38	------	------	------	------	46	10	A-5(1)	GM
4	--------	100	76	68	64	58	47	34	18	7	5	------	NP	A-4(2)	GM
3	--------	100	85	70	64	54	41	29	20	12	9	22	7	A-4(1)	GM-GC
3	--------	------	99	98	96	93	83	------	------	------	------	------	NP	A-4(8)	ML
1	--------	------	------	100	99	98	86	54	21	13	10	------	NP	A-4(8)	ML
--------	--------	------	------	99	99	97	83	40	15	9	7	------	NP	A-4(8)	ML
3	--------	98	92	82	74	67	57	44	28	13	11	20	6	A-4(5)	ML-CL
1	20	100	80	60	50	38	32	26	16	7	5	22	7	A-2-4(0)	GM-GC
3	--------	100	93	86	82	77	61	------	------	------	------	33	9	A-4(5)	ML-CL
2	--------	100	99	98	97	95	75	55	26	16	12	20	5	A-4(8)	ML-CL
2	--------	------	100	99	98	96	75	56	26	17	12	21	6	A-4(8)	ML-CL
3	--------	100	76	55	44	32	27	23	16	8	5	23	7	A-2-4(0)	GM-GC
4	--------	94	89	86	85	83	76	------	------	------	------	36	10	A-4(8)	ML-CL
2	--------	100	98	97	97	96	90	72	39	17	11	24	7	A-4(8)	ML-CL
3	--------	100	96	94	93	91	84	67	37	19	14	24	8	A-4(8)	CL
2	--------	100	96	88	82	72	55	47	26	14	10	18	4	A-4(4)	ML-CL
1	--------	100	93	79	67	52	38	30	18	8	6	18	4	A-4(1)	SM-SC
2	--------	100	89	75	65	51	41	34	22	11	8	19	8	A-4(1)	SC
5	--------	85	53	40	34	28	21	------	------	------	------	42	9	A-2-5(0)	GM
4	--------	92	53	37	32	26	19	17	11	7	5	30	9	A-2-4(0)	GC
1	--------	96	60	36	26	7	2	------	------	------	------	------	NP	A-1-a(0)	GW
1	--------	98	67	40	26	8	3	3	2	1	1	------	NP	A-1-a(0)	GW
3	--------	100	99	82	70	57	29	------	------	------	------	------	NP	A-2-4(0)	SM
1	--------	100	99	86	66	39	13	9	7	5	4	------	NP	A-1-b(0)	SM
--------	--------	------	100	95	81	54	2	------	------	------	------	------	NP	A-3(0)	SP
--------	--------	------	100	96	85	58	2	------	------	------	------	------	NP	A-3(0)	SP
6	--------	100	81	71	68	65	54	------	------	------	------	------	NP	A-4(4)	ML
4	1	100	80	64	56	51	41	34	25	13	9	31	9	A-4(1)	GC
3	--------	100	86	70	63	56	43	34	25	15	10	21	6	A-4(2)	GM-GC
4	1	98	71	58	53	47	36	29	24	16	12	22	8	A-4(0)	GC
3	--------	97	79	67	61	54	41	33	27	18	13	22	8	A-4(1)	GC

TABLE 4.—*Engineering*

Soil name and location	Parent material	SCS report No. S62NY-4	Horizon	Depth	Moisture-density data [1]		In place dry density	In place moisture content
					Maximum dry density	Optimum moisture		
				In.	*Lb. per cu. ft.*	*Pct.*	*Lb. per cu. ft.*	*Pct.*
Culvers channery silt loam—Con. Town of Sanford, 0.5 mi. NW. of Deposit on Shaver Hill Road, in pit in old meadow on W. side of road. (Low side of drainage range; intergrades to Mardin channery silt loam.)	Glacial till derived from a mixture of red and gray sandstone and shale.	17-1	Ap	0-6	90	25	--------	18
		17-5	B'x1	18-43	124	12	130	10
		17-6	Cx	43-60	127	10	--------	9
Town of Sanford, 2.5 mi. S. of Deposit, in pit behind barn in old meadow. (Moderately coarse textured fragipan.)	Multiple deposits of glacial till derived mainly from red sandstone and shale.	16-1	Ap	0-5	94	22	--------	11
		16-5	IIB'x1	22-51	127	10	132	9
		16-6	IIICx	51-81	130	9	125	9
Morris channery silt loam: Town of Sanford, 4 mi. SSW. of Deposit, near Blueberry Lake. (Modal.)	Glacial till derived mainly from red sandstone and shale.	13-1	Ap	0-7	87	27	67	26
		13-2	B2	7-13	108	18	74	24
		13-3	A'2	13-15	114	14	--------	--------
		13-4	B'x1	15-25	122	11	110	10
		13-5	B'x2	25-49	127	10	125	9
		13-6	Cx	49-85	129	9	111	12
Town of Sanford, 2.5 mi. S. of Deposit. (Low side of drainage range and with some accumulation of water.)	Multiple deposits of glacial till derived mainly from red sandstone and shale.	15-1	Ap	0-8	99	20	--------	21
		15-2	B2	8-13	111	16	--------	22
		15-4	IIB'x1	18-33	127	11	103	13
		15-5	IIIB'x2	33-47	128	9	128	12
		15-7	VC2	57-71	128	10	--------	3
Town of Sanford, 1.5 mi. NW. of Deposit, on Shaver Hill Road, 100 yds. NE. of farm buildings. (Wet side of drainage range.)	Glacial till (congeliturbate material) derived from a mixture of red and gray sandstone and shale.	18-1	A1	0-3	--------	--------	--------	41
		18-5	IIB'x	22-45	130	9	108	11
		18-6	IICx	48-87	131	8	114	9
Scio silt loam: Town of Windsor, 0.5 mi. S. of Ouaquaga, E. side of Susquehanna River, on stream terrace. (Modal.)	Old alluvial sediments consisting largely of silt and very fine sand.	12-1	Ap	0-7	117	13	84	17
		12-2	B21	7-13	101	20	--------	--------
		12-4	IIC1	16-26	108	17	85	24
		12-5	IIIC2	26-42	119	13	--------	--------
		12-7	VC4	59-70	113	15	--------	--------
Town of Windsor, 4.5 mi. S. of Windsor on State Route 79, 40 ft. W. of road, near buildings. (Underlain by varved silts and clays.)	Silt and very fine sand over varved silt and clay.	10-1	Ap	0-7	86	29	--------	--------
		10-4	IIB3	25-65	101	22	--------	--------
Town of Windsor, 2.9 mi. S. of Windsor on State Route 79, 75 yds. W. of road. (Very fine sandy loam inclusion.)	Dominantly very fine sand over gravelly and sandy glacial outwash derived mainly from sandstone and shale.	8-2	Ap2	2½-7	101	20	86	13
		8-3	B21	7-15	110	15	84	11
		8-4	B22	15-31	111	15	88	9
		8-5	B3	31-44	117	14	101	11
		8-6	IIC1	44-47	137	7	--------	--------
		8-7	IIIC2	47-60	128	11	122	4

See footnotes at end of table.

test data—Continued

Lineal shrinkage	Estimated percentage >3 inches discarded	Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
		Percentage passing sieve—						Percentage smaller than [3]—							
		3-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO	Unified [4]
Pct.												*Pct.*			
7	--------	100	95	88	85	80	68	------	------	------	------	52	16	A-7-5(12)	MH
5	--------	95	75	62	55	49	39	35	28	19	15	27	11	A-6(2)	GC
4	--------	100	82	68	61	53	43	36	28	19	15	25	10	A-4(2)	GC
6	--------	100	71	59	53	49	39	------	------	------	------	51	16	A-7-5(3)	GM
2	--------	100	86	70	60	49	33	26	18	9	7	26	10	A-2-4(0)	SC
3	--------	98	67	56	50	43	33	29	21	14	9	33	20	A-2-6(2)	GC
6	--------	98	87	85	84	80	62	------	------	------	------	46	14	A-7-5(8)	ML or OL
4	--------	94	80	71	68	62	46	37	26	15	10	32	10	A-4-(3)	SC
3	--------	100	95	87	82	75	52	45	33	19	13	26	9	A-4(3)	CL
4	--------	100	91	76	68	59	44	35	27	13	10	21	6	A-4(2)	SM-SC
4	8	98	66	52	47	42	32	27	22	14	10	23	8	A-2-4(0)	GC
4	5	100	78	64	57	51	38	32	26	18	13	22	9	A-4(1)	GC
5	--------	100	89	80	75	69	49	------	------	------	------	39	12	A-6(4)	SM
4	--------	94	70	55	50	45	35	29	20	8	6	32	10	A-4(0)	GM
2	--------	99	92	80	73	64	44	34	20	12	9	18	5	A-4(2)	SM-SC
2	--------	100	90	72	65	56	41	34	22	10	7	19	5	A-4(2)	SM-SC
2	--------	100	89	73	63	54	40	31	20	11	8	19	5	A-4(1)	SM-SC
4	--------	85	85	84	83	74	46	------	------	------	------	35	11	A-6(4)	CL
2	--------	88	59	44	40	32	19	15	10	6	5	18	5	A-2-4(0)	GM-GC
2	--------	96	87	71	62	53	36	29	21	12	9	18	5	A-4(0)	SM-SC
3	--------	100	92	80	72	61	33	22	15	7	4	------	NP	A-2-4(0)	SM
3	--------	------	------	------	100	98	75	57	31	11	7	------	NP	A-4(8)	ML
3	--------	------	------	100	98	94	54	39	26	16	9	------	NP	A-4(4)	ML
1	--------	------	------	------	100	98	53	40	24	13	10	------	NP	A-4(4)	ML
2	--------	------	------	------	100	97	86	68	36	15	11	------	NP	A-4(8)	ML
6	--------	100	94	91	88	83	77	------	------	------	------	53	17	A-7-5(13)	MH
2	--------	------	------	------	------	------	100	92	78	23	12	30	10	A-4(8)	CL
3	--------	------	100	99	99	94	41	------	------	------	------	------	NP	A-4(1)	SM
2	--------	------	100	99	99	97	38	28	19	9	8	------	NP	A-4(1)	SM
1	--------	------	------	------	100	99	22	5	2	1	1	------	NP	A-2-4(0)	SM
2	--------	------	100	99	99	96	53	32	18	10	8	------	NP	A-4(4)	ML
1	--------	100	72	55	48	28	11	8	6	3	3	------	NP	A-1-a(0)	GW-GM
0	--------	100	79	58	48	11	2	2	1	1	1	------	NP	A-1-a(0)	SP

353-032—71——3

TABLE 4.—*Engineering*

Soil name and location	Parent material	SCS report No. S62NY-4	Horizon	Depth	Moisture-density data [1] Maximum dry density	Moisture-density data [1] Optimum moisture	In place dry density	In place moisture content
				In.	*Lb. per cu. ft.*	*Pct.*	*Lb. per cu. ft.*	*Pct.*
Scio silt loam—Continued								
Town of Windsor, 2 mi. N. of Windsor on Ramble Mountain Road, in meadow 30 ft. W. of road. (Channery silt loam inclusion.)	Thin channery mantle of old alluvial fan material over silt and very fine sand; underlain by gravelly and sandy outwash derived mainly from sandstone and shale.	19–1	Ap	0–12	104	17	--------	--------
		19–2	IIB21	12–18	116	13	--------	--------
		19–3	IIB22	18–27	117	12	--------	--------
		19–5	IIC1	32–37	122	11	--------	--------
		19–6	IIIC2	37–41	122	10	--------	--------
		19–9	VIC5	52–70	136	7	--------	--------
Tioga gravelly silt loam, fan:								
Town of Union, 200 ft. N. of junction of Airport and Diminick Hill Roads, E. side of road. (Modal.)	Alluvial fan material derived mainly from sandstone, siltstone, and shale.	1–1	Ap	0–10	105	18	--------	--------
		1–2	IIB21	10–20	117	10	98	14
		1–3	IIIB22	20–68	134	9	--------	6
		1–4	IVC1	68	135	9	--------	--------
Unadilla silt loam:								
Town of Windsor, 1.6 mi. N. of Windsor on State Route 79, 100 yds. E. of road. (Modal.)	Old alluvial terrace deposits of silt and very fine sand; underlain by gravel and sand.	7–1	Ap	0–10	96	23	80	25
		7–2	B21	10–19	102	21	89	20
		7–3	B22	19–32	110	15	91	19
		7–4	C1	32–52	108	15	92	15
		7–6	IIIC3	62	128	9	--------	--------
Town of Windsor, 1.8 mi. N. of Windsor, W. side of State Route 79, near buildings. (Thin solum over gravel.)	Thin deposits of silt and very fine sand over glacial outwash derived mainly from sandstone and shale.	6–1	Ap	0–6	106	16	96	13
		6–2	B21	6–16	114	14	80	13
		6–3	B22	16–23	136	8	--------	--------
		6–4	IIB3	23–36	137	8	--------	3
		6–5	IIC	36–45	137	8	--------	--------
Town of Windsor, 0.5 mi. S. of Ouaquaga, E. of Susquehanna River, on stream terrace. (Lacks a gravelly substratum.)	Old alluvial sediments consisting largely of silt and very fine sand.	11–1	Ap	0–10	108	16	89	20
		11–2	B21	10–19	114	15	88	13
		11–3	IIB22	19–30	113	15	81	13
		11–4	IIIC1	30–37	122	12	94	5
		11–5	IVC2	37–42	121	11	--------	--------
		11–6	VC3	42–51	120	12	--------	--------
		11–7	VIC4	51–58	121	12	--------	--------
		11–8	VIIC5	58–78	115	13	--------	--------
Volusia channery silt loam:								
Town of Windsor, 1.5 mi. NW. of Occanum, at intersection of Dunbar and Thompson Roads. (Modal.)	Glacial till derived mainly from gray siltstone, sandstone, and shale.	22–1	Ap	0–8	84	28	--------	--------
		22–5	B′x	16–36	124	12	134	5
		22–6	Cx	36–74	127	11	128	12
Town of Maine, 1.8 mi. N. of Choconut Center, 75 yds. E. of road. (High side of drainage range.)	Glacial till (congeliturbate till) derived mainly from gray siltstone and shale.	2–1	Ap	0–6	95	22	69	25
		2–4	B′xl	17–35	126	11	129	6
		2–6	Cx	54–64	125	12	128	10
Town of Barker, 2 mi. SSE. of Triangle, 100 ft. W. of town highway. (Coarse end of texture range.)	Glacial till derived mainly from gray siltstone, sandstone, and shale.	3–1	Ap	0–7	102	20	74	19
		3–2	B2	7–11	123	10	--------	--------
		3–3	A′2	11–15	118	13	--------	--------
		3–4	B′xl	15–37	123	12	123	12
		3–5	B′x2	37–65	125	11	--------	--------

[1] Based on AASHO Designation: T 99–57, Method C (*2*).

[2] Mechanical analysis according to AASHO Designation: T 88–57 (*2*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service. (SCS) In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

test data—Continued

Lineal shrinkage	Estimated percentage >3 inches discarded	Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
		Percentage passing sieve—						Percentage smaller than [3]—						AASHO	Unified [4]
		3-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
Pct.												*Pct.*			
4	--------	100	82	75	71	67	53	------	------	------	------	31	9	A-4(4)	ML-CL
1	--------	------	100	99	97	94	63	48	24	15	11	19	4	A-4(6)	ML
1	--------	100	98	97	96	93	60	42	21	13	8	18	3	A-4(5)	ML
1	--------	100	87	79	76	73	50	28	15	9	7	18	4	A-4(3)	SM-SC
1	--------	100	87	78	74	68	35	21	10	7	6	------	NP	A-2-4(0)	SM
1	--------	96	85	64	48	30	16	13	8	4	3	17	3	A-1-b(0)	SM
4	--------	100	87	79	75	71	65	------	------	------	------	35	11	A-6(7)	ML-CL
3	--------	100	98	92	87	77	68	57	38	21	15	26	10	A-4(7)	CL
4	10	100	54	32	22	8	6	4	3	2	2	26	7	A-2-4(0)	GW-GC
6	--------	100	59	32	20	8	6	5	4	3	2	36	14	A-2-6(0)	GW-GC
4	--------	------	------	100	99	99	95	------	------	------	------	38	12	A-6(9)	ML-CL
3	--------	------	------	------	------	100	96	80	51	21	13	31	11	A-6(8)	CL
1	--------	------	------	------	------	100	92	70	37	15	10	------	NP	A-4(8)	ML
--------	--------	------	------	------	100	99	81	56	19	8	7	------	NP	A-4(8)	ML
--------	--------	100	80	66	58	47	27	16	7	4	3	------	NP	A-2-4(0)	SM
4	--------	100	93	82	77	70	51	------	------	------	------	------	NP	A-4(3)	ML
1	--------	100	95	91	88	84	64	49	24	10	8	------	NP	A-4(6)	ML
2	--------	100	71	45	35	20	11	8	5	3	2	18	3	A-1-a(0)	GW-GM
1	--------	100	65	38	30	14	5	4	3	2	1	------	NP	A-1-a(0)	GW-GM
1	--------	100	60	37	25	9	2	2	1	1	1	------	NP	A-1-a(0)	GW
3	--------	------	------	------	100	95	58	43	26	12	8	------	NP	A-4(5)	ML
2	--------	------	------	------	100	96	60	39	26	14	11	------	NP	A-4(5)	ML
2	--------	------	------	------	100	97	63	44	25	12	9	22	5	A-4(6)	ML-CL
2	--------	------	------	------	100	79	30	29	14	9	7	------	NP	A-2-4(0)	SM
1	--------	------	------	------	100	82	35	28	19	11	8	------	NP	A-2-4(0)	SM
2	--------	------	------	------	100	76	25	19	12	9	6	------	NP	A-2-4(0)	SM
1	--------	------	------	------	100	90	33	26	16	9	8	------	NP	A-2-4(0)	SM
2	--------	------	------	------	------	100	66	42	25	17	12	19	4	A-4(6)	ML-CL
8	--------	92	86	82	81	80	76	------	------	------	------	59	16	A-7-5(14)	MH or OH
5	1	98	87	73	62	52	49	40	33	20	14	28	11	A-6(3)	GC
4	2	100	92	77	67	55	49	44	34	21	16	26	9	A-4(3)	SC
7	--------	100	92	83	80	76	73	------	------	------	------	51	20	A-7-5(14)	MH or OH
5	--------	96	86	72	60	50	47	39	30	19	14	29	13	A-6(4)	GC
4	--------	100	82	68	57	48	45	38	30	19	13	29	12	A-6(3)	GC
5	--------	100	96	87	82	76	69	------	------	------	------	41	13	A-7-6(8)	ML or OL
2	--------	100	87	71	63	55	48	38	24	11	8	23	7	A-4(3)	GM-GC
2	--------	100	90	76	68	60	53	42	27	13	9	22	6	A-4(4)	ML-CL
2	--------	100	91	78	70	63	56	46	31	15	10	23	8	A-4(4)	CL
3	25	96	73	62	58	52	46	40	28	14	9	23	9	A-4(3)	GC

[3] Hydrometer analysis was not performed on soils that contained a considerable amount of organic material, because organic matter has a flocculating effect and results are unreliable.

[4] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are GM-GC, GW-GM, SM-SC, CL-OL, ML-CL, ML-OL, and MH-OH.

[5] NP=Nonplastic.

TABLE 5.—*Estimated*

Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface	Classification
				USDA texture
	Ft.	*Ft.*	*In.*	
Alden: AcA (For Chippewa part, see Chippewa series.)	4+	0	0–10 10–20 20–36	Silt loam Silty clay loam Dense silt loam till
Alluvial land: Ad	2+	0–2+	----------	----------
Arnot: ArD	1–2	1–2	0–16 16	Channery silt loam Siltstone bedrock.
Braceville: Br	5+	1½–2	0–18 18–41 41–48	Gravelly silt loam Firm gravelly silt loam fragipan Variable.
Canaseraga: CaB, CaC	5+	1½–3	0–23 23–60	Silt loam or very fine sandy loam Channery silt loam fragipan
Cattaraugus: CcC, CcD, CcE	5+	2½+	0–28 28–52	Channery silt loam Very channery silt loam fragipan
Chenango: ChA, ChC, ChD, ChE (For Howard part, see Howard series.)	5+	3+	0–29 29–88	Gravelly loam or gravelly sandy loam Stratified sand and gravel
Chippewa: CpB	4+	0–1	0–12 12–48	Channery silt loam Dense channery silt loam fragipan and substratum.
Culvers: CuB, CuC, CuD	4+	1–1½	0–20 20–91	Channery silt loam Dense channery and flaggy silt loam fragipan.
Cut and fill lands: Cv, Cw, Cy	----------	----------	----------	----------
Dalton: DaB, DaC	5+	1–2	0–20 20–60	Silt loam and very fine sandy loam Dense channery silt loam fragipan
Howard	5+	3+	0–20 20–40 40–50	Gravelly loam Sticky very gravelly loam Stratified sand and gravel
Lordstown: LdB, LdC, LdD, LoE, LrF, LsE (For Oquaga part of LoE, LrF and LsE, see Oquaga series.)	2–3½	2–3½+	0–28 28	Channery silt loam Sandstone or shale bedrock.
Made land, sanitary land fill: Mf	----------	----------	----------	----------
Mardin: MhB, MhC, MhD, MhE, MmB, MnC, MnD, MrF. (For Chenango part of MnC and MnD, see Chenango series. For Cattaraugus part of MrF, see Cattaraugus series.)	5+	1½–2	0–18 18–70	Channery silt loam Dense channery silt loam to very channery silt loam fragipan.
Middlebury: Ms	5+	1–1½	0–40 40	Silt loam and fine sandy loam Alluvium.

properties of the soils

Classification—Continued		Percentage passing sieve—			Permeability	Reaction	Available moisture capacity	Remarks
Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
					In. per hr.	*pH*	*In. per in. of soil*	
ML or CL	A-4	85–95	75–85	60–70	0.20–2.0	5.5–6.0	0.17–0.25	Highly variable content of stones larger than 3 inches in size in substratum.
ML or CL	A-4 or A-6	85–95	75–85	60–70	0.20–0.63	5.0–6.8	0.17–0.20	
ML or CL	A-4	65–80	60–70	50–60	<0.20	6.5–7.0	----------	
----------	----------	----------	----------	----------	----------	----------	----------	Subject to flooding; all other properties variable.
ML	A-4	>0–80	65–80	55–70	0.63–2.0	4.5–5.5	0.15–0.18	Highly variable content of stones larger than 3 inches in size.
GM–GC	A-4	50–70	45–65	35–50	0.63–2.0	5.0–6.5	0.18–0.20	
ML or CL	A-4	70–95	65–90	50–70	<0.63	5.0–6.5	0.15–0.17	
ML or CL	A-4	90–100	75–100	60–90	0.63–2.0	4.5–5.5	0.15–0.20	Highly variable content of stones larger than 3 inches in size in lower subsoil and in substratum.
ML or CL; GM or GC	A-2 or A-4	60–90	45–80	30–60	<0.63	5.5–6.5	----------	
ML or CL	A-4	60–80	50–75	50–65	0.63–2.0	5.0–5.5	0.15–0.20	Highly variable content of stones larger than 3 inches in size.
GM–GC	A-2 or A-4	60–70	40–50	30–40	<0.63	5.0–5.5	----------	
GM or GC	A-2	35–45	25–35	15–25	0.63–6.3	5.0–6.0	0.13–0.17	
GW	A-1	30–40	20–30	0–10	>6.3	5.0–7.6	0.07–0.10	
ML or CL	A-4	75–90	70–80	60–70	0.2–2.0	5.0–6.0	0.20–0.23	Highly variable content of stones larger than 3 inches in size.
ML or CL	A-4	70–85	70–85	50–60	<0.2	5.6–6.4	----------	
ML or GC	A-4	60–75	55–70	40–55	0.63–2.0	5.0–5.5	0.17–0.20	Highly variable content of stones larger than 3 inches in size.
GM or GC	A-2 or A-4	50–75	45–65	30–45	<0.2	5.2–7.0	----------	
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ML or CL	A-4	90–100	90–100	70–90	0.63–2.0	5.0–6.0	0.15–0.20	Highly variable content of stones larger than 3 inches in size.
ML or CL; GM or GC	A-2 or A-4	60–90	45–80	30–60	<0.20	5.0–6.5	----------	
GM or GC	A-1 or A-2	40–60	30–45	12–30	2.0–6.3	5.0–6.0	0.17–0.20	
GM or GC; SM or SC	A-1	30–50	20–40	3–25	0.63–6.3	5.5–6.5	0.12–0.15	
GM or GC; GP	A-1	30–50	20–40	5–20	>6.3	7.0–7.6	----------	
ML	A-4	70–85	65–80	55–70	0.63–2.0	5.0–5.5	0.17–0.20	Highly variable content of stones larger than 3 inches in size; water table occasionally perched on bedrock. Included with the LsE soils in mapping were very stony areas of Cattaraugus, Culvers, and Mardin soils.
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ML	A-4	75–85	60–70	50–60	0.63–2.0	5.0–5.5	0.17–0.20	Highly variable content of stones larger than 3 inches in size. The MmB soil is underlain by sandstone or shale bedrock at a depth of 20 to 40 inches.
ML; GM or GC	A-4 or A-6	50–70	45–65	45–55	<0.20	5.0–7.0	----------	
ML	A-4	100	95–100	65–85	0.63–6.3	5.5–6.5	0.18–0.23	Subject to flooding. The material below a depth of 40 inches is variable.

TABLE 5.—*Estimated*

Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface	Classification
				USDA texture
	Ft.	*Ft.*	*In.*	
Morris: MtB, MtC, MuD (For Tuller part of MuD, see Tuller series.)	5+	½–1	0–15	Channery silt loam and channery loam
			15–85	Dense channery silt loam fragipan
Oquaga: OuC, OuD	2–3½	2–3½+	0–32	Channery silt loam
			32	Sandstone, siltstone, or shale bedrock.
Peat and Muck: Pm	5+	0		
Scio: Sc	5+	1½–2	0–70	Silt loam and very fine sandy loam
			70	Gravelly and clayey or clayey strata.
Tioga: Ta	5+	>2	0–35	Silt loam and very fine sandy loam
			35–70	Gravelly and sandy or sandy strata.
Tg	5+	>2	0–19	Gravelly loam
			19–64	Stratified sand and gravel
Tuller: TuD	1–1½	½–1	0–17	Channery silt loam
			17	Siltstone or sandstone bedrock.
Unadilla: UnB, UnC	5+	2+	0–19	Silt loam
			19–52	Very fine sandy loam
			52–92	Stratified very fine sand and gravel
Volusia: VoA, VoB, VoC, VoC3, VoD	4+	½–1	0–17	Channery silt loam
			17–64	Dense channery silt loam fragipan
Wallington: Wa	5+	½–1	0–18	Silt loam to very fine sandy loam
			18–38	Dense silt loam to very fine sandy loam fragipan.
			38–45	Variable.
Wayland: Wd	5+	0–½	0–40	Silt loam
			40–45	Stratified silt loam, fine sandy loam, and sandy loam.

properties of the soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Reaction	Available moisture capacity	Remarks
Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
					In. per hr.	*pH*	*In. per in. of soil*	
SM or SC; GM or GC	A-2 or A-4	45-75	40-70	20-50	0. 63-2. 0	4. 5-5. 5	0. 14-0. 16	Highly variable content of stones more than 3 inches in size.
SM or SC; GM or GC	A-2 or A-4	40-85	40-75	15-45	<0. 20	5. 0-7. 0	------------	
GM, ML	A-4	70-80	65-75	45-70	0. 63-2. 0	4. 5-5. 5	0. 15-0. 20	Water table occasionally perched on bedrock; highly variable content of stones larger than 3 inches in size.
Pt	------------	--------	--------	--------	------------	----------	------------	At least 12 inches of peat and muck over variable substrata.
ML or SM	A-4	80-100	90-100	40-75	0. 63-2. 0	5. 2-5. 8	0. 16-0. 20	The material below a depth of 40 inches may be variable.
ML	A-4	100	95-100	65-85	0. 63-6. 3	5. 5-6. 5	0. 16-0. 20	Subject to flooding. The material below a depth of 35 inches is variable.
ML or CL	A-4 or A-6	75-95	70-90	60-70	0. 63-6. 3	5. 5-6. 0	0. 12-0. 15	
GW; GM or GC	A-1 or A-2	25-40	15-30	0-15	>6. 3	5. 0-5. 5	------------	
ML or CL	A-4	75-85	65-80	55-65	0. 63-2. 0	5. 0-5. 8	0. 16-0. 20	Highly variable content of stones larger than 3 inches in size.
ML or CL	A-4 or A-6	95-100	95-100	50-95	0. 63-2. 0	5. 0-6. 0	0. 16-0. 19	The material below a depth of 40 inches may be variable.
ML or SM	A-2 or A-4	95-100	95-100	25-85	0. 63-6. 3	5. 0-6. 0	0. 14-0. 17	
SM or GM	A-1 or A-2							
MH; ML or CL	A-7 or A-6	70-90	60-85	50-75	0. 63-2. 0	5. 0-5. 5	0. 17-0. 21	Highly variable content of stones larger than 3 inches in size.
GM or GC	A-4 or A-6	65-75	55-70	40-50	<0. 20	5. 0-6. 5	------------	
ML or CL	A-4 or A-6	95-100	95-100	50-95	0. 63-2. 0	5. 0-5. 5	0. 16-0. 19	
ML or CL	A-4 or A-6	95-100	95-100	50-95	<0. 63	5. 0-6. 0	------------	
ML	A-4	100	95-100	65-85	0. 20-2. 0	6. 5-7. 4	0. 16-0. 19	Subject to flooding. The material below a depth of 40 inches is variable.

TABLE 6.—*Interpretation*

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundation
Alden and Chippewa: [2] AcA.	Fair; wet in natural state.	Unsuitable	Fair to poor; may be too wet; surface soil high in organic-matter content.	Organic surface layer; prolonged high water table; subgrade and cut slopes unstable.	Generally adequate strength for moderately high embankments if topmost 20 inches is removed.
Alluvial land: Ad	Variable; may be wet in natural state; very gravelly and cobbly in places.	Generally unsuitable; may be granular in places.	Variable; may be wet in natural state.	Flooding; high water table.	Variable strength; may be underlain by compressible soils.
Arnot: ArD	Unsuitable	Unsuitable	Fair; low yield of soil material per acre; less than 20 inches thick over bedrock; high stone content.	Soil less than 20 inches thick over bedrock; some flat areas.	Generally adequate strength for high embankments; steep slopes in places.
Braceville: Br	Poor; gravelly surface.	Generally good; may have excessive fines or shaly material.	Fair to good; may be erodible.	Seasonal high water table; cuts wet in natural state.	Generally adequate strength for low embankments.
Canaseraga: CaB, CaC	Fair to good in topmost 24 inches.	Unsuitable	Good; silty mantle highly erodible; some stone in substratum.	Seasonal high water table; nonuniform subgrade; subject to differential frost heave; cut slopes unstable.	Strength of material below depth of 24 inches adequate for high embankments.
Cattaraugus: CcC, CcD, CcE.	Poor; too stony	Unsuitable	Good; contains some stones.	Slow permeability at depth of 24 to 30 inches; cut slopes subject to seepage and sloughing.	Generally adequate strength for high embankments. CcD, CcE: steep slopes.

See footnotes at end of table.

of engineering properties

Soil features affecting—Continued						
Foundations for low buildings [1]	Farm ponds		Agricultural drainage	Irrigation	Diversions	Waterways
	Reservoir	Embankment				
Prolonged high water table; slow permeability; topmost 12 to 20 inches compressible.	Prolonged high water table; slow permeability.	Fair to good stability below a depth of 1½ to 2 feet; slow permeability if compacted; surface soil high in organic-matter content.	High water table; cut slopes may be subject to piping and sloughing; natural outlets may be inadequate.	Not applicable	Not applicable	Prolonged seepage; outlets limited.
Flooding; variable strength.	Variable permeability; flooding.	Variable material; generally wet in natural state.	Flooding; cut slopes unstable; natural outlets may be inadequate.	Not applicable	Not applicable	Not applicable.
High bearing capacity; bedrock in excavations; steep slopes in places.	Less than 20 inches thick over bedrock.	High content of stones; less than 20 inches thick over bedrock; low yield of soil material.	Soil less than 20 inches thick over bedrock; steep slopes in places.	Low available moisture capacity; less than 20 inches thick over bedrock; steep slopes in places.	Less than 20 inches thick over bedrock.	Less than 20 inches thick over bedrock.
Seasonal high water table; variable compressibility.	Excessive seepage in dry periods; stratified sand and gravel.	Good stability if mixed and compacted.	Cut slopes subject to seepage and sloughing; fragipan layer impedes internal water movement.	Fair water-intake rate; high to moderate available moisture capacity; seasonal high water table at depth of 1½ to 2 feet.	Seasonal high water table; moderately slow permeability in fragipan at depth of 1½ to 2 feet.	Prolonged seepage.
High bearing capacity and low compressibility below depth of 24 inches; seasonal high water table.	Moderately slow to slow permeability at depth of 1½ to 2½ feet. CaC: moderate slopes; seasonal high water table at depth of 1½ to 3 feet.	Good stability if mixed and compacted.	Local seeps; cut slopes subject to seepage and sloughing.	Moderate water-intake rate; moderate to high available moisture capacity; fragipan at depth of 1½ to 2½ feet.	Moderately slow to slow permeability at depth of 1½ to 2½ feet.	Silty mantle; extreme erodibility.
Generally high bearing capacity and very low compressibility. CcD, CcE: steep slopes.	Moderately slow or slow permeability. CcD, CcE: steep slopes.	Good stability; good shear strength; slow permeability; some large stones.	Generally not needed; moderate or slow permeability below depth of 2 to 2½ feet. CcD, CcE: steep slopes.	Good water-intake rate; good available moisture capacity. CcD, CcE: steep slopes.	Moderate or slow permeability in fragipan at depth of 2 to 2½ feet. CcD, CcE: steep slopes.	CcD, CcE: erodible on slopes.

353-032—71——4

TABLE 6.—*Interpretation of*

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundation
Chenango and Howard[2]: ChA, ChC, ChD, ChE.	Poor; gravelly surface.	Generally good on outwash terraces; generally dirty and unsound on kame terraces; poor on alluvial fans.	Good; highly erodible if dominantly sandy.	Water table below depth of 36 inches in places; cut slopes subject to seepage and sloughing; highly erodible if sandy.	Generally adequate strength for moderately high embankments. ChD, ChE: steep slopes.
Chippewa: CpB	Poor; contains rock fragments.	Unsuitable	Generally good in substratum; highly organic surface layer; may be wet; some large stones.	Highly organic surface layer; fragipan at depth of 10 to 18 inches; cut slopes unstable.	Generally adequate strength for high embankments.
Culvers: CuB, CuC, CuD.	Poor; contains rock fragments.	Unsuitable	Good; some large stones.	Generally good; cuts encounter fragipan; subject to seepage and sloughing above pan at depth of 18 to 24 inches; deep cuts may encounter bedrock.	Generally adequate strength for high embankments. CuD: steep slopes.
Cut and fill lands: Cv, Cw, Cy. Requires onsite investigations.					
Dalton: DaB, DaC	Fair to good in topmost 24 inches.	Uusuitable	Good in substratum; silty mantle highly erodible; few large stones in some places.	Nonuniform subgrade; subject to differential frost heave; cut slopes unstable; seasonal high water table.	Variable bearing capacity.
Lordstown: LdB, LdC, LdD.	Poor; contains rock fragments.	Unsuitable	Fair to good; low yield of soil material per acre; may encounter large stones.	20 to 40 inches thick over bedrock; subject to seepage and sloughing.	Adequate strength for high embankments. LdD: steep slopes.

See footnotes at end of table.

engineering properties—Continued

Soil features affecting—Continued						
Foundations for low buildings [1]	Farm ponds		Agricultural drainage	Irrigation	Diversions	Waterways
	Reservoir	Embankment				
Variable bearing capacity, depending on character of underlying material; low compressibility; large settlements possible under vibratory loads. ChD, ChE: steep slopes.	Rapid permeability below depth of 30 to 40 inches. ChC, ChD, ChE: steep slopes.	Good stability for outside shell; permeable.	Generally not needed; may contain pockets of fine sand; subject to piping when saturated. ChD, ChE: steep slopes.	High water-intake rate; moderate available moisture capacity. ChD, ChE: steep slopes.	Rapid permeability below depth of 30 to 40 inches. ChD, ChE: steep slopes.	Rapid permeability below depth of 30 to 40 inches; sandy pockets erodible. ChD, ChE: steep slopes.
Prolonged high water table; slow permeability below depth of 10 to 18 inches.	Slow permeability below depth of 10 to 18 inches; seasonal high water table.	Highly organic surface layer, otherwise good stability; slow permeability if compacted; some large stones in places.	Slow permeability at depth of 10 to 18 inches.	Moderate water-intake rate; moderate available moisture capacity; limited root zone.	Slow permeability at depth of 10 to 18 inches; seepage.	Seepage.
Generally high bearing capacity and low compressibility. CuC, CuD: moderate and steep slopes.	Slow permeability in fragipan at depth of 18 to 24 inches. CuC, CuD: steep slopes.	Good stability if mixed and compacted; slow permeability; some large stones.	Slow permeability in fragipan at depth of 18 to 24 inches; subject to seepage and sloughing above pan. CuC, CuD: steep slopes.	Moderate water-intake rate; moderate available moisture capacity; root zone limited to depth of 18 to 24 inches. CuC, CuD: steep slopes.	Slow permeability in fragipan at depth of 18 to 24 inches; prolonged seepage above pan. CuD: steep slopes.	Prolonged seepage. CuD: erodible.
Variable bearing capacity; seasonal high water table.	Slow permeability at depth of about 20 inches. DaC: moderate slopes.	Good stability below depth of 24 inches if compacted; slow permeability; some large stones in places.	Slow permeability in fragipan at depth of about 20 inches; subject to seepage and sloughing above the pan. DaC: moderate slopes.	Moderate water-intake rate; moderate available moisture capacity; limited root zone. DaC: moderate slopes.	Slow permeability in fragipan at depth of about 20 inches; prolonged seepage above pan; highly erodible.	High erodibility; prolonged seepage.
High bearing capacity; bedrock in most excavations. LdC:, LdD: moderate to steep slopes.	Bedrock at depth of 20 to 40 inches. LdC, LdD: some moderate and steep slopes.	Good stability above bedrock; some large stones.	Generally not needed; 20 to 40 inches thick over bedrock. LdC, LdD: moderate and steep slopes.	Moderate water-intake rate; moderate to high available moisture capacity. LdC, LdD: moderate and steep slopes.	Bedrock at depth of 20 to 40 inches. LdD: steep slopes.	Bedrock at depth of 20 to 40 inches. LdD: steep slopes.

TABLE 6.—*Interpretation of*

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundation
Lordstown and Oquaga[2]: LoE	Poor; contains rock fragments.	Unsuitable	Fair to good; low yield of soil material per acre; may encounter large stones.	20 to 40 inches thick over bedrock; steep slopes; adverse topography; subject to seepage and sloughing;	Steep slopes
LrF	Poor; too stony	Unsuitable	Poor; generally extremely stony or rocky; low yield of soil material per acre.	Very steep slopes; 20 to 40 inches thick over bedrock; many outcrops; adverse topography; subject to seepage and sloughing.	Very steep slopes
LsE	Poor; extremely stony.	Unsuitable	Poor; extremely stony or rocky; low yield of soil material per acre.	Bedrock generally at depth of 20 to 40 inches; subject to seepage and sloughing; steep slopes in places.	Adequate strength for high embankments; some steep slopes.
Made land, sanitary land fill: Mf. Requires onsite investigations.					
Mardin: MhB, MhC, MhD, MhE.	Poor; contains rock fragments.	Unsuitable	Good; some large stones.	Cuts encounter fragipan at depth of 18 to 22 inches; subject to seepage and sloughing above pan; deep cuts may encounter bedrock.	Generally adequate strength for high embankments. MhD, MhE: steep slopes.
MmB	Poor; contains rock fragments.	Unsuitable	Good; low yield of soil material per acre; some large stones.	Cuts encounter bedrock at depth of 20 to 40 inches; subject to seepage and sloughing.	Generally adequate strength for high embankments.
Mardin-Chenango:[2] MnC, MnD.	Poor; contains rock fragments.	Mardin: unsuitable. Chenango: fair to poor; usually dirty and unsound.	Generally good	Generally nonuniform in cuts; subgrade subject to differential frost heave.	Mardin: generally adequate strength for high embankments. Chenango: moderately high strength. MnD: steep slopes.

See footnotes at end of table.

engineering properties—Continued

Soil features affecting—Continued						
Foundations for low buildings [1]	Farm ponds		Agricultural drainage	Irrigation	Diversions	Waterways
	Reservoir	Embankment				
Steep slopes; bedrock will be encountered in excavations.	Bedrock at depth of 20 to 40 inches; steep slopes.	Good stability above bedrock; some large stones.	Not applicable	Not applicable	Not applicable	Not applicable.
Very steep slopes	Very steep slopes.	Generally extremely stony or rocky.	Not applicable	Not applicable	Not applicable	Not applicable.
High bearing capacity; some steep slopes; boulders and bedrock in most excavations.	Pervious bedrock at depth of 20 to 40 inches; some moderate and steep slopes.	Extremely stony or rocky.	Not applicable	Not applicable	Not applicable	Bedrock generally at depth of 20 to 40 inches; some steep slopes.
Generally high bearing capacity and very low compressibility; seasonal high water table at depth of 1½ to 2 feet. MhC, MhD, MhE: moderate and steep slopes.	Seasonal high water table at depth of 1½ to 2 feet; slow permeability below this depth. MhC, MhD, MhE: too steep.	Good stability; slow permeability if compacted.	Slow permeability in fragipan at depth of 18 to 22 inches; seasonal high water table at depth of 1½ to 2 feet. MhC, MhD, MhE: moderate and steep slopes.	Moderate water-intake rate; moderate available moisture capacity; root zone 18 to 22 inches thick. MhC, MhD, MhE: moderate and steep slopes.	Slow permeability in fragipan at depth of 18 to 22 inches; prolonged seepage. MhC, MhE: steep slopes.	Slow permeability in fragipan at depth of 18 to 22 inches; prolonged seepage. MhD, MhE: steep slopes.
Generally high bearing capacity and low compressibility; seasonal high water table at depth of 1½ to 2 feet; most excavations will encounter bedrock.	Pervious bedrock at depth of 20 to 40 inches; seasonal high water table at depth of 1½ to 2 feet.	Good stability over bedrock; slow permeability if compacted; low yield of soil material per acre; some large stones.	Bedrock at depth of 20 to 40 inches; slow permeability in fragipan at depth of 18 to 22 inches; seasonal high water table at depth of 1½ to 2 feet.	Moderate water-intake rate; moderate available moisture capacity; root zone 18 to 22 inches thick.	Slow permeability in fragipan at depth of 18 to 22 inches; prolonged seepage; bedrock at depth of 20 to 40 inches.	Slow permeability in fragipan at depth of 18 to 22 inches; prolonged seepage; bedrock at depth of 20 to 40 inches.
Low compressibility; some moderate and steep slopes. Mardin: high bearing capacity. Chenango: moderately high bearing capacity.	Variable permeability; some slopes too steep.	Generally good stability if mixed and compacted; permeability and erodibility may vary.	Not generally needed; cut slopes may be unstable; fine sands subject to piping; some moderate and steep slopes.	Variable water-intake rate, available moisture capacity, and thickness of root zone; some moderate and steep slopes.	Undulating topography; rapid permeability in places. MnD: steep slopes.	High erodibility in spots; undulating topography.

TABLE 6.—*Interpretation of*

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundation
Mardin and Cattaraugus:[2] MrF.	Poor; contains rock fragments.	Unsuitable	Generally good; many large stones in some places.	Cuts encounter slowly permeable fragipan below depth of 18 to 30 inches; subject to seepage and sloughing above pan; deep cuts may encounter bedrock; very steep slopes.	Very steep slopes
Middlebury: Ms	Good; may be wet in substratum.	Unsuitable	Fair to poor; may be too wet and poorly graded.	Flooding; high water table.	Generally adequate strength for low embankments; variable compressibility.
Morris: MtB, MtC	Poor; contains rock fragments.	Unsuitable	Good when dry; seasonally wet; some large stones.	Slow permeability in fragipan at depth of 12 to 18 inches; subgrades may be wet; subject to seepage and sloughing above pan; deep cuts may encounter bedrock.	Generally adequate strength for high embankments.
Morris and Tuller:[2] MuD.	Poor; contains stones.	Unsuitable	Fair to poor; many large stones. Tuller: low yield of soil material per acre.	Some flat areas; subject to seepage and sloughing. Tuller: bedrock at depth of 10 to 20 inches. Morris: fragipan at depth of 12 to 18 inches.	Adequate strength for high embankments; some moderately steep slopes.
Oquaga: OuC, OuD	Poor; contains rock fragments.	Unsuitable	Good; low yield of soil material per acre; some large stones.	Bedrock at depth of 20 to 40 inches; subject to seepage and sloughing.	Adequate strength for high embankments. OuD: steep slopes.
Peat and Muck: Pm	Possible to use as an amendment to mineral soils.	Unsuitable	Unsuitable	Prolonged high water table; wet, compressible material.	Not applicable

See footnotes at end of table.

engineering properties—Continued

Soil features affecting—Continued						
Foundations for low buildings [1]	Farm ponds		Agricultural drainage	Irrigation	Diversions	Waterways
	Reservoir	Embankment				
Very steep slopes	Not applicable	Generally good features; may contain many large stones.	Not applicable	Not applicable	Not applicable	Not applicable.
Subject to flooding; high water table; variable compressibility.	High water table; variable permeability.	Poor stability; subject to piping.	Annual flooding; cut slopes unstable; outlets inadequate.	Not applicable	Not applicable	Not applicable.
Generally high bearing capacity; low compressibility; seasonal high water table. MtC: moderately sloping.	Seasonal high water table at depth of ½ to 1 foot; slow permeability in fragipan at depth of 12 to 18 inches. MtC: moderately sloping.	Good stability; slow permeability; some large stones.	Slow permeability in fragipan at depth of 12 to 18 inches; prolonged seepage above pan. MtC: moderately sloping.	Moderate water-intake rate; moderate to low available moisture capacity; root zone 12 to 18 inches thick. MtC: moderate slopes.	Slow permeability in fragipan at depth of 12 to 18 inches; prolonged seepage.	Prolonged seepage.
High bearing capacity; seasonal high water table at depth of ½ to 1 foot; some moderate and steep slopes. Tuller: bedrock at depth of 10 to 20 inches.	Very stony; some moderate and steep slopes. Tuller: pervious bedrock at depth of 10 to 20 inches. Morris: slow permeability in fragipan at depth of 12 to 18 inches.	Fair to poor material; many large stones. Tuller: low yield of soil material per acre.	Not applicable	Not applicable	Very stony; prolonged seepage; some steep slopes. Tuller: bedrock at depth of 10 to 20 inches.	Very stony; prolonged seepage; some steep slopes. Tuller: bedrock at depth of 10 to 20 inches.
High bearing capacity; bedrock encountered in most excavations; some moderate and steep slopes.	Pervious bedrock at depth of 20 to 40 inches; some moderate and steep slopes.	Good to fair material; low yield of soil material per acre; some large stones.	Not applicable	Moderate water-intake rate; moderate to high available moisture capacity; root zone 20 to 40 inches thick; moderate or steep slopes.	Bedrock at depth of 20 to 40 inches. OuD: steep slopes.	Bedrock at depth of 20 to 40 inches. OuD: steep slopes.
Not applicable	Prolonged high water table; wet, compressible material.	Not applicable	Very high shrinkage when drained; thickness ranges from 18 inches to 10 feet or more; strongly acid peat in some places.	High water-intake rate; variable available moisture capacity.	Not applicable	Not applicable.

TABLE 6.—*Interpretation of*

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundation
Scio: Sc	Good	Unsuitable	Variable; poorly graded in many places.	Seasonal high water table at depth of 18 to 24 inches; flooding in spots; cut slopes unstable; subject to differential frost heave.	Generally adequate strength for low embankments.
Tioga: Ta	Good	Possibly in deep substratum.	Variable; poorly graded in many places; sandy layers highly erodible.	Flooding; may encounter water table below depth of 24 inches; cut slopes unstable; subject to differential frost heave.	Variable strength
Tg	Poor; contains rock fragments.	Fair to poor; dirty and unsound in many places.	Generally good; sandy layers highly erodible.	Occasional flooding; seasonal high water table; cut slopes subject to seepage and sloughing.	Variable strength
Tuller: TuD	Poor; contains rock fragments.	Unsuitable	Fair to poor; very low yield of soil material per acre; wet in places.	Bedrock at depth of 10 to 20 inches; some flat areas; subject to seepage.	Adequate strength for high embankments; some moderately steep slopes.
Unadilla: UnB, UnC	Good	Possibly in deep substratum.	Variable; poorly graded in many places.	Cut slopes very unstable; may be underlain by wet, soft soils; subgrades subject to differential frost heave.	Generally adequate strength for low embankments.

See footnotes at end of table.

engineering properties—Continued

Soil features affecting—Continued						
Foundations for low buildings [1]	Farm ponds		Agricultural drainage	Irrigation	Diversions	Waterways
	Reservoir	Embankment				
Variable strength, depending on underlying material; seasonal high water table at depth of 18 to 24 inches; flooding in spots.	Seasonal high water table at depth of 18 to 24 inches; moderate permeability.	Poorly graded material in many places; subject to piping; extremely erodible.	Flooding in places; cut slopes unstable; very fine sands; subject to piping.	Moderate water-intake rate; high available moisture capacity; root zone 24 to 30 inches thick.	Not applicable	Not applicable.
Flooding; variable strength.	Flooding; variable permeability.	Poorly graded material in many places; subject to piping; extremely erodible.	Not generally needed; cut slopes very unstable; subject to piping; subject to flooding; outlets may be inadequate.	Moderate to high water-intake rate; moderate to moderately rapid permeability; high available moisture capacity; root zone at least 40 inches thick.	Not applicable	Not applicable.
Occasional flooding; variable bearing strength.	Not applicable	Extremely variable material.	Not generally needed.	Occasional flooding; moderate to high water-intake rate; variable available moisture capacity; variable root zone thickness.	Occasional flooding; rapid permeability in lower part.	Occasional flooding.
High bearing capacity; bedrock in excavations; seasonal high water table at depth of 1 to 1½ feet; some moderate and steep slopes.	Bedrock at depth of 10 to 20 inches.	Very low yield of soil material per acre; wet in places.	Not applicable	Not applicable	Not applicable	Not applicable.
Variable strength; occasional flooding in some areas. UnC: some moderate slopes.	Excess seepage	Variable; poorly graded in many places; highly erodible.	Not generally needed; cut slopes very unstable; sandy layers; subject to piping; some areas flooded on rare occasions. UnC: some moderate slopes.	Moderate to high water-intake rate; high available moisture capacity; root zone at least 40 inches thick. UnC: some moderate slopes.	Variable permeability; generally moderately rapid or rapid in lower subsoil and substratum.	Extreme erodibility.

TABLE 6.—*Interpretation of*

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundation
Volusia: VoA, VoB, VoC, VoC3, VoD.	Poor; contains stone fragments.	Unsuitable	Good when dry; seasonally wet; some large stones.	Subgrades may be wet; cut slopes subject to seepage and sloughing above pan; deep cuts may encounter bedrock.	Generally adequate strength for high embankments. VoD: steep slopes.
Wallington: Wa	Good; seasonally wet	Unsuitable	Fair to poor; poorly graded in many places; seasonally wet; extremely erodible.	Fragipan at depth of 18 inches; subgrades wet; cut slopes very unstable; adverse silty soils.	Generally adequate strength for low embankments; moderately high compressibility.
Wayland: Wd	Good; seasonally wet.	Unsuitable	Fair to poor; poorly graded in many places; seasonally wet; highly organic surface layer; silty material highly erodible.	Flooding; prolonged high water table.	Variable

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity of the soils.

The Alden, Cattaraugus, Chippewa, Culvers, Mardin, Morris, and Volusia soils formed in thick glacial till. Canaseraga and Dalton soils formed in a mantle of silty material 18 to 36 inches thick over thick glacial till.

The glacial till provides stable subgrades, good embankment foundations, and, with proper treatment, stable cut slopes for highways. It also furnishes good foundation support for buildings. If properly compacted, material excavated from till deposits, either from highway cuts or from outside borrow areas, can be used to form stable embankments. Some till deposits, however, contain many boulders and coarse fragments.

Thin Glacial Till

This material is similar to thick glacial till, but in most places the depth to bedrock is less than 3½ feet. Consequently, even in light grading operations, bedrock generally is encountered in cuts. The content of coarse fragments commonly is higher than in the thicker glacial till.

The Arnot, Lordstown, Oquaga, and Tuller soils and the moderately shallow variant of the Mardin soils formed in thin glacial till.

Some of these soils are underlain by soft shale that tends to disintegrate and become unstable if exposed to the effect of frost or to alternate wetting and drying.

Glacial Outwash

This material consists mainly of sorted sand and gravel deposited by meltwater from a glacier, but it commonly includes localized strata of silt, which impede drainage. The deposits include outwash terraces, deltas, valley trains, kames, and lake beaches.

The Braceville, Chenango, and Howard soils formed in deposits of glacial outwash.

Sand and gravel from outwash are suitable for many uses. Depending on gradation, soundness, and plasticity, these materials can be used for such purposes as (1) fill material for underwater placement; (2) ordinary fill; (3) material to strengthen unstable subgrade soils; (4) subbase for pavements; (5) wearing surfaces for driveways, parking lots, and some low-class roads; (6) mate-

engineering properties—Continued

Soil features affecting—Continued						
Foundations for low buildings [1]	Farm ponds		Agricultural drainage	Irrigation	Diversions	Waterways
	Reservoir	Embankment				
Generally high bearing capacity and low compressibility; seasonal high water table at depth of ½ to 1 foot. VoC, VoC3, VoD: moderate to steep slopes.	Slow permeability in fragipan at depth of 15 to 18 inches; prolonged high water table. VoC, VoC3, VoD: moderate to steep slopes.	Very good stability; very good shear strength; slow permeability if compacted; some large stones.	Slow permeability in fragipan at depth of 15 to 18 inches; prolonged seepage above pan. VoC, VoC3, VoD: moderate to steep slopes.	Moderate water-intake rate; moderate to low available moisture capacity; root zone 15 to 18 inches thick. VoC, VoC3, VoD moderate to steep slopes.	Slow permeability in fragipan at depth of 15 to 18 inches; prolonged seepage above pan. VoD: steep slopes.	Prolonged seepage. VoD: steep slopes.
Generally low bearing capacity; moderately high compressibility; large settlements possible; seasonal high water table at depth of ½ to 1 foot.	Prolonged high water table; moderately slow or slow permeability in fragipan at depth of about 18 inches; pan variable in thickness; variable permeability below pan.	Variable; poorly graded in many places; seasonally wet; highly erodible.	Moderately slow or slow permeability in fragipan at depth of about 18 inches; seasonal high water table at depth of ½ to 1 foot; cut slopes unstable; subject to piping.	Moderate water-intake rate; moderate available moisture capacity; root zone 15 to 18 inches thick.	Prolonged high water table.	Prolonged high water table.
Frequent flooding; prolonged high water table; variable strength.	Frequent flooding; variable permeability below depth of 30 inches.	Poorly graded in many places; seasonally wet; silty material extremely erodible; surface layer high in organic-matter content.	Flooding; outlets inadequate.	Not applicable___	Not applicable__	Not applicable.

[1] Unless otherwise noted, interpretive information applies to both series in the mapping unit or units.

rial for highway shoulders; (7) blankets for protection of slopes; (8) free-draining, granular backfill for structures and pipes; (9) outside shells of impounding dams; and (10) abrasives for ice control on highways. This granular material may be too permeable for use as embankments intended to hold water. Cut slopes in the more sandy material and fill constructed with such material are subject to severe erosion.

Lacustrine Sediments

These deposits consist of the finer textured material that washed into glacial lakes and eventually settled to the bottom. In some places they are stratified fine sand and silt; in others they are varved silt and clay. Occasional lenses of sand and silt are interbedded with the varved material. Because lake elevations fluctuated, silt and clay lacustrine sediments underlie many of the outwash and alluvial deposits.

Many of these lacustrine deposits have a high water table. Thus, loose, wet silt and clay may underlie the surface material. In most places lacustrine sediments are increasingly wetter with depth. Infiltration is restricted, and where the topography is flat, runoff is slow.

The landform consists of plains or terraces. In places the terraces are dissected and there are steep, unstable terrace fronts. Here, erosion is serious and landslides are common.

Only Wallington soils in this county formed in lacustrine sediments. Nevertheless, such deposits are known to underlie deposits of other materials in some of the major valleys.

In proportion to their extent, soils that formed in lacustrine deposits present more engineering problems than any other soils in the county, except peat and muck. They may settle considerably under heavy fills and structures, they are highly susceptible to frost heave, and they lose strength when thawing increases the moisture content. Cut slopes generally are unstable.

Alluvial Sediments

Alluvial sediments consist of soil material that has been moved and redeposited on land by streams. These deposits, which form the flood plains adjacent to streams, vary widely in texture within short distances. In Broome County, lake-laid silts and clays underlie alluvial deposits along many of the major valleys.

Alluvium is subject to periodic flooding. Surface drainage varies, and a water table near the surface is characteristic.

In Broome County, Middlebury, Tioga, and Wayland soils and Alluvial land formed in recent alluvial sediments. Unadilla and Scio soils formed in older sediments on terraces that are rarely flooded.

Soils formed in recent alluvium should be avoided as building sites. Sewage disposal by leaching is always troublesome because the water table is seasonally or permanently high. Most alluvial soils are a good source of topsoil.

PEAT AND MUCK

These accumulations are mostly organic matter, but they may contain various amounts of inorganic material. They are in swamps and at the surface of other poorly drained depressional areas.

The only organic mapping unit in this county is Peat and Muck.

Ordinarily, organic soils are unsuitable for highway and other embankment sites, because they are highly compressible and unstable. They generally are underlain by soft, wet alluvium, marl, or lacustrine sediments.

BEDROCK

The extent and geographical occurrence of the different kinds of bedrock underlying the soils of Broome County are described in the section "Geology and Physiography." Bedrock is encountered at a shallow depth in areas where the glacial till is thin, and it may be encountered in some deeper cuts in areas where the till is thick. In addition, there are some exposed outcrops of bedrock.

The bedrock in this county generally furnishes excellent foundations for highway embankments. Bedrock encountered in the foundation of dams for storing water must be properly sealed to prevent excess seepage.

Soils and engineering construction

Highways, dams, bridges, buildings, drainage installations, and other engineering structures are constructed either on or partly of earth material. Thus, the design of such structures should reflect the nature and physical properties of the soils involved. Some features of engineering works are highly dependent on such soil properties as depth to bedrock, depth to the water table, texture, and permeability. Discussed in the following paragraphs are the soil features that commonly affect engineering structures for soil and water conservation and that influence the location of highways or the placement of embankments.

SOIL AND WATER CONSERVATION WORK

Farm drainage, irrigation, farm ponds, dikes and levees, diversions, and waterways are used to conserve soil and water.

Some of the soils derived from glacial till are underlain by a compact fragipan, or platy substratum, that retards the movement of water. Seepage along the top of this layer causes wet spots. Thus, interception drains of both surface and subsurface types may be required. Sod waterways and diversions that are cut into the fragipan are subject to prolonged seepage in spring. The wetness coupled with cycles of freezing and thawing makes it difficult to establish and maintain the sod. The installation of irrigation systems in these soils and in soils that are shallow to bedrock requires careful investigation at the site because the depth of permeable soil is limited.

Most soils that formed in glacial till have impeded permeability and are suitable for the construction of farm ponds, although some contain sandy lenses that can cause excess seepage from a reservoir. The sandy lenses may also cause piping and instability in drainage structures.

Soils that formed in lacustrine sediments have extremely variable engineering properties and require careful investigation for most uses. The clayey lacustrine soils are generally suitable for farm ponds, but in places they contain lenses of sand that may cause piping.

Soils derived from glacial outwash and alluvium, as a rule, are more permeable than those derived from glacial till. If farm ponds for storing water above ground are built in these soils, a sealing agent may be needed to prevent seepage of water from the reservoir. Ponds that are dug to store water below the surface have been successful in areas where the water table is close to the surface. Layers of poorly graded silt, fine sand, or sand present problems if open ditches or subsurface drains are installed because these materials are subject to erosion, sloughing, and slumping. Subsurface drainage systems installed in such layers must be protected against plugging with silt and fine sand. The fact that some gravelly and sandy outwash soils are droughty and have moderate to low water-holding capacity should be considered when planning an irrigation system.

SOIL FEATURES AFFECTING HIGHWAY LOCATION

Highway location may be influenced by many soil features. Consideration must be given both to location on the landscape and to the selection of the gradeline with respect to the surface.

Highway construction on sloping to steep soils on till uplands and outwash deposits generally involves cuts and fills. More earthwork is involved in construction on these soils than on soils on well-drained and flood-free terraces.

Undulating or gully-dissected, silty and clayey lacustrine soils also require cuts and fills. Cuts in these soils may involve both the handling of wet material and the instability of foundation embankments. By comparison, the volume of earthwork on till uplands and outwash deposits may be greater than on a lacustrine landscape, but the overall cost of construction may be less. In wet seasons construction generally is easier on a till landscape than on a lacustrine landscape. As a rule, however, sandy lacustrine sediments present few difficulties, although cuts in this material may be troublesome because of ground water.

On nearly level terraces of well-drained granular material (sand and gravel), highway construction generally is easy and involves relatively light cuts and fills. Good drainage permits uninterrupted grading operations. Even after rainstorms these areas can be occupied without delay.

The gradeline selected for highway location is influenced by drainage, soil texture, topography, and other soil properties. Areas that are poorly drained and subject to flooding require a moderately high gradeline. In granular material, strata having variable permeability may be encountered in cuts. As a result, subgrades in such cuts are not uniform and are subject to differential frost heave.

Alluvial soils are variable. They are subject to overflow and often have a relatively high water table. Consequently, a moderately high gradeline is necessary to avoid roadway flooding and wet subgrades. Borrow material generally must be obtained from a source other than alluvial soils, which are likely to be wet and hence unsuitable for use as embankment material. Unless alluvial deposits are sandy, compaction of the subgrade soil is difficult. Subgrades that are not adequately compacted eventually yield enough to cause pavements to be uneven.

Some soils in this county have a dense fragipan. Where possible, the grade should be planned so that cutting in and out of the pan is not necessary.

Where soils, such as the Arnot, are shallow over bedrock, the grade should be high enough, if possible, to avoid the blasting of rock for ditches.

Soil Features Affecting Embankment Foundations

The major soil features that affect the placement of embankments are compressibility, sheer strength, and shrink-swell potential. Topography is also an important feature.

Most glacial till soils, such as the Mardin and Volusia, furnish adequate support for embankments 10 feet or more in height. Glacial outwash soils, such as the Chenango and Howard, may contain substratum layers of wet, compressible soil material and may be suitable only for embankments of 5 to 10 feet. Alluvial soils vary in their ability to support embankments. Organic soils are not suitable for the foundation of embankments, and such material should be removed.

Soil slope generally becomes a factor to be considered if it is more than 15 percent.

Nonfarm Uses of the Soils [9]

This section is designed to aid in the comprehensive planning and developing of land for selected nonfarm uses. Table 7 lists the soils in the county and shows the kinds and estimated degrees of limitations that affect their use for specified purposes. *Slight* indicates that no special measures are required to overcome limitations imposed by soil properties. *Moderate* indicates that moderate problems exist, but that they can be overcome or corrected. *Severe* indicates that usually expensive measures are needed to overcome the limitations imposed, but it does not imply that the soil properties prevent the use of the soil for the specified purpose. The evaluations are general and do not eliminate the need for onsite investigations for a given use.

Soil properties may not restrict all types of nonfarm uses equally. For example, the deep, well-drained, permeable, nearly level to gently sloping Chenango and Howard soils have slight limitations for residential use, but they have severe limitations for use as athletic fields for organized games, such as football or baseball, because they are high in content of gravel. The Tioga and Middlebury soils are similar to the Chenango and Howard soils, but they are occasionally flooded. As a result, they have chiefly moderate or severe limitations for many of the uses shown in table 7.

Many of the soils in the uplands, such as Arnot, Canaseraga, Cattaraugus, Lordstown, Mardin, and Oquaga soils, have moderate or severe limitations for homesites because of stones, slope, depth to bedrock, or a dense, slowly permeable fragipan. The slowly permeable fragipan encountered in some of the deeper soils severely limits their use for septic tank fields and for structures with basements. In the Arnot, Lordstown, Oquaga, and Tuller soils, intensive measures are needed to overcome the limitations caused by shallowness or moderate depth to bedrock.

Following are some of the limiting factors that, singly or in combination with others, commonly affect use of a soil for nonfarm purposes.

Flooding.—Soils subject to flooding are considered to have severe limitations for use as septic tank fields, homesites, streets or parking lots, and sites for sanitary land fill. Consequently, they should not be used for these purposes unless protected by dikes, levees, or other structures. Even then, flooding may be a hazard. Other sites that may be affected by flooding are landscaped areas, such as golf courses, campsites, and picnic and play areas. These sites, however, may be affected to only a slight or moderate degree because flooding commonly is infrequent during the season of use. Flooding is an important limitation to consider on the Middlebury and Tioga soils, which are extensive, better drained soils on bottom lands along the major streams.

Prolonged and seasonal wetness.—Soils that are wet most of the year, though not necessarily flooded, have severe limitations for most uses. Examples of these are the Alden, Chippewa, and Wayland soils and Peat and Muck. These are poorly drained and very poorly drained soils in depressions throughout the county.

Some soils are wet only part of the year. These have a water table that is seasonally perched on a restricting layer or a water table that fluctuates without reaching the surface. Among them are the moderately well drained Culvers and Scio soils and all of the somewhat poorly drained soils, such as the Volusia, Morris, and Wallington. All of the foregoing soils have moderate to severe limitations for many uses.

Texture of surface layer.— Texture affects trafficability, infiltration, the length of drying time after rains, and the ease of establishing and maintaining a grass cover.

[9] This section was prepared by Leslie W. Kick, soil scientist, Soil Conservation Service.

TABLE 7.—*Estimated degrees and kinds of limita-*

Soil	Septic-tank effluent disposal	Homesites	Streets and parking lots	Lawns and fairways
Alden and Chippewa soils, 0 to 3 percent slopes.	Severe: prolonged wetness; slow permeability.	Severe: prolonged wetness.	Severe: prolonged wetness.	Severe: prolonged wetness.
Alluvial land	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.
Arnot channery silt loam, 0 to 25 percent slopes.	Severe: shallow to bedrock; slope.	Severe: shallow to bedrock; slope.	Severe: shallow to bedrock; slope.	Severe: shallow to bedrock; slope.
Braceville gravelly silt loam	Severe: moderately slow and slow permeability.	Moderate: seasonal wetness.	Moderate: seasonal wetness.	Moderate: gravel
Canaseraga silt loam, 3 to 8 percent slopes.	Severe: moderately slow and slow permeability.	Moderate: seasonal wetness.	Moderate: seasonal wetness; slope.	Slight
Canaseraga silt loam, 8 to 15 percent slopes.	Severe: moderately slow and slow permeability.	Moderate: seasonal wetness; slope.	Severe: slope	Moderate: slope
Cattaraugus channery silt loam, 5 to 15 percent slopes.	Severe: moderately slow and slow permeability.	Moderate: slope	Severe: slope	Moderate: slope; sandstone fragments.
Cattaraugus channery silt loam, 15 to 25 percent slopes.	Severe: slope; moderately slow and slow permeability.	Severe: slope	Severe: slope	Severe: slope
Cattaraugus channery silt loam, 25 to 35 percent slopes.	Severe: Slope; moderately slow and slow permeability.	Severe: slope	Severe: slope	Severe: slope
Chenango and Howard gravelly loams, 0 to 5 percent slopes.	Slight	Slight	Slight	Moderate: gravel
Chenango and Howard gravelly loams, 5 to 15 percent slopes.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: gravel; slope.
Chenango and Howard gravelly loams, 15 to 25 percent slopes.	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Chenango and Howard gravelly loams, 25 to 40 percent slopes.	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Chippewa channery silt loam, 3 to 8 percent slopes.	Severe: slow permeability; prolonged wetness.	Severe: prolonged wetness.	Severe: prolonged wetness.	Severe: prolonged wetness.
Culvers channery silt loam, 2 to 8 percent slopes.	Severe: slow permeability.	Moderate: seasonal wetness.	Moderate: seasonal wetness; slope.	Moderate: sandstone fragments.
Culvers channery silt loam, 8 to 15 percent slopes.	Severe: slow permeability.	Moderate: slope; seasonal wetness.	Severe: slope	Moderate: sandstone fragments; slope.
Culvers channery silt loam, 15 to 25 percent slopes.	Severe: slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope
Cut and fill lands, gravelly materials.	Variable	Variable	Variable	Variable
Cut and fill lands, loamy materials.	Variable	Variable	Variable	Variable
Cut and fill lands, silty materials.	Variable	Variable	Variable	Variable
Dalton silt loam, 2 to 8 percent slopes.	Severe: slow permeability; seasonal wetness.	Severe: seasonal wetness.	Severe: seasonal wetness.	Moderate: seasonal wetness.
Dalton silt loam, 8 to 15 percent slopes.	Severe: slow permeability; seasonal wetness.	Severe: seasonal wetness.	Severe: slope; seasonal wetness.	Moderate: seasonal wetness; slope.
Lordstown channery silt loam, 0 to 5 percent slopes.	Severe: moderately deep to bedrock.	Severe: moderately deep to bedrock.	Severe: moderately deep to bedrock.	Moderate: sandstone fragments; moderately deep to bedrock.

tions for selected nonfarm uses of the soils

Sanitary land fill	Camp sites and trailer sites	Tent sites	Athletic fields	Play areas and picnic areas
Severe: prolonged wetness; slow permeability.	Severe: prolonged wetness; slow permeability.	Severe: prolonged wetness; slow permeability.	Severe: prolonged wetness; slow permeability.	Severe: prolonged wetness.
Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness; cobblestones.	Severe: flooding; prolonged wetness.
Severe: shallow to bedrock; slope.	Severe: shallow to bedrock; slope.	Severe: shallow to bedrock; slope.	Severe: shallow to bedrock; slope.	Severe: shallow to bedrock; slope.
Severe: seasonal wetness.	Moderate: seasonal wetness; moderately slow and slow permeability.	Moderate: seasonal wetness; moderately slow and slow permeability.	Severe: gravel	Slight.
Severe: moderately slow and slow permeability; seasonal wetness.	Moderate: moderately slow and slow permeability; seasonal wetness; slope.	Moderate: moderately slow and slow permeability; seasonal wetness.	Severe: moderately slow and slow permeability.	Slight.
Severe: moderately slow and slow permeability; seasonal wetness.	Severe: slope	Moderate: moderately slow and slow permeability; seasonal wetness; slope.	Severe: moderately slow and slow permeability; slope.	Moderate: slope.
Severe: moderately slow and slow permeability.	Severe: slope	Moderate: moderately slow and slow permeability; slope.	Severe: moderately slow and slow permeability; slope; sandstone fragments.	Moderate: slope.
Severe: slope; moderately slow and slow permeability.	Severe: slope	Severe: slope	Severe: moderately slow and slow permeability; slope; sandstone fragments.	Severe: slope.
Severe: slope; moderately slow and slow permeability.	Severe: slope	Severe: slope	Severe: moderately slow and slow permeability; slope; sandstone fragments.	Severe: slope.
Severe: rapid permeability; pollution hazard.	Moderate: gravel	Moderate: gravel	Severe: gravel	Slight.
Severe: rapid permeability; pollution hazard.	Severe: slope	Moderate: slope; gravel.	Severe: gravel; slope	Moderate: slope.
Severe: slope; rapid permeability; pollution hazard.	Severe: slope	Severe: slope	Severe: gravel; slope	Severe: slope.
Severe: slope; rapid permeability; pollution hazard.	Severe: slope	Severe: slope	Severe: gravel; slope	Severe: slope.
Severe: prolonged wetness; slow permeability.	Severe: prolonged wetness; slow permeability.	Severe: prolonged wetness; slow permeability.	Severe: slow permeability; prolonged wetness; sandstone fragments.	Severe: prolonged wetness.
Severe: slow permeability.	Severe: slow permeability.	Severe: slow permeability.	Severe: sandstone fragments; slow permeability.	Slight.
Severe: slow permeability.	Severe: slow permeability; slope.	Severe: slow permeability.	Severe: sandstone fragments; slope; slow permeability.	Moderate: slope.
Severe: slope; slow permeability.	Severe: slope; slow permeability.	Severe: slope; slow permeability.	Severe: slope; sandstone fragments; slow permeability.	Severe: slope.
Variable	Variable	Variable	Variable	Variable.
Variable	Variable	Variable	Variable	Variable.
Variable	Variable	Variable	Variable	Variable.
Severe: slow permeability; seasonal wetness.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: slow permeability; seasonal wetness.	Moderate: seasonal wetness.
Severe: slow permeability; seasonal wetness.	Severe: slope; seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: slow permeability; seasonal wetness; slope.	Moderate: seasonal wetness; slope.
Severe: moderately deep to bedrock.	Slight	Slight	Severe: moderately deep to bedrock; sandstone fragments.	Slight.

TABLE 7.—*Estimated degrees and kinds of limita-*

Soil	Septic-tank effluent disposal	Homesites	Streets and parking lots	Lawns and fairways
Lordstown channery silt loam, 5 to 15 percent slopes.	Severe: moderately deep to bedrock.	Severe: moderately deep to bedrock.	Severe: moderately deep to bedrock; slope.	Moderate: sandstone fragments; moderately deep to bedrock; slope.
Lordstown channery silt loam, 15 to 25 percent slopes.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: slope
Lordstown and Oquaga channery silt loams, 25 to 35 percent slopes.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: slope
Lordstown and Oquaga soils, 35 to 60 percent slopes.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: slope
Lordstown and Oquaga extremely stony and rocky soils, 0 to 35 percent slopes.	Severe: moderately deep to bedrock; slope; stones.	Severe: moderately deep to bedrock; stones; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; stones.
Made land, sanitary land fill	Severe: variable	Severe: variable	Severe: variable	Severe: variable
Mardin channery silt loam, 2 to 8 percent slopes.	Severe: slow permeability.	Moderate: seasonal wetness.	Moderate: seasonal wetness; slope.	Moderate: sandstone fragments.
Mardin channery silt loam, 8 to 15 percent slopes.	Severe: slow permeability.	Moderate: slope; seasonal wetness.	Severe: slope	Moderate: sandstone fragments; slope.
Mardin channery silt loam, 15 to 25 percent slopes.	Severe: slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope
Mardin channery silt loam, 25 to 35 percent slopes.	Severe: slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope
Mardin channery silt loam, moderately shallow variant, 2 to 8 percent slopes.	Severe: slow permeability; moderately shallow to bedrock.	Severe: moderately shallow to bedrock.	Severe: moderately shallow to bedrock.	Moderate: sandstone fragments; moderately shallow to bedrock.
Mardin-Chenango channery silt loams, 5 to 15 percent slopes.	Severe: variable permeability.	Moderate: slope	Severe: slope	Moderate: gravel and sandstone fragments; slope.
Mardin-Chenango channery silt loams, 15 to 25 percent slopes.	Severe: variable permeability; slope.	Severe: slope	Severe: slope	Severe: slope
Mardin and Cattaraugus soils, 35 to 60 percent slopes.	Severe: slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope
Middlebury silt loam	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding
Morris channery silt loam, 2 to 8 percent slopes.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness.	Severe: seasonal wetness.	Moderate: seasonal wetness; sandstone fragments.
Morris channery silt loam, 8 to 15 percent slopes.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness.	Severe: seasonal wetness; slope.	Moderate: seasonal wetness; sandstone fragments; slope.
Morris and Tuller very stony soils, 3 to 25 percent slopes.	Severe: shallow to bedrock in places; slow permeability; slope; seasonal wetness.	Severe: seasonal wetness; shallow to bedrock in places; slope.	Severe: seasonal wetness; shallow to bedrock in places; slope.	Severe: shallow to bedrock in places; slope; stones.
Oquaga channery silt loam, 5 to 15 percent slopes.	Severe: moderately deep to bedrock.	Severe: moderately deep to bedrock.	Severe: moderately deep to bedrock; slope.	Moderate: sandstone fragments; moderately deep to bedrock; slope.
Oquaga channery silt loam, 15 to 25 percent slopes.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.
Peat and Muck	Severe: prolonged wetness.	Severe: prolonged wetness.	Severe: prolonged wetness.	Severe: prolonged wetness; mucky texture.
Scio silt loam	Moderate: seasonal wetness.	Moderate: seasonal wetness.	Moderate: seasonal wetness.	Slight
Tioga silt loam	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding
Tioga gravelly silt loam, fan	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: gravel
Tuller channery silt loam, 0 to 25 percent slopes.	Severe: shallow to bedrock; slope; seasonal wetness.	Severe: shallow to bedrock; slope; seasonal wetness.	Severe: shallow to bedrock; slope; seasonal wetness.	Severe: shallow to bedrock; slope.

tions for selected nonfarm uses of the soils—Continued

Sanitary land fill	Camp sites and trailer sites	Tent sites	Athletic fields	Play areas and picnic areas
Severe: moderately deep to bedrock.	Severe: slope	Moderate: slope	Severe: moderately deep to bedrock; sandstone fragments; slope.	Moderate: slope.
Severe: moderately deep to bedrock; slope.	Severe: slope	Severe: slope	Severe: moderately deep to bedrock; sandstone fragments; slope.	Severe: slope.
Severe: moderately deep to bedrock; slope.	Severe: slope	Severe: slope	Severe: moderately deep to bedrock; sandstone fragments; slope.	Severe: slope.
Severe: moderately deep to bedrock; slope.	Severe: slope	Severe: slope	Severe: moderately deep to bedrock; sandstone fragments; slope.	Severe: slope.
Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; slope.	Severe: moderately deep to bedrock; stones; slope.	Severe: moderately deep to bedrock; slope; stones.
Severe: variable	Severe: variable	Severe: variable	Severe: variable	Severe: variable.
Severe: slow permeability.	Severe: slow permeability.	Severe: slow permeability.	Severe: sandstone fragments; slow permeability.	Slight.
Severe: slow permeability.	Severe: slope; slow permeability.	Severe: slow permeability.	Severe: sandstone fragments; slope; slow permeability.	Moderate: slope.
Severe: slope; slow permeability.	Severe: slope; slow permeability.	Severe: slope; slow permeability.	Severe: slope; sandstone fragments; slow permeability.	Severe: slope.
Severe: slope; slow permeability.	Severe: slope; slow permeability.	Severe: slope; slow permeability.	Severe: slope; sandstone fragments; slow permeability.	Severe: slope.
Severe: moderately shallow to bedrock; slow permeability.	Severe: slow permeability.	Severe: slow permeability.	Severe: moderately shallow to bedrock; sandstone fragments; slow permeability.	Slight.
Severe: variable permeability.	Severe: slope; variable permeability.	Severe: variable permeability.	Severe: gravel and sandstone fragments; slope.	Moderate: slope.
Severe: variable permeability; slope.	Severe: slope; variable permeability.	Severe: slope; variable permeability.	Severe: slope; gravel and sandstone fragments.	Severe: slope.
Severe: slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope; sandstone fragments; slow permeability.	Severe: slope.
Severe: flooding	Moderate: flooding	Moderate: flooding	Moderate: flooding	Moderate: flooding.
Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Moderate: seasonal wetness.
Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; slope.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; slope.	Moderate: seasonal wetness; slope.
Severe: shallow to bedrock in places; slow permeability; slope; seasonal wetness.	Severe: seasonal wetness; slow permeability; slope; shallow to bedrock in places.	Severe: seasonal wetness; slow permeability; slope; shallow to bedrock in places.	Severe: slope; shallow to bedrock in places; slow permeability; seasonal wetness.	Severe: slope; shallow to bedrock in places.
Severe: moderately deep to bedrock.	Severe: slope	Moderate: slope; sandstone fragments.	Severe: moderately deep to bedrock; sandstone fragments; slope.	Moderate: slope.
Severe: moderately deep to bedrock; slope.	Severe: slope	Severe: slope	Severe: moderately deep to bedrock; sandstone fragments; slope.	Severe: slope.
Severe: prolonged wetness.	Severe: prolonged wetness; mucky texture.	Severe: prolonged wetness; mucky texture.	Severe: prolonged wetness; mucky texture.	Severe: prolonged wetness; mucky texture.
Moderate: seasonal wetness.	Moderate: seasonal wetness.	Moderate: seasonal wetness.	Moderate: seasonal wetness.	Slight.
Severe: flooding	Slight	Slight	Moderate: flooding	Slight.
Severe: flooding	Moderate: gravel	Moderate: gravel	Severe: gravel	Slight.
Severe: shallow to bedrock; slope; seasonal wetness.	Severe: shallow to bedrock; seasonal wetness; slope.	Severe: shallow to bedrock; seasonal wetness; slope.	Severe: shallow to bedrock; seasonal wetness.	Severe: shallow to bedrock.

TABLE 7.—*Estimated degrees and kinds of limita-*

Soil	Septic-tank effluent disposal	Homesites	Streets and parking lots	Lawns and fairways
Unadilla silt loam, 0 to 5 percent slopes.	Slight	Slight	Slight	Slight
Unadilla silt loam, 5 to 15 percent slopes.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope
Volusia channery silt loam, 0 to 3 percent slopes.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness.	Severe: seasonal wetness.	Moderate: seasonal wetness; sandstone fragments.
Volusia channery silt loam, 3 to 8 percent slopes.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness.	Severe: seasonal wetness.	Moderate: seasonal wetness; sandstone fragments.
Volusia channery silt loam, 8 to 15 percent slopes.	Severe: slow permeability; seasonal wetness.	Severe: seasonal wetness.	Severe: seasonal wetness; slope.	Moderate: seasonal wetness; sandstone fragments; slope.
Volusia channery silt loam, 8 to 15 percent slopes, eroded.	Severe: slow permeability; seasonal wetness.	Severe: seasonal wetness.	Severe: seasonal wetness; slope.	Moderate: seasonal wetness; sandstone fragments; slope.
Volusia channery silt loam, 15 to 25 percent slopes.	Severe: slow permeability; seasonal wetness; slope.	Severe: seasonal wetness; slope.	Severe: seasonal wetness; slope.	Severe: slope
Wallington silt loam	Severe: slow permeability; seasonal wetness.	Severe: seasonal wetness.	Severe: seasonal wetness.	Moderate: seasonal wetness.
Wayland silt loam	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.

The presence of gravel and stone fragments on the soil surface is most critical in athletic fields used for baseball and football. If gravel, cobblestones, or fragments of stone less than 10 inches in diameter make up 15 percent or more of the volume, the soil is given a rating of severe. In this county only the soils on the flood plains and the Scio, Unadilla, and Wallington soils are free of coarse fragments.

Depth to bedrock.—Depth to bedrock affects many uses, especially those where excavating or grading is needed. Among the uses most affected are septic tank fields, homesites, streets or parking lots, and campsites. Vegetation generally is difficult to establish on shallow soils.

Soils that are underlain by bedrock at a depth of 10 to 20 inches are considered shallow, and soils that are underlain by bedrock at a depth of 20 to 40 inches are considered moderately deep. Both shallow and moderately deep soils are extensive in Broome County.

Slope.—Soil slope affects most uses. Where it is significant, it is expressed in percentage in the soil name. Nearly level and gently sloping soils that have no other undesirable properties have slight limitations for most uses; moderately sloping soils, exclusive of other soil properties, have moderate limitations; and steep soils have severe limitations.

Erosion is an ever-present hazard on sloping soils. The erosion hazard should be considered particularly in developing paths and trails, in landscaping, and in selecting intensively used picnic areas. The Canaseraga, Dalton, Scio, and Unadilla soils are among those where the erosion hazard is serious.

Stoniness or rockiness.—Numerous large stones or rock outcrops impose limitations to the use of soils for some purposes. The soil name generally indicates which soils contain sufficient stones and rock outcrops to interfere with land uses.

Permeability.—Permeability is the quality that enables a soil to transmit water or air. It is of major importance in rating soils for septic-tank effluent disposal. Soils that have rapid permeability, mainly those in the valleys, are rated as having slight limitations for such use. Soils that have slow or moderately slow permeability, for example, those that have a fragipan or dense till, have severe limitations.

Although soils with rapid permeability commonly have slight limitations for septic-tank effluent disposal, a contamination hazard exists if there are shallow wells, streams, ponds, lakes, or watercourses nearby.

Stability.—Stability is a property relating to the capacity of a soil to bear loads and its ability to stand in cuts. The most critical period occurs when the soil is wet.

Although stability was not considered in table 7, this property is of major importance in the construction of buildings. Most of the soils in this county are stable, but onsite studies are needed in planning any use that requires the support of heavy loads. Among the unstable soils are those on flood plains; the Scio, Unadilla, and Wallington soils; and the Braceville, Chenango, and Howard soils, which formed in water-deposited material and may have unstable subsurface layers.

Fragipan.—Most of the deep soils in the uplands have a dense fragipan within 3 feet of the surface. This layer slows percolation of water, inhibits penetration of roots, and makes excavation difficult, especially in *tions for selected nonfarm uses of the soils*—Continued

Sanitary land fill	Camp sites and trailer sites	Tent sites	Athletic fields	Play areas and picnic areas
Slight	Slight	Slight	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Severe: slope	Moderate: slope.
Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; sandstone fragments.	Moderate: seasonal wetness.
Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; sandstone fragments.	Moderate: seasonal wetness.
Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; slope.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; slope; sandstone fragments.	Moderate: seasonal wetness; slope.
Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; slope.	Severe: seasonal wetness; slow permeability.	Severe: seasonal wetness; slow permeability; slope; sandstone fragments.	Moderate: seasonal wetness; slope.
Severe: seasonal wetness; slow permeability; slope.	Severe: seasonal wetness; slow permeability; slope.	Severe: seasonal wetness; slow permeability; slope.	Severe: seasonal wetness; slow permeability; slope; sandstone fragments.	Severe: slope.
Severe: seasonal wetness; moderately slow and slow permeability.	Severe: seasonal wetness; moderately slow and slow permeability.	Severe: seasonal wetness; moderately slow and slow permeability.	Severe: seasonal wetness; moderately slow and slow permeability.	Moderate: seasonal wetness.
Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.	Severe: flooding; prolonged wetness.

dry periods. It is also the major cause of a perched water table in wet periods.

Selected Uses

Following are explanations of the selected nonfarm uses shown in table 7 and the features considered in evaluating the limitations of the soils for such use (*9*, *10*, *14*, *15*, *16*, *17*).

Septic-tank effluent disposal.—It is assumed that septic-tank systems are properly designed and that the minimum size of the lot is half an acre. The main features considered are permeability, depth to a seasonal or prolonged high water table, depth to bedrock, slope, and flood hazard.

Homesites.—These are sites for year-round homes or other buildings of three stories or less, with basements averaging 5 feet in depth below the undisturbed ground level. The main features considered are depth to a seasonal or prolonged high water table, slope, depth to bedrock, flood hazard, and surface stoniness or rockiness.

Streets and parking lots.—These are streets in subdivisions and all-weather parking lots. (See also the section "Engineering Applications.") The features considered are slope, depth to a seasonal or prolonged high water table (wetness), depth to bedrock, and flood hazard.

Lawns and fairways.—These are areas subjected to moderate traffic and to frequent mowing. It is assumed that the soil material at the site will be used and that there will be no importation of fill or topsoil. Traps or roughs are not considered as part of the golf fairway. The main features considered are depth to a seasonal or prolonged high water table (wetness), slope, depth to bedrock, surface stoniness (stones 10 inches or more in diameter), texture of the surface and subsurface layers, and flood hazard.

Sanitary land fill.—It is assumed that the trench method of sanitary land fill will be used and that the trench will have a minimum depth of 6 feet and will be underlain by 2 to 3 feet of soil material. The main features considered are depth to a seasonal or prolonged high water table, permeability, slope, depth to bedrock, texture of surface and subsurface layers, and flood hazard.

Camp sites, trailer sites, and tent sites.—These are areas used as sites for tents or camp trailers. Frequent use during the camping season and heavy foot and vehicular traffic are assumed. The main features considered are depth to a seasonal or prolonged high water table, permeability, slope, depth to bedrock, soil texture, stoniness, and flood hazard. Slope is less of a consideration for tent sites than for trailer sites.

Athletic fields.—These are mainly areas used for organized sports, such as baseball and football, but they also apply to playgrounds. These uses generally require a nearly level, firm surface, good drainage, and a cover of vegetation. The main features considered are depth to a seasonal or prolonged high water table (wetness), flood hazard, soil texture, stoniness, slope, permeability, and depth to bedrock.

Play areas and picnic areas.—These are play areas used largely by children and areas provided with tables and fireplaces for the use of a large number of people. The main features considered are depth to a seasonal or prolonged high water table, slope, depth to bedrock, soil texture, stoniness, and flood hazard.

Descriptions of the Soils

This section describes the soil series and the mapping units in Broome County. The procedure is first to describe each soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs.

The soil series contains a short description of a typical soil profile, and a more detailed description of the same profile that soil scientists, engineers, and others can use to make highly technical interpretations. If the profile for a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit.

Alluvial land, Cut and fill lands, Made land, and Peat and Muck are miscellaneous land types and do not belong to a soil series. Nevertheless, they are listed in alphabetic order along with the soil series.

Following the name of each mapping unit is the symbol that identifies the soil or land type on the detailed map at the back of the survey. Shown at the end of each description are the capability classification and the woodland group in which the mapping unit has been placed. The page on which each mapping unit and each capability unit is described is listed on the "Guide to Mapping Units" near the back of this publication. Table 2 describes the woodland groups and lists the soils in each group. The approximate acreage and proportionate extent of each mapping unit are given in table 8.

Alden Series

The Alden series consists of deep, very poorly drained soils that formed in medium-lime or slightly acid glacial till derived mainly from sandstone, siltstone, and shale. These soils are in depressions and along drainageways on uplands. They are underlain by dense, slowly permeable glacial till and consequently are waterlogged much of the time.

The surface layer typically is very dark gray to dark gray heavy silt loam about 10 inches thick. It is underlain to a depth of about 20 inches by gray, firm silty clay loam mottled with yellowish brown. Below this is firm, faintly mottled, grayish-brown silt loam that contains a few fragments of sandstone and siltstone.

The available moisture capacity is moderate to high. The total nitrogen content is very high, but nitrogen is released very slowly. The reserves of phosphorus and potassium are medium. The surface layer is commonly medium acid or slightly acid but may be very strongly acid when dry.

In Broome County, Alden soils are mapped only in an undifferentiated mapping unit with Chippewa soils.

Typical profile of an Alden silt loam; pasture, 1 percent slope.

A11—0 to 3 inches, very dark gray (N 3/0) heavy silt loam; dark yellowish-brown (10YR 4/4) mottles around root channels; weak, fine, granular structure; friable; abundant fine and some medium-sized roots; medium acid; clear, smooth boundary, 2 to 4 inches thick.

A12—3 to 10 inches, dark-gray (N 4/0) heavy silt loam; dark yellowish-brown (10YR 4/4) root stains; weak, medium, subangular blocky structure; firm; plentiful to few, fine and medium roots; slightly acid; clear, wavy boundary. 4 to 8 inches thick.

C1g—10 to 20 inches, gray (N 5/0) silty clay loam; few, coarse, prominent, yellowish-brown (10YR 5/6) mottles; weak coarse prisms crush to weak, medium, blocky structure; firm, sticky; few roots; neutral; clear, wavy boundary. 12 to 15 inches thick.

IIC2g—20 to 45 inches, grayish-brown (10YR 5/2) silt loam; few, coarse, faint, yellowish-brown (10YR 5/4) mottles; 5 to 15 percent coarse fragments; massive; sticky; no roots; neutral.

The texture ranges from silt loam to silty clay loam throughout the profile. In places the surface horizon is overlain by a layer of peat that ranges to as much as 6 inches in thickness. In some areas flagstones and channery fragments make up as much as 15 percent, by volume, of the surface and subsurface horizons. The surface horizon commonly is black (10YR 2/1) or very dark gray (10YR 3/1 or N 3/0) in color and generally is granular in structure. Below the A1 or Ap horizon, the color commonly is dark gray (10YR 4/1 or N 4/0), gray (10YR 5/1 or N 5/0), or dark bluish gray (5B 4/1), and there are few to common, prominent mottles. The structure commonly is weak prismatic that breaks to weak subangular blocky. Below the A1 or Ap horizon, the pH value ranges from 5.0 to 6.8. In some places the soil material is calcareous at a depth of 36 inches, but in most places, it is noncalcareous to a depth of 5 feet or more.

Alden soils are associated mainly with poorly drained Chippewa soils, well drained and moderately well drained Mardin soils, somewhat poorly drained Volusia soils, and somewhat poorly drained and poorly drained Tuller soils. In the southeastern part of the county, they are also associated with the dark-brownish to reddish Cattaraugus, Culvers, and Morris soils. Alden soils are wetter than Chippewa soils, and they lack the fragipan that is characteristic of those soils. They are also wetter than Tuller soils, which are underlain by bedrock at a depth of less than 20 inches.

Alden and Chippewa soils, 0 to 3 percent slopes (AcA).—Some areas of this unit consist of Alden soils, some of Chippewa soils, and others of both. The Alden soil commonly is dominant. In the eastern part of the county, both soils are more reddish than typical. Otherwise, the profile of the Alden soil is like the one described as typical of the series. The Chippewa soil, although commonly at the wetter end of the moisture range, has a profile like the one described as typical of the Chippewa series.

This unit is on uplands throughout the county. It occupies saucer-shaped depressions and long, narrow areas along drainageways. It is surrounded by somewhat poorly drained Volusia soils and well drained and moderately well drained Mardin soils. Some areas adjoin areas of Chippewa channery silt loam, 3 to 8 percent slopes, and a few border Alluvial land. Spots of Alden and Chippewa soils that are included in other mapping units are shown on the detailed soil map by wet spot symbols.

Wetness and ponding limit the use of these soils. Some areas provide excellent sites for ponds or for wildlife developments. Drainage is desirable if these soils occur as wet spots in cultivated fields. (Capability unit IVw-2; woodland group 8)

Alluvial land (0 to 5 percent slopes) (Ad).—This miscellaneous land type consists of mixed alluvial material that range in particle size from clay to large boulders. It occurs on low terraces and on bottom lands. Included

TABLE 8.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Alden and Chippewa soils, 0 to 3 percent slopes	1, 230	0. 3	Mardin channery silt loam, 8 to 15 percent slopes	53, 390	11. 8
Alluvial land	6, 110	1. 3	Mardin channery silt loam, 15 to 25 percent slopes	28, 280	6. 2
Arnot channery silt loam, 0 to 25 percent slopes	1, 490	. 3	Mardin channery silt loam, 25 to 35 percent slopes	9, 740	2. 2
Braceville gravelly silt loam	300	. 1	Mardin and Cattaraugus soils, 35 to 60 percent slopes	1, 820	. 4
Canaseraga silt loam, 3 to 8 percent slopes	1, 100	. 2	Mardin-Chenango channery silt loams, 5 to 15 percent slopes	480	. 1
Canaseraga silt loam, 8 to 15 percent slopes	2, 310	. 5	Mardin-Chenango channery silt loams, 15 to 25 percent slopes	310	. 1
Cattaraugus channery silt loam, 5 to 15 percent slopes	5, 000	1. 1	Mardin channery silt loam, moderately shallow variant, 2 to 8 percent slopes	1, 440	. 3
Cattaraugus channery silt loam, 15 to 25 percent slopes	6, 550	1. 4	Middlebury silt loam	4, 640	1. 0
Cattaraugus channery silt loam, 25 to 35 percent slopes	2, 250	. 5	Morris channery silt loam, 2 to 8 percent slopes	2, 100	. 5
Chenango and Howard gravelly loams, 0 to 5 percent slopes	6, 590	1. 5	Morris channery silt loam, 8 to 15 percent slopes	5, 650	1. 2
Chenango and Howard gravelly loams, 5 to 15 percent slopes	6, 980	1. 5	Morris and Tuller very stony soils, 3 to 25 percent slopes	970	. 2
Chenango and Howard gravelly loams, 15 to 25 percent slopes	2, 530	. 6	Oquaga channery silt loam, 5 to 15 percent slopes	1, 250	. 3
Chenango and Howard gravelly loams, 25 to 40 percent slopes	2, 240	. 5	Oquaga channery silt loam, 15 to 25 percent slopes	3, 660	. 8
Chippewa channery silt loam, 3 to 8 percent slopes	860	. 2	Peat and Muck	240	. 1
Culvers channery silt loam, 2 to 8 percent slopes	1, 270	. 3	Scio silt loam	600	. 1
Culvers channery silt loam, 8 to 15 percent slopes	3, 090	. 7	Tioga silt loam	7, 490	1. 6
Culvers channery silt loam, 15 to 25 percent slopes	1, 340	. 3	Tioga gravelly silt loam, fan	2, 510	. 6
Cut and fill lands, gravelly materials	3, 040	. 7	Tuller channery silt loam, 0 to 25 percent slopes	540	. 1
Cut and fill lands, loamy materials	2, 060	. 5	Unadilla silt loam, 0 to 5 percent slopes	3, 590	. 8
Cut and fill lands, silty materials	1, 830	. 4	Unadilla silt loam, 5 to 15 percent slopes	1, 120	. 2
Dalton silt loam, 2 to 8 percent slopes	960	. 2	Volusia channery silt loam, 0 to 3 percent slopes	470	. 1
Dalton silt loam, 8 to 15 percent slopes	840	. 2	Volusia channery silt loam, 3 to 8 percent slopes	34, 540	7. 6
Lordstown channery silt loam, 0 to 5 percent slopes	420	. 1	Volusia channery silt loam, 8 to 15 percent slopes	116, 890	25. 7
Lordstown channery silt loam, 5 to 15 percent slopes	17, 170	3. 8	Volusia channery silt loam, 8 to 15 percent slopes, eroded	670	. 1
Lordstown channery silt loam, 15 to 25 percent slopes	23, 790	5. 2	Volusia channery silt loam, 15 to 25 percent slopes	9, 140	2. 0
Lordstown and Oquaga channery silt loams, 25 to 35 percent slopes	15, 130	3. 3	Wallington silt loam	910	. 2
Lordstown and Oquaga soils, 35 to 60 percent slopes	5, 310	1. 2	Wayland silt loam	9, 260	2. 0
Lordstown and Oquaga extremely stony and rocky soils, 0 to 35 percent slopes	14, 310	3. 2	Water	4, 220	. 9
Made land, sanitary land fill	410	. 1			
Mardin channery silt loam, 2 to 8 percent slopes	11, 970	2. 6	Total	454, 400	100. 0

in mapping were spots of Tioga, Middlebury, and Wayland soils.

In the larger valleys, a layer of gravel or, in places, glacial till, generally more than 50 feet thick, occurs below a depth of 5 feet. In the small valleys, which have little glacial till, bedrock is 15 feet or less below the stream bottoms. In a few places, some near Damascus, the streams flow over bedrock. In most areas the soil material is acid, but in a few areas in the Chenango and Tioughnioga River valleys, it is slightly acid to neutral in reaction. The variable texture, the flood hazard, and wetness are the major limitations for most uses. (Capability unit Vw–1; woodland group 9)

Arnot Series

The Arnot series consists of well drained and moderately well drained, medium-textured soils on uplands. These soils formed in thin deposits of glacial till containing a considerable amount of gray or red sandstone and siltstone and a smaller amount of shale. They are nearly level to moderately steep and are only 12 to 20 inches deep over bedrock.

A typical profile has a very dark grayish-brown channery silt loam surface layer about 6 inches thick. The subsoil extends to the gray siltstone bedrock, which is at a depth of 16 inches. It is friable channery silt loam and is dark yellowish brown to a depth of 15 inches. The lower inch above the bedrock is light olive brown, faintly mottled with yellowish brown and grayish brown.

The root zone consists of 12 to 20 inches of well-aerated soil material over bedrock. Where the bedrock is fractured, this depth is increased slightly. Because of this shallowness to bedrock, the moisture capacity is low or very low and plants wilt early during dry periods. At times there are short periods of wetness in spring when water is perched above the bedrock. These soils have a moderate amount of organic matter, which releases nitrogen, and a moderate supply of phosphorus and potassium. They are strongly acid. Liming is important.

Shallowness to bedrock is the main limitation to many nonfarm uses. In some places, however, the bedrock can be ripped with construction equipment.

Typical profile of Arnot channery silt loam, 0 to 25 percent slopes, in an idle area:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) channery silt loam; weak, medium and fine, granular structure; very friable; abundant fine roots; many fine pores; strongly acid; abrupt, smooth boundary. 5 to 7 inches thick.

B2—6 to 15 inches, dark yellowish-brown (10YR 4/4) channery silt loam; weak, medium, granular structure in weak, medium and fine, subangular blocky clods; very friable; plentiful fine roots; many fine pores; strongly acid; abrupt, smooth boundary. 7 to 10 inches thick.

B3—15 to 16 inches, light olive-brown (2.5Y 5/4) channery silt loam; a few, fine, faint, dark yellowish-brown (10YR 4/4) and grayish-brown (2.5Y 5/2) mottles; weak, thin, platy structure; friable; plentiful fine roots; many fine pores; strongly acid; abrupt, smooth boundary, 0 to 3 inches thick.

R—16 inches +, gray siltstone bedrock; massive.

In undisturbed areas there are O1, O2, and A1 horizons instead of an Ap, horizon. The A1 horizon is 1 to 2 inches thick and is black (10YR 2/1). In places a thin, light-gray A2 horizon underlies the A1.

The Ap horizon has a hue of 10YR or 7.5YR in a value of 3 or 4 and a chroma of 2 or 3. The B horizon has a hue of 10YR or 2.5Y where it was derived from gray sandstone, siltstone, and shale and a hue of 7.5YR or 5YR where derived from red sandstone and shale. A value of 3 to 5 and a chroma of 3 or 4 are predominant. A mottled B3 or C horizon overlies the bedrock in places.

The depth to bedrock ranges from 12 to 20 inches. In places thinly bedded siltstone and shale are fractured considerably and interspersed with fines.

The solum has a texture of channery or flaggy silt loam and loam. The average content of coarse fragments is 35 to 60 percent by volume. The reaction of the solum ranges from very strongly acid to strongly acid.

Arnot soils occur with somewhat poorly drained, shallow Tuller soils and their slightly deeper analogs, Lordstown and Oquaga soils. They are also associated with Mardin, Cattaraugus, and Culvers soils, the wetter Volusia and Morris soils, and other deep soils that have a fragipan.

Arnot channery silt loam, 0 to 25 percent slopes (ArD).—This soil is nearly level on hilltops and moderate to steep on valley side slopes. In many places it occupies a narrow, treadlike position in stairstep topography. The risers are commonly outcrops of sandstone and siltstone bedrock. Included in mapping were the wetter Tuller soils in the flatter areas and the deeper Lordstown and Oquaga soils in the steeper areas. Also included were the deeper Mardin and Cattaraugus soils and their wetter associates.

This soil can be used for crops, pasture, or forest. Because of shallowness, it is droughty. It is generally better suited to early maturing grain and shallow-rooted crops that can tolerate dryness. Measures to conserve moisture and control erosion are needed on sloping areas. Slopes of over 15 percent are difficult and hazardous to work and are better left in sod or woodland.

Shallowness to bedrock and slope are the main limitations to nonfarm uses. (Capability unit IVs–1; woodland group 6)

Braceville Series

The Braceville series consists of deep, acid, moderately well drained, medium-textured soils that formed in glacial outwash. These soils are in nearly level depressions in gravelly outwash and on kame terraces.

A typical Braceville soil has a very dark grayish-brown gravelly silt loam plow layer about 5 inches thick. The upper subsoil is yellowish-brown gravelly silt loam, faintly mottled in the lower part. It is separated from the lower subsoil by a thin, leached layer of friable, pale-brown gravelly silt loam that is distinctly mottled. The lower subsoil is at a depth of about 18 inches. It is a firm, brittle fragipan of dark yellowish-brown gravelly silt loam that is distinctly mottled. The substratum of glacial outwash is at a depth of about 31 inches. It consists of brown to dark-brown, firm gravelly silt loam in the upper 10 inches. Below this it is friable, light brownish-gray very fine sandy loam that has distinct, prominent, brown mottles. The layers in the substratum vary in texture and thickness.

The depth of the root zone is limited primarily to the 18 to 24 inches of soil over the dense fragipan, which is moderately slowly to slowly permeable. The root zone holds only 3 to 5 inches of water for plants. In the earlier part of the growing season and for short periods after rains, this is not so significant, because the soil above the fragipan frequently is saturated by free water. During droughts, however, plants show signs of moisture deficiency within 7 to 10 days. The plow layer generally contains 3 to 6 percent organic matter and is moderately well supplied with nitrogen. The ability to supply potassium and phosphorus is medium. The reaction of unlimed areas ranges from slightly acid to strongly acid.

Typical profile of Braceville gravelly silt loam in a cultivated field:

Ap—0 to 5 inches, very dark grayish-brown (10YR 3/2) gravelly silt loam; weak, very fine, granular structure; very friable; abundant fine roots; medium acid; abrupt, smooth boundary. 5 to 6 inches thick.

B21—5 to 13 inches, yellowish-brown (10YR 5/6) gravelly silt loam; weak, very fine, subangular blocky structure; friable; plentiful fine roots; medium acid; clear, wavy boundary. 7 to 9 inches thick.

B22—13 to 16 inches, yellowish-brown (10YR 5/4) gravelly silt loam (high coarse silt content); few, fine, very faint, yellowish-brown (10YR 5/4) mottles; weak platy structure; friable; plentiful fine roots; strongly acid; clear, wavy boundary. 2 to 5 inches thick.

A'2—16 to 18 inches, pale-brown (10YR 6/3) gravelly silt loam (high coarse silt content); many, fine, distinct, strong-brown (7.5YR 5/8) mottles; weak, fine, subangular blocky structure in weak plates; friable; few fine roots; strongly acid; clear, irregular boundary. 2 to 4 inches thick; tonguing into horizon below.

B'x1—18 to 26 inches, dark yellowish-brown (10YR 3/4) gravelly silt loam (high coarse silt content); many, medium and coarse, distinct, pale-brown (10YR 6/3) mottles; weak, medium, platy structure within prisms 24 to 30 inches across; prisms are separated by streaks that have light brownish-gray (2.5Y 6/2) centers and strong-brown (7.5YR 5/8) borders; firm and brittle; few fine roots in streaks; strongly acid; gradual, wavy boundary. 6 to 12 inches thick.

B'x2—26 to 31 inches, dark yellowish-brown (10YR 3/4) gravelly silt loam (high coarse silt content); many, medium and coarse, distinct, pale-brown (10YR 6/3) and light-gray (10YR 7/2) mottles; weak, medium, platy structure in prisms 24 to 30 inches across; prisms are separated by streaks that terminate in the lower part of this horizon; streaks have light brownish-gray (2.5Y 6/2) centers and strong-brown (7.5YR 5/8) borders; firm and brittle; no roots; strongly acid; clear, wavy boundary. 4 to 10 inches thick.

C1x—31 to 41 inches, brown to dark-brown (10YR 4/3) gravelly silt loam (high coarse silt content) with erratic-sized color bodies of pale brown (10YR 6/3); weak, medium, platy structure; firm and brittle; no roots; strongly acid; clear, wavy boundary. 8 to 14 inches thick.

IIC2—41 to 48 inches, light brownish-gray (2.5Y 6/2) very fine sandy loam; many, medium, distinct, light olive-brown (2.5Y 5/4) and prominent, strong-brown (7.5YR 5/8) mottles; weak, thick, platy structure; friable; no roots; strongly acid. At random in the mass are 2- to 6-inch reddish-brown (5YR 4/3), clayey bodies that are firm and plastic.

The solum ranges from 26 to 46 inches in thickness. Gravel and cobbles make up from 5 to 35 percent of the solum by volume, and in places the content increases in the substratum. The texture of the surface layer is commonly gravelly silt loam, but the range includes silt loam, loam, gravelly loam, very fine sandy loam, and gravelly very fine sandy loam.

The B horizon is yellowish brown (10YR 5/4 or 5/6) to light olive brown (2.5Y 5/4 or 5/6) and is generally faintly mottled in the lower part. The chroma is higher than 2. The texture of this horizon is predominantly gravelly silt loam, but the range includes very fine sandy loam, loam, and silt loam and a few pebbly to gravelly variations.

The color of the A'2 horizon ranges from pale brown (10YR 6/3) to olive (5Y 5/3), and there are common to many distinct mottles. The texture of this horizon ranges from gravelly very fine sandy loam to gravelly silt loam.

The color of the fragipan ranges from dark yellowish brown (10YR 3/4) to olive (5Y 4/3), and there are distinct mottles. The texture ranges from gravelly very fine sandy loam to gravelly silt loam. In some places the clay flow is patchy in pores.

The texture of the underlying substratum varies greatly but commonly is stratified sand and gravel. The reaction ranges from slightly acid to strongly acid.

Braceville soils are associated with well-drained Chenango and Howard soils. They are also associated with moderately well drained Scio and somewhat poorly drained Wallington soils, which are silty and lack the gravel content common to Braceville soils. Also, Scio soils lack a fragipan, and Wallington soils are distinctly mottled immediately below the plow layer. Mardin, Cattaraugus, Culvers, and Canaseraga are glacial till soils that have a fragipan and adjoin Braceville soils on valley side slopes.

Braceville gravelly silt loam (0 to 5 percent slopes) (Br).—This soil generally occupies small, snakelike, backwater areas on gravel terraces. The slopes are concave. A few areas are seep spots on gravelly fans or terraces, and these are round or oblong in shape. Well-drained Chenango and Howard soils generally surround this soil. Spots of somewhat poorly drained Wallington and moderately well drained Scio soils were included in mapping.

This soil is suited to crops, pasture, or forest. Drainage improves it for crops, particularly if it occurs in fields made up largely of well-drained Chenango soils. Erosion is not a problem.

Seasonal wetness and the moderately slowly to slowly permeable fragipan are the major limitations to many nonfarm uses. (Capability unit IIw-1; woodland group 1)

Canaseraga Series

The Canaseraga series consists of deep, moderately well drained and well drained, acid silty soils that formed in two kinds of deposits, one over the other (fig. 15). The upper deposit is coarse silt loam or very fine sandy loam. The lower deposit is medium-textured, firm, acid basal till. These soils are generally in small areas on lower slopes of valley walls. The largest areas are near the State Hospital and near Conklin, Vestal, Ouaquaga, Damascus, and Harpursville.

A typical profile has a dark grayish-brown silt loam plow layer about 8 inches thick. Underlying this layer is the upper subsoil, which extends to a depth of 18 inches. It is friable, yellowish-brown to brown silt loam that is faintly mottled below a depth of 15 inches. A leached layer, about 5 inches thick, separates it from the lower subsoil. This leached layer is firm, light olive-brown very fine sandy loam that is distinctly mottled with yellowish brown. The lower subsoil is a very firm, dense fragipan of dark grayish-brown channery silt loam. There are thin, vertical streaks of grayish-brown very fine sandy loam surrounding large prisms in the

***Figure 15.*—A profile of a Canaseraga soil, showing the contrasting materials in which it formed. The windblown or lake-laid silty layer is about 24 inches thick over firm loamy till.**

fragipan. The streaks pinch out at a depth of about 60 inches where the substratum of glacial till occurs. The till is also firm, dense, dark grayish-brown channery silt loam.

Plant roots are largely confined to the 18 to 30 inches of soil above the fragipan. This zone holds 4 to 6 inches of moisture available to plants. The water table usually lies above the pan early in the growing season and later during rainy spells. Plants begin to wilt after a week or 10 days without rain. The supply of nitrogen and phosphorus is medium; that of potassium is low. Lime is needed to neutralize the acidity.

Slope, seasonal wetness, and the dense, slowly permeable fragipan are limitations to nonfarm uses.

Typical profile of Canaseraga silt loam, 3 to 8 percent slopes, in a cultivated field:

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

B2—8 to 18 inches, yellowish-brown (10YR 5/4) silt loam grading with depth to brown (10YR 5/3); common, medium, faint mottles below a depth of 15 inches; weak, medium to coarse, prismatic structure that readily breaks to very weak, fine, subangular blocky structure; friable; plentiful roots; strongly acid; clear, smooth boundary. 6 to 16 inches thick.

A'2—18 to 23 inches, light olive-brown (2.5Y 5/3) very fine sandy loam; common, medium, distinct, yellowish-brown (10YR 5/4) and 5/6) mottles; weak, thin, platy structure; firm; plentiful roots; a few pebbles and channery fragments; strongly acid; abrupt, irregular boundary. 0 to 6 inches thick.

IIB'x1—23 to 36 inches, dark grayish-brown (2.5Y 4/2) channery silt loam; very weak, medium and coarse, subangular blocky structure in 8- to 18-inch prisms; prisms are surrounded by ½-inch to 1-inch streaks of very fine sandy loam that have a grayish-brown (2.5Y 5/2) center and a yellowish-brown (10YR 5/6) border; very firm and brittle; few roots in streaks; strongly acid; diffuse boundary. 10 to 20 inches thick.

IIB'x2—36 to 60 inches, dark grayish-brown (2.5Y 4/2) channery silt loam; massive within 8- to 18-inch prisms; prisms are surrounded by streaks of very fine sandy loam, as in the horizon above, but the streaks dissipate in an erratic pattern with depth; very firm and brittle; no roots; medium acid; diffuse boundary. 15 to 30 inches thick.

IICx—60 inches, dark grayish-brown (2.5Y 4/2) channery silt loam glacial till; moderate, lenticular, platy structure or massive; firm and brittle; no roots; slightly acid.

The thickness of the silty or very fine sandy mantle ranges from 18 to 36 inches. The color of the Ap horizon ranges from dark brown (10YR 3/3) and dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2). The texture of the Ap and B horizons is silt loam or very fine sandy loam, and there are a few coarse fragments in places. The color of the B horizon ranges from dark brown to yellowish brown in the upper part and generally fades to light olive brown in the lower part. The faint mottling is absent in the lower part in places. The A'2 horizon is not always present.

The color of the fragipan ranges from dark grayish brown (2.5Y 4/2 or 10YR 4/2) to brown (10YR 5/3), and it may be distinctly mottled. Where reddish till has influenced the soil, the hue is 7.5YR or 5YR. The depth to the fragipan ranges from 18 to 30 inches. Generally, the fragipan has formed only in the till, but in places where the silty overburden is thick enough, it has formed in both the overburden and the till. The texture ranges from very fine sandy loam or silt loam to channery loam or channery silt loam. In places clay flows are prominent in the pores and around coarse fragments in the lower part of the pan. The reaction of the profile ranges from very strongly acid to slightly acid.

Canaseraga soils are associated with Dalton, Mardin, Lordstown, Unadilla, and Scio soils. They are better drained than Dalton soils and are not so distinctly mottled under the plow layer. They have a thicker, stone-free silty mantle than Mardin and Lordstown soils and are deeper than Lordstown soils. They are similar to Unadilla and Scio soils but have a fragipan in the lower subsoil.

Canaseraga silt loam, 3 to 8 percent slopes (CaB).—This soil has the profile described as typical of the series. It commonly occupies convex knolls or smooth side slopes in valleys. Most areas are not more than 10 acres in size. Those on upper slopes and knolls are round, and those on foot slopes are oblong and parallel with the valley. Included in mapping were the somewhat poorly drained Dalton and Volusia soils in depressions and the well drained and moderately well drained Mardin soils.

This soil is suitable for crops, pasture, or forest. It is generally free of stones in the plowed layer and is easily cultivated. Wetness is only a minor problem. Erosion is a severe hazard and should be controlled by conservation practices.

Seasonal wetness and a slowly permeable fragipan are limitations to many nonfarm uses. (Capability unit IIe–3; woodland group 2)

Canaseraga silt loam, 8 to 15 percent slopes (CaC).—This soil is in small areas on knolls and smoothly sloping hillsides. It is better drained than the soil described as typical of the series and is generally free of mottles above the fragipan. Drainageways are common and have eroded areas that were included in mapping. Also included were somewhat poorly drained Dalton and Volusia soils, poorly drained Chippewa soils, and Mardin and Lordstown soils.

This soil can be used for crops, pasture, or forest. If it is used for cultivated crops, erosion is a hazard. Wetness is only a minor problem.

Seasonal wetness, a slowly permeable fragipan, and slope are limitations to many nonfarm uses. (Capability unit IIIe–5; woodland group 2)

Cattaraugus Series

The Cattaraugus series consists of deep, well-drained loamy soils that formed in very firm, acid till. The till has been strongly influenced by red sandstone and shale. These are extensive, gently sloping to steep soils on hilltops and valley sides in uplands in the eastern part of the county.

A typical profile has a dark-brown channery silt loam plow layer about 6 inches thick. Underlying this layer is the upper subsoil, which is brown to dark-brown channery silt loam that grades from friable to moderately firm with depth. It extends to a depth of about 28 inches. The lower subsoil is a very firm, dense fragipan. It is reddish-brown very channery silt loam, very faintly mottled in the upper part. Thin vertical streaks of gray silty material surround very coarse prisms in the fragipan. These streaks pinch out at a depth of about 48 inches. Stone fragments of different sizes are prominent in the surface layer and subsoil. The substratum is brown very channery silt loam till. It also is very firm and dense.

The root zone is confined to the 24 to 30 inches of soil above the fragipan. It holds 5 to 6 inches of moisture available for plants. In May, 3 or 4 drying days are usually required before the soils can be plowed. Plants begin to wilt after 7 to 10 days without rain. The ability to supply nitrogen, potassium, and phosphorus is medium. The reaction is strongly acid.

The slowly permeable fragipan is the major limitation to many nonfarm uses. Slope and stoniness are also limitations. Because of their location in the foothills of the Catskills, Cattaraugus soils have desirable esthetic aspects.

Typical profile of Cattaraugus channery silt loam, 15 to 25 percent slopes, in a forested area:

Ap—0 to 6 inches, dark-brown (7.5YR 3/2) channery silt loam; weak, fine, granular structure; very friable; many fine roots; strongly acid; abrupt, smooth boundary. 5 to 6 inches thick.

B21—6 to 16 inches, brown (7.5YR 5/4) channery silt loam; weak, fine, granular structure; friable; many roots in upper part, common roots in lower part; strongly acid; clear, wavy boundary. 9 to 12 inches thick.

B22—16 to 23 inches, dark-brown to brown (7.5YR 4/4) channery silt loam; weak, fine, subangular blocky structure breaking to weak, fine, granular structure; friable; common roots; strongly acid; clear, wavy boundary. 6 to 10 inches thick.

B23—23 to 28 inches, dark-brown to brown (7.5YR 4/2) channery silt loam; weak, fine, subangular blocky structure; firm; few roots; strongly acid; clear, wavy boundary. 4 to 7 inches thick.

Bx—28 to 48 inches, reddish-brown (5YR 4/3) very channery silt loam; very faint, incipient mottling; many small channery fragments and stone chips; weak, medium, subangular blocky structure in 12- to 18-inch prisms; gray silty material one-half inch thick surrounds the prisms; very firm and brittle, slightly sticky; a few clay films in pores in lower part; few roots in upper part; strongly acid; clear, wavy boundary. 16 to 24 inches thick.

Cx—48 to 52 inches, brown (7.5YR 5/2) very channery silt loam; weak, thick, platy structure; very firm and brittle; no roots; strongly acid in upper part, neutral at a depth of 72 inches.

The texture of the surface layer is predominantly channery silt loam, but the range includes channery loam. Channery fragments and flagstones of sandstone make up 20 to 60 percent of the solum by volume, and there are stony to extremely stony phases.

The color of the Ap horizon ranges from dark brown (7.5YR 3/2) to dark reddish brown (5YR 3/2 to 3/4). The color of the B horizon ranges from dark brown to brown in a hue of 7.5YR and from reddish brown to yellowish red in a hue of 5YR.

The depth to the fragipan ranges from 24 to 30 inches, and the colors are reddish brown (5YR 4/3) to dark reddish brown (5YR 3/4). Faint mottling is present in places.

The reaction of the solum is strongly acid. Where the soil is undisturbed, the uppermost 6 inches has a thin sequence of layers with a light-colored A2 horizon and a reddish B2 horizon. Where the soil has been plowed, this sequence is mixed in the Ap horizon.

Cattaraugus soils are in a drainage sequence with moderately well drained Culvers and somewhat poorly drained Morris soils. They are similar to and associated with Arnot and Oquaga soils but are deeper and have a fragipan. Cattaraugus soils are dark brownish to reddish in contrast to the brown and olive-brown Mardin soils, which are their analogs in the central and western parts of the county.

Cattaraugus channery silt loam, 5 to 15 percent slopes (CcC).—This soil has a few mottles above the fragipan in places. It is on hill crests or valley sides where water does not accumulate. Included in mapping were moderately well drained Culvers and somewhat poorly drained Morris soils in depressions and along drainageways. Also included were Arnot soils, which are shallow to bedrock, and Oquaga soils, which are moderately deep.

This soil is suited to crops, pasture, or forest. If it is cropped, conservation measures are needed to control runoff and erosion.

This is among the better soils in upland till for foundations of buildings and for many other nonfarm uses. The depth to the fragipan affects the design of sewage disposal systems. (Capability unit IIIe–1; woodland group 2)

Cattaraugus channery silt loam, 15 to 25 percent slopes (CcD).—This soil is in large, oblong areas on the upper slopes of valley walls or on north and south sides of ridges just below Oquaga soils. It has the profile described as typical of the series. Runoff is rapid on its convex slopes. These slopes are cut by intermittent drainageways that run at right angles to the general contour and form a rolling landscape up and down the slopes. Shallow Arnot and moderately deep Oquaga soils generally adjoin this soil. Very small areas of moderately well drained Culvers soils in drainageways were included in mapping.

This soil can be used for crops, pasture, or forest. It is better suited to hay crops, however, because the slopes limit the use of heavy machinery and create an erosion hazard. Careful conservation practices are needed to control erosion.

Slope is the major limitation to many nonfarm uses. (Capability unit IVe–1; woodland group 2)

Cattaraugus channery silt loam, 25 to 35 percent slopes (CcE).—This soil is a little drier than is typical of the series. It is in deep till high on valley walls or on sides of ravines. Shallow Arnot and moderately deep Oquaga soils were included in mapping. Also included were moderately well drained Culvers and somewhat poorly drained Morris soils near seeps and drainageways.

Some areas of this soil have been farmed, but the slopes are too steep for modern machinery. These areas can be used to a limited extent for pasture and are suitable for forest.

Slope is the major limitation to many nonfarm uses. (Capability unit VIe–1; woodland group 3)

Chenango Series

The Chenango series consists of deep, well-drained, medium-textured gravelly soils that formed in glacial outwash influenced by acid sandstone and shale. These soils are extensive on valley floors and terraces and alluvial fans and on kames and eskers (fig. 16).

A typical profile has a dark-brown gravelly loam surface layer about 5 inches thick. This layer is underlain by the subsoil, which extends to a depth of about 29 inches. The subsoil is very friable, brown to dark-brown gravelly loam to a depth of 17 inches. Below this it is strong-brown very gravelly sandy loam. The underlying substratum consists of layers of gravelly, sandy, and cobbly material that is slightly firm to loose.

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Figure 16.—An esker on which Chenango soils occur along the highway near Killawog. These soils are good sources of gravel. The ridges of gravelly deposits formed along the courses of streams that flowed in and underneath melting glacial ice.

Gently sloping Chenango soils are among the best in the county for crops, although the medium moisture capacity limits yields in dry years. Roots of deep-rooted crops and trees penetrate the gravelly substratum, but most crops obtain their moisture from the top 30 or 40 inches. This volume of soil holds from 3 to 5 inches of water that plants can use, but not all of this moisture is readily available. Consequently, crops begin to wilt after 7 to 10 days without rain. The steeper slopes are very droughty. The ability to supply nitrogen, phosphorus, and potassium is medium. Unlimed areas are strongly acid. Large amounts of lime and fertilizer are needed.

Many areas of these soils are excellent for some nonfarm uses. They are very good sources of sand and gravel.

Typical profile of Chenango gravelly loam in pasture:

Ap—0 to 5 inches, dark-brown (7.5YR 3/2) gravelly loam; weak, medium and fine, granular structure; very friable; abundant fine roots; medium acid; abrupt, smooth boundary. 5 to 8 inches thick.

B21—5 to 17 inches, brown to dark-brown (7.5YR 4/4) very gravelly loam; weak, medium and fine, granular structure; very friable; plentiful fine roots; medium acid; clear, wavy boundary. 7 to 14 inches thick.

B22—17 to 29 inches, strong-brown (7.5YR 4/6) very gravelly sandy loam; weak, very fine, subangular blocky structure; very friable; plentiful fine roots; medium acid; clear, wavy boundary. 8 to 14 inches thick.

IIC1—29 to 42 inches, brown to dark-brown (10YR 4/3) very gravelly coarse sand with a few cobbles; structureless; firm, loose when crushed; pebbles are capped with silty material; few fine roots; strongly acid; gradual, wavy boundary. 10 to 20 inches thick.

IIIC2—42 to 76 inches, dark-brown (10YR 3/3) very cobbly coarse sand and gravel; structureless; loose; pebbles and cobbles are capped with silty material; few fine roots; strongly acid; gradual, wavy boundary. 30 to 40 inches thick.

IVC3—76 to 88 inches, dark-brown (10YR 3/3) very gravelly coarse sand with a few cobbles; structureless; loose; no roots; medium acid.

The solum thickness is commonly about 30 inches but ranges from 20 to 36 inches. Gravel and cobbles constitute from 35 to 60 percent of the material between depths of 10 and 40 inches. The colors of the solum are hues of 10YR and 7.5YR; the 7.5YR hue is where red sediments have influenced the colors. The color of the Ap horizon ranges from very dark grayish brown to dark brown. The texture is predominantly gravelly loam, but the range includes gravelly silt loam, silt loam, very fine sandy loam, and channery silt loam.

The color of the B horizon ranges from light yellowish brown to strong brown. The texture of the B2 horizon is predominantly very gravelly loam, but the range includes very gravelly silt loam. Very gravelly sandy loam occurs as subhorizons. In some places there is a thin upper B2 horizon of silt loam or very fine sandy loam. A transitional B3 horizon of gravelly or very gravelly sandy loam is present in places. The reaction of the solum ranges from strongly acid to medium acid.

The gravelly and sandy substratum consists mostly of acid, gray material derived from sandstone and shale, but in the southeastern part of the county there is enough red sandstone and shale to influence slightly the color of the soil material. In the valleys of the Chenango River and its tributaries, limestone is a minor component of the substratum and appears as disintegrating ghosts in the upper C horizons. Though free lime is generally below a depth of 5 feet in these places, locally it may be at a depth of 4 feet.

Chenango soils occur with Howard and Mardin soils and are mapped with them in Broome County. Howard soils have a noticeable amount of clay in the lower subsoil and enough limestone gravel to be calcareous within a depth of 3 to 4 feet. Mardin soils formed in dense glacial till and have a fragipan. Chenango soils are in a drainage sequence with moderately well drained Braceville soils, which formed in the same kind of material but have a fragipan. Other associates of Chenango soils are deep, silty Unadilla, Scio, and Wallington soils on terraces and Tioga, Middlebury, and Wayland soils on flood plains.

Chenango and Howard gravelly loams, 0 to 5 percent slopes (ChA).—Either or both of these soils may occur in any mapped area. Their profiles are like those described for the Chenango and Howard series.

Areas of these soils are generally 10 acres or more in size and conform to the shape of the valley floor. Adjoining them at lower elevations are soils formed in alluvium, including the well-drained Tioga and poorer drained soils. Included in mapping were moderately well drained Braceville and well drained silty Unadilla soils.

These Chenango and Howard soils are excellent for crops (fig. 17), pasture, or forest. Gravel does not seriously interfere with tillage. A few wet spots need drainage.

These are among the best soils in the county for many nonfarm uses. (Capability unit I–1; woodland group 1)

Chenango and Howard gravelly loams, 5 to 15 percent slopes (ChC).—These soils are on terraces adjoining valley sides, on slopes adjoining terrace depressions, or on fans where streams from uplands drop rapidly and spread out on the valley floor. Where these soils are on terraces, their profiles are similar to those described for the series. Where they are on stream fans, many of the rock fragments are angular. In a few places they have kame and kettle topography, and the deposits are not so well sorted as in the typical profiles. A good example is in the Chenango Valley State Park.

These soils generally adjoin less strongly sloping Chenango and Howard soils at lower elevations. In some places they adjoin steeper Chenango and Howard soils and well drained and moderately well drained Mardin soils. Included in mapping were moderately well drained Braceville soils and well drained silty Unadilla soils.

These soils are suitable for crops, pasture, or forest. The slopes impose some limitations. Row crops can be grown if runoff and erosion are controlled.

These are good soils for many nonfarm uses, and they are generally good sources of gravel. Slope is the main limitation to nonfarm use. (Capability unit IIIe–2; woodland group 1)

Chenango and Howard gravelly loams, 15 to 25 percent slopes (ChD).—These soils are generally thinner over the sandy and gravelly substratum than is typical of the

Figure 17.—**Corn crop on Chenango and Howard gravelly loams. The steeply sloping soils in the background are Mardin, Volusia, and Lordstown.**

series. The areas are generally 10 acres or more in size. They are on terrace faces, on valley sides, or on valley or upland hills where the ice front stood for a long time. In places they adjoin well drained and moderately well drained Mardin and Canaseraga soils and other Chenango and Howard soils. Small areas of all of these soils and of silty Unadilla soils were included in mapping.

These soils are suitable for hay, pasture, or forest. The slopes make the use of machinery very difficult and create an erosion hazard, which is severe when the soils are bare. Conservation practices are needed. Runoff is rapid, and little water is stored in the soils. Some pastures are productive in spring and fall but droughty in midsummer.

Slope is a limitation to nonfarm use. These soils are good sources of gravel. (Capability unit IVe–2; woodland group 1)

Chenango and Howard gravelly loams, 25 to 40 percent slopes (ChE).—In some places these soils have thinner, less well developed profiles than those described for the series. They are on steep terrace faces, steep valley sides, and hummocky or hilly places in valleys or uplands where the ice front stood for long periods. The areas are as much as 10 acres in size.

This mapping unit adjoins well drained and moderately well drained Mardin soils, well drained Unadilla soils, and moderately well drained Canaseraga and Scio soils.

These soils are suitable for pasture or forest. Many areas are wooded. Use of heavy machinery is difficult because of the steep slopes. Runoff is very rapid, and little water is stored for plants. Some pastures are productive in spring and fall but droughty in midsummer.

Areas of these soils are good sources of gravel. Slope is a limitation to other nonfarm uses. (Capability unit VIe–1; woodland group 3)

Chippewa Series

The Chippewa series consists of deep, strongly acid, poorly drained loamy soils that formed in acid or very low lime glacial till. These soils are in depressions, drainageways, and seeps in uplands.

A typical profile has a very dark gray channery silt loam surface layer that is rich in organic matter and about 5 inches thick. Just below this layer are firm layers of dark grayish-brown and gray channery silt loam that are mottled. These layers extend to the subsoil, which is at a depth of about 12 inches. The subsoil is a very firm, dense fragipan of channery silt loam. It is gray, prominently mottled with yellowish brown to a depth of about 20 inches. Below this it is grayish brown to light olive brown and faintly mottled. The fragipan has large prisms surrounded by thin silty streaks of light brownish gray that pinch out at a depth of about 36 inches. The substratum is very firm, olive-brown channery silt loam till.

The depth of rooting in Chippewa soils is confined to the 10 to 18 inches above the slowly permeable fragipan. This amount of soil holds from 2½ to 4 inches of water available to plants. Plants rarely are affected by lack of water because the soils are usually saturated in spring, and water seeps into them from adjacent areas long after rains. Chippewa soils can rarely be used for spring-planted crops unless drained. They are high in total nitrogen, but it is released very slowly during the cold, wet spring. In midsummer it is released rapidly and fosters the lodging of small grains that have been heavily fertilized. The ability to supply potassium and phosphorus is medium. The reaction is strongly or very strongly acid.

Wetness and ponding are the major limitations to forestry and nonfarm use. There is a potential for wildlife habitat or for recreation.

Typical profile of Chippewa channery silt loam, 3 to 8 percent slopes, in pasture:

A1—0 to 5 inches, very dark gray (10YR 3/1) channery silt loam; few, medium, distinct, dark-brown (10YR 4/3) mottles; weak, fine, granular structure; very friable; abundant fine roots; strongly acid; abrupt, smooth boundary. 4 to 6 inches thick.

A21—5 to 8 inches, dark grayish-brown (10YR 4/2) to grayish-brown (10YR 5/2) channery silt loam; some medium, prominent, yellowish-brown (10YR 5/8) mottles; weak, fine, angular blocky structure; firm; few fine roots; strongly acid; clear, wavy boundary. 4 to 5 inches thick.

A22—8 to 12 inches, gray (10YR 6/1) channery silt loam; a few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, angular blocky structure; firm; few fine roots; strongly acid; clear, wavy boundary. 3 to 6 inches thick.

Bx1—12 to 20 inches, gray (10YR 6/1) channery silt loam; many, coarse, prominent, yellowish-brown (10YR 5/8) mottles; light brownish-gray (10YR 6/2) silty lines originating in the horizon above divide this layer into prisms, 10 to 20 inches across, that have weak, fine, subangular blocky structure; firm and brittle; no roots; medium acid; clear, wavy boundary. 6 to 10 inches thick.

Bx2—20 to 36 inches, grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 5/4) channery silt loam; common, fine, faint, olive-brown (2.5Y 4/4) mottles; weak, medium, angular blocky structure in prisms separated by narrow, light brownish-gray (10YR 6/2) silty lines that dissipate within this horizon; very firm and brittle; no roots; medium acid; clear, wavy boundary. 12 to 20 inches thick.

C—36 to 48 inches, olive-brown (2.5Y 4/4) channery gritty silt loam; weak, coarse, blocky structure; very firm; no roots; slightly acid.

The surface layer ranges from loam to heavy silt loam and is channery or flaggy. Channery and flaggy rock fragments constitute 15 to 40 percent of the subsurface layers. The color of the surface layer ranges from very dark gray (10YR 3/1) to very dark grayish brown (10YR 3/2 and 2.5Y 3/2). The colors of the subsurface layers are dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or gray (10YR 6/1).

The fragipan colors are gray (10YR 6/1), olive brown (2.5Y 4/4), and light olive brown (2.5Y 5/4). Mottles are dark brown (10YR 4/3), yellowish brown (10YR 5/4, 5/6, 5/8), olive brown (2.5Y 4/4), and light olive brown (2.5Y 5/6).

The structure of the surface layer is granular, and the consistence is friable to very friable. The structure of the B horizon is angular blocky to subangular blocky within prisms. The depth to bedrock is rarely less than 40 inches. The profile is strongly acid to a depth of about 12 to 15 inches, medium acid to 36 inches, and neutral at about 60 inches.

Chippewa soils occur with Alden soils, but Alden soils are wetter and lack a fragipan. They are in a drainage sequence with well drained and moderately well drained Mardin soils and somewhat poorly drained Volusia soils. Volusia soils lack the predominance of gray color in the upper subsoil. Chippewa soils also occur with somewhat poorly drained Tuller soils, which lack a fragipan and are less than 20 inches in depth to bedrock. In the eastern part of the county, Chippewa soils are in a drainage sequence with dark brownish to reddish colored, well-drained Cattaraugus, moderately well drained Culvers, and somewhat poorly drained Morris soils.

Chippewa channery silt loam, 3 to 8 percent slopes (CpB).—This soil has concave slopes. It is in seep spots in uplands and along drainageways in small valleys. Most of the slopes are less than 8 percent, but some of the slopes near seep spots and springs on hillsides range up to 15 percent or more. In the eastern part of the county, this soil is redder than in other parts.

Somewhat poorly drained Volusia and moderately well drained Mardin soils surround this soil. In some places it adjoins Alden and Chippewa soils, 0 to 3 percent slopes, and in a few places it adjoins Alluvial land. Small spots of this soil are shown on the map by wet symbols within the areas of many other mapping units. Included with this soil in mapping were spots of very poorly drained Alden soils.

Seepage and wetness are limitations to farm and many nonfarm uses. Many areas are good sites for ponds. (Capability unit IVw-2; woodland group 8)

Culvers Series

The Culvers series consists of deep, strongly acid, moderately well drained, loamy soils that formed in firm, dense, reddish-brown glacial till strongly influenced by local red sandstone and shale. These soils have gentle to moderately steep, uniform slopes and occur on uplands in the eastern part of the county.

A typical profile has a dark-brown channery silt loam plow layer about 7 inches thick. Underlying this layer is the upper part of the subsoil, which extends to a depth of 18 inches. It is reddish-brown and brown to dark-brown, friable channery silt loam that is faintly mottled and firmer in the lower part. A thin, leached layer of firm, light-brown, mottled channery loam separates the upper part of the subsoil from the lower part. The lower part is an extremely firm, dense fragipan. It is at a depth of about 20 inches. To a depth of 27 inches, the fragipan is reddish-brown channery silt loam with very faint mottles. Below 27 inches it is dark reddish-gray, flaggy heavy silt loam. Streaks of light-brown loamy material surround coarse prisms in the fragipan. The streaks pinch out at a depth of about 55 inches. The substratum is extremely firm, reddish-brown channery silt loam till. Stony fragments of different sizes are prominent in many places.

The root zone is confined mostly to the 18 to 24 inches of soil above the slowly permeable fragipan. This amount of soil can hold 3½ to 5 inches of moisture available to plants. Early in spring the zone above the pan is usually saturated, and during May, 3 or 4 drying days are needed before tillage. During dry periods, plants begin to wilt after 10 or 15 days without rain. The ability to supply nitrogen, potassium, and phosphorus is medium. Unlimed areas are strongly acid. In general, the growing season is slightly shorter than on other upland areas of the county. This should be taken into account in selecting plant varieties.

Seasonal wetness, depth to fragipan, and stoniness are the major limitations to many nonfarm uses. Many areas of Culvers soils have desirable esthetic aspects.

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Typical profile of Culvers channery silt loam, 2 to 8 percent slopes, in a cultivated field:

Ap—0 to 7 inches, dark-brown (7.5YR 3/2) channery silt loam; weak, medium and fine, granular structure; very friable; abundant fine roots; strongly acid; abrupt, smooth boundary. 6 to 8 inches thick.

B21—7 to 13 inches, reddish-brown (5YR 4/4) and brown to dark-brown (7.5YR 4/4) channery silt loam; weak, fine, subangular blocky structure within weak plates; friable; plentiful fine roots; strongly acid; clear, wavy boundary. 5 to 8 inches thick.

B22—13 to 18 inches, reddish-brown (5YR 4/4) channery silt loam with few to common, fine, faint, brown to dark-brown (7.5YR 4/4) and light-brown (7.5YR 6/4) mottles; weak, fine, subangular blocky structure within weak plates; firm; few fine roots; strongly acid; clear, wavy boundary. 4 to 8 inches thick.

A'2—18 to 20 inches, light-brown (7.5YR 6/3) channery loam with many, fine and medium, distinct, elongated, brown (7.5YR 5/3) and strong-brown (7.5YR 5/8) mottles; weak, medium and thick, platy structure; firm; few fine roots; strongly acid; abrupt, irregular boundary. 2 to 5 inches thick, with tonguing separating prisms of horizons below.

B'x1—20 to 27 inches, reddish-brown (5YR 4/3) channery silt loam, very faintly mottled; weak, medium and coarse, subangular blocky structure within very coarse prisms, 18 to 24 inches across, coated with material from the A'2; fragmentary clay films in pores; extremely firm and brittle; few fine roots along prism faces; strongly acid; diffuse, wavy boundary. 6 to 12 inches thick.

B'x2—27 to 55 inches, dark reddish-gray (5YR 4/2), flaggy, fine-textured silt loam with prominent manganese staining; weak, coarse and medium, subangular blocky structure within very coarse prisms coated with material from the A'2; clay films discontinuous on ped surfaces and prominent in pores; extremely firm and brittle; few fine roots along prism faces; medium acid; diffuse, wavy boundary. 26 to 34 inches thick.

Cx—55 to 91 inches, reddish-brown (5YR 4/3) channery heavy silt loam or light silty clay loam with dark reddish-gray (5YR 4/2) ped coats; weak, thick, platy structure; clay skins discontinuous on ped surfaces and prominent in pores; extremely firm and brittle; no roots; neutral.

The silt loam surface horizon is flaggy or very stony in places instead of channery. The fragipan and the till substratum are generally medium textured, but in a few places they are moderately coarse textured. In many places there are boulders throughout the solum. Bedrock ledges in the horizontal rock strata make the depth of the soil uneven in many areas.

The fragipan begins at a depth of 18 to 24 inches and ranges from 3 to 10 feet in thickness. It is very hard and dense. The upper part of the fragipan has weak blocky structure or is massive within prisms, which are 1 to 2 feet across. The lower part generally has a thick platy structure or is massive.

The basal till is also very dense and massive and has thick platy structure. It is difficult to distinguish from the fragipan above it. The depth to bedrock is 10 feet or more in most places.

The Ap horizon is generally dark brown in color. The B2 horizon ranges from brown to reddish brown in hues of 7.5YR and 5YR. The depth to faint mottling ranges from 12 to 18 inches. The fragipan horizons are generally reddish brown, dark reddish brown, or reddish gray.

Culvers soils are in a drainage sequence with well-drained Cattaraugus and somewhat poorly drained Morris soils. They are shallower to the fragipan than Cattaraugus soils and have mottles in the lower part of the subsoil. In contrast to the Culvers soils, Morris soils have mottling directly under the plow layer. Culvers soils are similar to Mardin soils, which occur in the central and western parts of the county, but

Mardin soils are not reddish in the subsoil and have more clay in the B horizon. Culvers soils are also associated with well drained and moderately well drained Arnot soils, which are shallow to bedrock and lack a fragipan, and with well-drained Oquaga soils, which are moderately deep to bedrock and also lack a fragipan. In some places poorly drained Chippewa and very poorly drained Alden soils occur as seeps or depressions adjoining Culvers soils.

Culvers channery silt loam, 2 to 8 percent slopes (CuB).—This soil has the profile described as typical of the series. It commonly has slightly convex, uniform slopes on valley walls. At the higher elevations the slopes are gently undulating. Areas of this soil are generally less than 10 acres in size, but some are larger. It adjoins larger areas of somewhat poorly drained Morris soils, spots of which were included in mapping. It also adjoins steeper Culvers and Cattaraugus soils.

This soil can be used for pasture, forest, or crops. If it is cultivated, conservation practices are needed to conserve moisture and control erosion. Wetness is a slight problem early in spring. Small flat stones hinder tillage in some places.

Seasonal wetness and depth to the fragipan are the major limitations to many nonfarm uses. (Capability unit IIe–2; woodland group 2)

Culvers channery silt loam, 8 to 15 percent slopes (CuC).—This soil is in the eastern part of the county in the Catskill foothills. It occurs as nearly round or oblong areas, generally more than 10 acres in size, that have convex slopes. The slopes generally extend in one direction but are slightly rolling. Spots of well-drained Cattaraugus and somewhat poorly drained Morris soils were included in mapping.

This soil is suited to crops, pasture, or forest. If it is used for row crops, erosion is a hazard because of the slope. Conservation practices are needed. Wetness is a slight problem early in spring. Small flat stones hinder tillage in some places.

Seasonal wetness and depth to the pan are the major limitations to many nonfarm uses. (Capability unit IIIe–4; woodland group 2)

Culvers channery silt loam, 15 to 25 percent slopes (CuD).—This soil receives runoff from adjacent soils, but it has moderately good drainage because of the slopes. Small spots of other Culvers soils, well-drained Cattaraugus soils, and moderately deep Oquaga soils were included in mapping. Also included were small spots of Morris and Chippewa soils along drainageways and around seeps.

This soil is suited to limited cultivation or to pasture and forest. It is better suited to hay or pasture than to other crops. The slopes are hazardous to work, and the erosion hazard is severe.

Slope and seasonal wetness are the major limitations to many nonfarm uses. (Capability unit IVe–1; woodland group 2)

Cut and Fill Lands

Cut and fill lands is a miscellaneous land type made by landforming operations for urban development or other construction purposes. It consists of areas that have been excavated or have been filled with soils and other geologic materials. The characteristics of this land type vary according to the soils and other materials that have been moved in landforming operations. Consequently, onsite investigation is necessary for use of any given area.

Areas of this land type conform in size and shape to plot boundaries and building sites. Some areas are fairly large where one cut or filled property site joins another. The surface of the areas may be nearly level, but the sides may be steep.

Cut and fill lands, gravelly materials (Cv).—This land type consists of fill that came mostly from areas of Chenango and Howard soils or from leveled areas of these soils. Fill from these materials generally is excellent for highways and for building sites. It has been used at Chenango Bridge (fig. 18) and at Whitney Point Dam. Areas of this fill near Binghamton commonly consist of 5 to 10 feet of Chenango soil material over alluvial Tioga soil material. (Not in a capability unit; woodland group 9)

Cut and fill lands, loamy materials (Cw).—This land type is made up of excavated areas or areas filled with soils that formed in glacial till. Most of the areas are in Mardin and Volusia soils; some are in Canaseraga and Dalton soils. Glacial till, if not too stony, makes good fill. It is fairly impervious and can be used to make dike cores for earth dams, such as the dam at Whitney Point that protects the village from floods. (Not in a capability unit; woodland group 9)

Cut and fill lands, silty materials (Cy).—Areas of this mapping unit are filled with alluvial materials or are graded areas of alluvial soils. Fill from these materials does not support heavy loads well and is subject to erosion. It is generally used only when glacial till or gravelly outwash is not available. Some of the buildings on the west side of the highway below Hillcrest are on this kind of fill. Some grading has been done to straighten the river channel below the dam at Whitney Point. (Not in a capability unit; woodland group 9)

Dalton Series

The Dalton series consists of deep, somewhat poorly drained, silty acid soils that formed in two contrasting

Figure 18.—Cut and fill lands, gravelly materials, near Chenango Bridge. This fill raises the land above flood level so that it can be used for urban development.

deposits. The upper deposit is coarse silt or very fine sand; the lower one is medium-textured, firm basal till derived mainly from acid sandstone and shale. These soils are in small, slightly concave areas along valley walls. The largest areas are near the State Hospital and near Conklin, Vestal, Ouaquaga, Damascus, and Harpursville.

A typical profile has a dark grayish-brown silt loam surface layer about 6 inches thick. This layer is underlain by the upper part of the subsoil, which is friable, brown to pale-brown silt loam with distinct grayish-brown mottles. This upper part extends to a depth of 15 inches and is separated from the lower part of the subsoil by a leached layer of light brownish-gray very fine sandy loam that is distinctly mottled. At a depth of about 20 inches is the lower subsoil, which is a very firm, dense fragipan of channery silt loam. It is dark yellowish brown to light brownish gray and is distinctly mottled in the upper part. Below 40 inches it is dark brown to brown and has no mottles. Streaks of gray silty material surround coarse prisms throughout the fragipan. These streaks begin to pinch out at a depth of about 54 inches. The substratum below the fragipan is light olive-brown channery silt loam till. It also is very firm. Where the silt mantle is thick enough, the fragipan has formed in it and in the underlying till.

Plant roots are confined largely to the 20 inches of soil above the slowly permeable fragipan. This amount of soil holds from 2 to 4 inches of moisture available to plants. Although this amount is low, plants rarely are affected by lack of moisture in spring, because the zone above the pan is usually saturated. In May, from 4 to 7 drying days are usually required before tillage. During dry periods plants show moisture stress after 7 to 10 days without rain. The ability to supply nitrogen and phosphorus is medium; the ability to supply potassium is low. Unlimed areas are strongly acid. Erosion is a hazard if these soils are left bare.

Seasonal wetness and depth to the fragipan are the major limitations to many nonfarm uses.

Typical profile of Dalton silt loam, 2 to 8 percent slopes, in an idle area:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; abundant fine to medium roots; strongly acid; abrupt, smooth boundary. 5 to 8 inches thick.

B2—6 to 15 inches, brown (10YR 5/3) to pale-brown (10YR 6/3) silt loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, platy structure; friable; abundant fine to medium roots; strongly acid; gradual, wavy boundary. 6 to 12 inches thick.

A'2—15 to 20 inches, light brownish-gray (10YR 6/2) very fine sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, thin and medium, platy structure; friable; plentiful fine to medium roots; medium acid; wavy boundary. 4 to 6 inches thick.

IIB'x1—20 to 40 inches, dark yellowish-brown (10YR 4/4) to light brownish-gray (10YR 6/2) channery silt loam; common, fine, distinct, brown (10YR 5/2) mottles; weak, fine, subangular blocky structure within coarse prisms 8 to 12 inches across, separated by gray (10YR 6/1) silty A'2 material 1 inch to 1½ inches wide; very firm and brittle; few fine roots in upper part of horizon; medium acid; gradual, wavy boundary. 18 to 22 inches thick.

IIB'x2—40 to 54 inches, dark-brown (10YR 3/3) to brown (10YR 5/3) channery silt loam; weak, medium, subangular blocky structure; coarse prisms and silty lines of horizon above continue through this horizon; very firm and brittle; no roots; medium acid; gradual, wavy boundary. 12 to 16 inches thick.

IICx—54 to 60 inches, light olive-brown (2.5Y 5/4) channery silt loam; moderate, platy structure breaking to weak, fine, subangular blocky structure; prisms and silty lines of horizon above dissipate in the upper part of this horizon; very firm and brittle; no roots; medium acid at 54 inches, slightly acid at 60 inches.

The texture of the surface layer is silt loam or very fine sandy loam. The texture of the IIB and IIC horizons ranges from channery loam to silt loam. The till contains water-worked gravel and cobbles in some places, but generally it contains angular shale, siltstone, and sandstone fragments.

The color of the Ap horizon ranges from dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2). The color of the B2 horizon ranges from dark yellowish brown (10YR 4/4) to light brownish gray (10YR 6/2), and that of the A'2 horizon ranges from grayish brown to brown (10YR 5/2–5/3) and from light brownish gray to pale brown (10YR 6/2–6/3). The fragipan colors include dark grayish brown (2.5Y 4/2), light brownish gray (10YR 6/2), dark brown (10YR 3/3 and 4/3), brown (10YR 5/3), and dark yellowish brown (10YR 4/4).

The structure of the surface layer is granular, and the consistence is friable to very friable. The subsoil structure is platy, angular blocky, and subangular blocky.

The silty deposit is 18 to 36 inches thick and is generally free of gravel. In places where it is less than 24 inches thick. the fragipan has formed in the till; where the silty deposit is more than 24 inches thick, the top part of the fragipan has formed in the bottom part of the silty deposit. At higher elevations, the depth to bedrock is only 10 feet in places, but the till is generally 40 feet or more thick over bedrock.

The reaction is strongly acid to a depth of about 15 or 16 inches, medium acid to a depth of about 54 inches, and slightly acid to a depth of 7 or 8 feet.

Dalton soils are in a drainage sequence with moderately well drained and well drained Canaseraga soils, which lack mottles immediately below the plow layer. Dalton soils are associated with somewhat poorly drained Volusia soils, which have a thinner silty mantle. Wallington soils on adjoining stream terraces have the surface layer and upper subsoil characteristics of Dalton soils but formed entirely in deep, silty deposits. The associated Morris soils are reddish in the fragipan layer and lack the silty mantle.

Dalton silt loam, 2 to 8 percent slopes (DaB).—This soil is like the one described as typical of the series. The slopes are concave, and the areas are generally less than 10 acres in size. They commonly are next to areas of moderately well drained Mardin and Canaseraga soils. Small knolls of these soils and spots of somewhat poorly drained Volusia soils were included in mapping.

This soil can be used for crops, pasture, or forest. Somewhat poor drainage and low fertility are limitations. Controlling erosion is a serious problem and requires careful application of conservation measures.

Seasonal wetness and slow or moderately slow permeability are major limitations to many nonfarm uses. (Capability unit IIIw-3; woodland group 5)

Dalton silt loam, 8 to 15 percent slopes (DaC).—This soil occurs as concave areas in seeps and drainageways along valley sides. The areas are generally less than 5 acres in size.

Adjoining this soil are the more gently sloping Dalton soils, the moderately well drained Canaseraga and Mardin soils, and the somewhat poorly drained Volusia soils. Small knolls of Canaseraga and Mardin soils were included in mapping, as well as small areas of Volusia soils where the silty mantle is thinner.

This soil can be used for crops, pasture, or forest, but it is probably better suited to hay crops. If it is cultivated, conservation measures are necessary. Seasonal wetness, low fertility, and the serious erosion hazard are the greater limitations.

Seasonal wetness and slow or moderately slow permeability are major limitations to many nonfarm uses. (Capability unit IIIe-7; woodland group 5)

Howard Series

The Howard series consists of deep, well-drained, medium-textured gravelly soils that formed in glacial outwash containing limestone gravel, sandstone, and shale. These soils are on level or hilly kame terraces, mostly in the valleys of the Chenango River and its tributaries.

A typical profile has a dark yellowish-brown gravelly loam surface layer about 7 inches thick. The underlying subsoil extends to a depth of about 40 inches. In the upper part it is strong-brown to brown, very friable gravelly loam. Below a depth of 20 inches it is dark-brown, sticky very gravelly loam. The substratum is at a depth of 40 inches and consists of loose, stratified sand and gravel. It is neutral in the upper part and calcareous below a depth of 60 inches. In places the substratum contains layers cemented with lime.

Roots of deep-rooted crops and trees penetrate the rapidly permeable gravelly substratum, but most rooting is within the upper 30 or 40 inches of soil, which holds 4 to 6 inches of water available to plants. Because of the higher clay content, this is slightly more water than the closely associated Chenango soils hold. Plants often show signs of wilting after 10 days without rain. The ability to supply nitrogen, potassium, and phosphorus is medium. Unlimed areas are strongly acid. Alfalfa and other deep-rooted plants flourish in the limy lower subsoil and substratum.

The gently sloping Howard soils are among the more productive in the county. They are also good urban sites and, with Chenango soils, are the best sources of sand and gravel.

Typical profile of Howard gravelly loam, 0 to 5 percent slopes, in an idle area:

Ap—0 to 7 inches, dark yellowish-brown (10YR 4/4) gravelly loam; very weak, very fine, granular structure; very friable; abundant fine and medium roots; strongly acid; abrupt, smooth boundary. 7 to 8 inches thick.

B1—7 to 15 inches, strong-brown (7.5YR 5/6) gravelly loam; weak, very fine, granular structure; very friable; abundant fine and medium roots; strongly acid; abrupt, wavy boundary. 7 to 10 inches thick.

B21t—15 to 20 inches, brown (7.5YR 5/4) to strong-brown (7.5YR 5/6) gravelly loam; weak, fine, granular structure; very friable, somewhat sticky; abundant fine and medium roots; medium acid; clear, wavy boundary. 4 to 8 inches thick.

B22t—20 to 30 inches, dark-brown (7.5YR 4/4), sticky very gravelly loam; weak, fine, subangular blocky structure; clay films on ped faces; friable, slightly sticky and plastic; plentiful medium roots; medium acid; clear, wavy boundary. 9 to 14 inches thick.

B23t—30 to 40 inches, dark-brown (7.5YR 4/2), sticky very gravelly loam; patches of strong-brown (7.5YR 5/6), weathered limestone; weak, medium, subangular blocky structure; dark clay skins on ped faces; firm, sticky and plastic; plentiful medium roots; medium to slightly acid; clear, wavy boundary. 9 to 15 inches thick.

C—40 to 60 inches, grayish-brown (10YR 5/2) to dark-brown (10YR 4/3), loose, stratified sand and gravel; few roots in upper part; neutral at 45 inches, calcareous at 60 inches.

The texture of the surface layer is loam or gravelly loam to gravelly silt loam. The color of the Ap horizon ranges from dark grayish brown (10YR 4/2) to dark yellowish brown (10YR 4/4). The B horizon colors are brown (10YR 5/3 and 7.5YR 5/4), yellowish brown (10YR 5/4 to 5/8), light yellowish brown (10YR 6/4), strong brown (7.5YR 5/6 to 5/8), and dark brown (7.5YR 4/2 and 4/4). The Ap horizon is granular in structure and friable to very friable. The B22t horizon is granular or subangular blocky in structure. The B horizon generally contains a few dark reddish-brown remnants of limestone gravel that are in the process of solution and disintegration. The depth to carbonates ranges from 40 to 72 inches.

Howard soils occur with Chenango soils in Broome County and are mapped with them in undifferentiated units. Chenango soils, however, lack the sticky lower subsoil and are deeper to calcareous material. Howard soils are in a drainage sequence with moderately well drained Braceville soils, which have a fragipan and mottles in the lower subsoil. Other associated soils are Unadilla and Scio, which formed in deep silty deposits at slightly lower elevations, and Mardin, Canaseraga, and Lordstown soils in glacial till on uplands.

Lordstown Series

The Lordstown series consists of well-drained, strongly acid soils that formed in loamy till that had been influenced by the underlying gray sandstone and shale bedrock. The bedrock is at a depth of 20 to 40 inches, and in the soil mass above it there are many flat rock fragments of all sizes. Lordstown soils are gently to steeply sloping and are scattered throughout much of the county.

Typically, the surface layer is dark grayish-brown loam or channery silt loam about 7 inches thick. The subsoil is friable, yellowish-brown to dark yellowish-brown channery silt loam that extends to a depth of about 26 inches. It is underlain by a thin layer of light olive-brown very channery silt loam. Gray sandstone bedrock is at a depth of about 28 inches.

The root zone consists of 20 to 40 inches of moderately permeable soil that lies over bedrock. In many of the shallower areas the bedrock is shattered and interspersed with fines, so that nutrients and moisture are available. From 3 to 6 inches of moisture is held available to plants. After 10 to 20 days without rain, plants are seriously affected by lack of moisture. These soils are suitable for early tillage and for spring grazing. The ability to supply nitrogen, potassium, and phosphorus is medium. Unlimed areas are strongly or very strongly acid.

Slope and depth to bedrock are limitations for many nonfarm uses of these soils.

Typical profile of Lordstown channery silt loam, 15 to 25 percent slopes, in a forest plantation:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) channery silt loam; weak, fine, granular structure; friable; abundant fine roots; strongly acid; abrupt, smooth boundary. 6 to 8 inches thick.

B21—7 to 16 inches, yellowish-brown (10YR 5/4) channery silt loam; weak, very fine to fine, subangular blocky structure breaking to very weak, very fine to fine, granular structure; friable; abundant fine roots; strongly acid; clear, wavy boundary. 5 to 12 inches thick.

B22—16 to 26 inches, yellowish-brown (10YR 5/4) to dark yellowish-brown (10YR 4/4) channery silt loam; weak, fine, subangular blocky structure; friable; plentiful roots; strongly acid; abrupt, smooth boundary. 7 to 14 inches thick.

C—26 to 28 inches, light olive-brown (2.5Y 5/4) very channery silt loam; structureless; many channery rock fragments; very friable; few roots; strongly acid; abrupt, smooth boundary. 2 to 6 inches thick.

R—28 to 36 inches, gray, acid sandstone bedrock.

The texture ranges from channery loam to silt loam. Channery and flaggy coarse fragments are 20 to 35 percent of the soil profile, and some areas are extremely stony and rocky. The Ap horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), dark brown (10YR 4/3), or dark yellowish brown (10YR 4/4). It generally has granular structure and is friable to very friable. The B horizon is yellowish brown (10YR 5/4 to 10YR 5/8) to dark yellowish brown (10YR 4/4). Its structure is generally subangular blocky breaking to granular. In many places, particularly where the underlying rock is smooth and massive without cracks, the thin horizon directly above the rock becomes waterlogged briefly during wet periods and is mottled. The depth to bedrock ranges from 20 to 40 inches but commonly is 20 to 30 inches. The profile is strongly acid.

Lordstown soils occur with Arnot and Tuller soils, which are less than 20 inches to bedrock. Arnot soils are well drained and moderately well drained. Tuller soils are somewhat poorly drained and poorly drained and are distinctly mottled under the plow layer. Deeper soils that occur with Lordstown are well drained and moderately well drained Mardin and Canaseraga soils and somewhat poorly drained Volusia and Dalton soils. These soils have a prominent fragipan and a varying degree of mottling above the fragipan, depending upon drainage. In depressions and along drainageways, Lordstown soils occur with the wetter Chippewa and Alden soils. In the southeastern part of the county, Lordstown soils occur with Oquaga soils, which are reddish colored in the B horizon. Some areas of Lordstown and Oquaga soils are mapped together as undifferentiated units.

Lordstown channery silt loam, 0 to 5 percent slopes (LdB).—A profile of this soil is similar to the one described as typical of the series, except for a thin, mottled layer over the bedrock in those places where the water table is perched temporarily. Spots of Mardin soil and of shallow Arnot and Tuller soils were included in mapping.

This soil is well suited to crops, pasture, hay, and forest. Because it is at a high elevation, climate affects the selection of crops and the methods of farming. The depth of rooting ranges from 20 to 40 inches, and plant growth is generally better in the deeper areas. Flat stone fragments hinder some tillage and harvesting.

The depth to bedrock is the main consideration for nonfarm use of this soil. Some areas have esthetic qualities and panoramic views for homesites. (Capability unit IIs-1; woodland group 2)

Lordstown channery silt loam, 5 to 15 percent slopes (LdC).—Areas of this soil are generally less than 5 or 10 acres in size. Included in mapping were moderately well drained Mardin, somewhat poorly drained Volusia, and shallow Arnot and Tuller soils.

This soil is suited to crops, pasture, hay, and forest. It is subject to erosion and requires conservation measures if cultivated. Water runs off rapidly, and little water is received from other areas. Plant growth is generally better in the places that are deeper to bedrock. Flat stone fragments hinder some harvesting and tillage operations.

Depth to bedrock is the main consideration for nonfarm use of this soil. In many places the bedrock is fairly soft and can be excavated. Some areas have esthetic qualities and panoramic views for homesites. (Capability unit IIIe-1; woodland group 2)

Lordstown channery silt loam, 15 to 25 percent slopes (LdD).—Except for more variable depth to bedrock, the profile of this soil is like the one described as typical of the series. Included in mapping were areas where the depth to bedrock ranges from a few inches to more than 40 inches within a few feet, and there are occasional outcrops. Also included were areas of well drained and moderately well drained Mardin soils, somewhat poorly drained Volusia soils, and shallow Arnot soils.

This soil occurs as long narrow strips, generally less than 20 acres in size, along hillsides. It has rapid runoff and receives very little water from other areas, but contributes considerable seepage to soils on lower slopes.

This soil is suitable for limited cultivation, for pasture, or for forest. The erosion hazard is very severe, and operation of machinery is hazardous and difficult.

Slope and depth to bedrock are the major limitations for nonfarm use. Many areas can be developed for skiing (*15*). (Capability unit IVe-1; woodland group 2)

Lordstown and Oquaga channery silt loams, 25 to 35 percent slopes (LoE).—Some areas of this unit consist of Lordstown soils, some of Oquaga soils, and some of both. The Lordstown soil is dominant in central and western Broome County, and the Oquaga is dominant in some of the eastern areas. Profiles of these soils are like those described as typical of the Lordstown and Oquaga series, except for more variable depth to bedrock. Included in mapping were areas where the depth ranges from a few inches to more than 40 inches within a few feet. Outcrops are common. Also included were areas of shallow Arnot and deep Mardin and Cattaraugus soils.

The soils of this mapping unit can be used for forest or pasture, but steepness of slope limits improvement of pasture. The erosion hazard is very severe. Water runs off rapidly, and little water is received from other areas, but these soils supply considerable seepage water to lower lying soils.

Steep slopes and depth to bedrock are the major limitations for nonfarm use. Some areas can be developed for skiing. (Capability unit VIe-1; woodland group 3)

Lordstown and Oquaga soils, 35 to 60 percent slopes (LrF).—The profiles of these soils are like those described for the series, except for the extremely variable depth to bedrock within short distances. This unit consists of the Lordstown soil in central and western parts of the county and of both soils or just Oquaga soil in the eastern part.

Areas of this mapping unit are generally less than 20 acres in size and are in long, narrow strips on hillsides. Included in mapping were spots of well-drained Mardin and Cattaraugus soils, poorly drained Chippewa soils, and very poorly drained Alden soils. Included also were some extremely stony and rocky areas.

The soils of this unit can be used for forest. They are too steep or too stony and rocky for many uses. They have very rapid runoff and receive little water from other soils but supply considerable seepage water to soils on lower slopes. (Capability unit VIIs–1; woodland group 4)

Lordstown and Oquaga extremely stony and rocky soils, 0 to 35 percent slopes (LsE).—The profiles of these soils are like those described as typical of their series, except for the extreme stoniness and rockiness. The Lordstown or Oquaga soil makes up 50 to 60 percent or more of any area; Arnot, Cattaraugus, Culvers, and Mardin soils make up most of the rest. Included in mapping were wet spots of Morris, Tuller, Volusia, and Chippewa soils.

Slope is a limitation, but extreme stoniness or rockiness is the main limitation. In a few places, especially in the eastern part of the county, there are slabs of loose rock as large as boxcars. (Capability unit VIIs–1; woodland group 7)

Made land, sanitary land fill (Mf).—This miscellaneous land type consists of filled areas, generally near urban centers, in which garbage and solid waste have been buried beneath soil materials of varying composition. In some places the fill has been put on wet soils in low spots, then compacted and used for construction sites. There is some danger of pollution from seepage through the fill. There is also a stability problem. The areas are generally less than 5 acres in size. They are nearly level on top as a result of landshaping, but they may have very steep sides. (Not in a capability unit; woodland group 9)

Mardin Series

The Mardin series consists of deep, gently sloping to steep, well drained and moderately well drained soils that formed in acid or low-lime glacial till derived principally from gray, acid sandstone, siltstone, and shale. The slopes are convex or smooth, and little water accumulates. A slowly permeable fragipan occurs at a depth of 18 to 22 inches. Mardin soils occur in all parts of the county except the highlands in the southeastern part, where the Cattaraugus and Culvers soils, which formed in reddish till, are dominant.

Typically, Mardin soils have a plow layer of dark yellowish-brown channery silt loam about 7 inches thick. The upper part of the subsoil, to a depth of about 15 inches, is friable, yellowish-brown channery silt loam. It is separated from the lower part by a leached, firm layer of brown to pale-brown, mottled channery silt loam. The lower part, which begins at a depth of about 18 inches, is a very firm, dense fragipan of channery or very channery silt loam. This material is dark yellowish brown to grayish brown and faintly mottled to a depth of about 28 inches. Below this depth it is dark yellowish brown to olive brown and is free of mottling. Vertical streaks of light brownish-gray silty material surround coarse prisms in the fragipan but disappear at a depth of 36 to 48 inches. The substratum, which begins at a depth of 58 inches, is very firm, olive to pale-olive channery or very channery silt loam glacial till.

The root zone of these soils is confined to the 18 to 22 inches above the fragipan (fig. 19). It holds from 3½ to 5 inches of water that is available to plants.

Early in spring these soils, particularly the more gently sloping ones, are saturated above the fragipan. As a rule, they need to dry out for 2 to 4 days before they can be tilled in May. They are medium in ability to supply nitrogen, potassium, and phosphorus. In unlimed areas, the reaction is very strongly acid.

The depth to the fragipan and a slight seasonal wetness are the major limitations for many nonfarm uses.

Typical profile of Mardin channery silt loam, 8 to 15 percent slopes, in a cultivated field:

Ap—0 to 7 inches, dark yellowish-brown (10YR 4/4) channery silt loam; weak, fine and medium, granular structure; very friable; abundant roots; strongly acid; abrupt, smooth boundary. 6 to 8 inches thick.

B2—7 to 15 inches, yellowish-brown (10YR 5/6) channery silt loam; weak, fine, subangular blocky structure breaking to weak, fine, granular structure; friable; abundant roots; strongly acid; clear, wavy boundary. 8 to 18 inches thick.

A'2—15 to 18 inches, brown (10YR 5/3) to pale-brown (10YR 6/3) channery silt loam; few, medium, faint, brownish-yellow (10YR 6/6) mottles; weak, thin to medium, platy structure; firm; few roots; strongly acid; clear, wavy boundary. 0 to 6 inches thick.

B'x1—18 to 28 inches, dark yellowish-brown (10YR 4/4) to grayish-brown (2.5Y 5/2) channery silt loam; few, medium, prominent, yellowish-brown (10YR 5/6) mottles; light brownish-gray (10YR 6/2) silty tongues originating in horizon above divide this horizon into prisms 12 to 24 inches in width, the interiors of which have weak, medium to coarse, blocky structure; very firm; brittle; a few roots follow silt lines; strongly acid; clear, wavy boundary. 10 to 14 inches thick.

B'x2—28 to 58 inches, dark yellowish-brown (10YR 4/4) to olive-brown (2.5Y 4/4) channery to very channery silt loam; weak, thick, platy structure; silty lines and prisms of horizon above extend into this horizon but dissipate at a depth of 3 to 4 feet; very firm and brittle; no roots; few clay films in pores; strongly acid in upper part, medium acid in lower part; clear, wavy boundary. 26 to 36 inches thick.

Cx—58 to 70 inches +, olive (5Y 5/3) to pale-olive (5Y 6/4) channery to very channery silt loam; weak, thick, platy structure; very firm; no roots; medium acid to slightly acid at a depth of 60 inches, neutral at a depth of about 80 inches.

The texture of the surface layer and subsoil ranges from channery silt loam to loam. Channery fragments and flagstones make up from 10 to 35 percent, by volume, of the soil material. On the lower walls of the larger valleys, the soils generally are more silty and are comparatively free of coarse fragments.

In color, the Ap horizon is very dark grayish brown (10YR 3/2), dark yellowish brown (10YR 3/4), dark grayish brown (10YR 4/2), dark brown (10YR 4/3), or dark yellowish brown (10YR 4/4). The B horizon ranges from yellowish brown (10YR 5/4) through pale brown (10YR 6/3) to light yellowish brown (10YR 6/4). In places the B horizon is faintly mottled, and in others it is clear of mottling. The A'2 horizon is brown (10YR 5/3) and pale brown (10YR 6/3). The fragipan is dark brown (10YR 4/3), dark yellowish brown (10YR 4/4), grayish brown (2.5Y 5/2), olive brown (2.5Y 4/4), light olive brown (2.5Y 5/4), or olive (5Y 5/3 to 5/4). Where mottling occurs, the colors range from yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), grayish brown (2.5Y 5/2), and light olive brown (2.5Y 5/4 to 5/6) to light olive gray (5Y 6/2).

The surface horizon is granular in structure and is friable to very friable. The A'2 horizon generally has platy structure. The fragipan has weak, blocky or platy structure within the 12- to 24-inch prisms. The depth to bedrock is at least 40 inches and in places as much as 40 feet or more.

Mardin soils are strongly acid to a depth of about 4 feet, medium acid to slightly acid at a depth of 5 feet, and neutral at a depth of 6 to 7 feet.

Mardin soils are part of a drainage sequence with, and are associated with, the somewhat poorly drained Volusia

Figure 19.—**Fragipan in Mardin soils exposed in road cut. This dense, impermeable layer restricts the growth of roots to the soil above the pan.**

soils, the poorly drained Chippewa soils, and the very poorly drained Alden soils. They lack the distinct or prominent mottling that is immediately below the plow layer in those wetter soils, and their fragipan typically is at a greater depth than that in Volusia and Chippewa soils. Along the lower part of valley walls, Mardin soils are closely associated with the well drained and moderately well drained Canaseraga soils, which formed in a silty mantle at least 15 inches thick and the underlying glacial till.

The upper horizons of Mardin soils are similar to those of Lordstown and Arnot soils, but Lordstown and Arnot soils are less than 40 inches in depth to bedrock, and they lack a fragipan.

Mardin channery silt loam, 2 to 8 percent slopes (MhB).—A profile of this soil is similar to the one described as typical of the series, except that the lower part of the B horizon commonly is faintly mottled and the leached A′2 horizon is grayer.

This soil is wetter than the more strongly sloping Mardin soils. The areas generally are less than 10 acres in size and are nearly round. Most areas are gently undulating and are on the higher landforms that do not receive water from other areas. They are adjacent to larger areas of somewhat poorly drained Volusia soils. Included in mapping were spots of Volusia soils and spots of a soil underlain by bedrock at a depth of 20 to 40 inches.

This soil is suited to crops, pasture plants, hay, and forest. Under careful management that includes measures for control of runoff and erosion, it is productive. Drainage of wet spots allows fields to be farmed uniformly. Low fertility, slight wetness, and the hazard of erosion are limitations for farm use. Seasonal wetness and slow permeability are limitations for many nonfarm uses. (Capability unit IIe–2; woodland group 2)

Mardin channery silt loam, 8 to 15 percent slopes (MhC).—This soil is on the side slopes of large hills. It generally occurs as strips, several hundred feet in width, that encircle and are roughly parallel to the contour of the hill. In places these strips are not clearly defined, and in some spots they are discontinuous. Included in mapping were small areas of somewhat poorly drained Volusia soils; some small areas of Canaseraga soils along the lower part of valley walls; and small spots of better drained soils that lack mottling and are deeper to the fragipan.

This soil is suited to crops, pasture plants, hay, and forest. Droughtiness in midsummer and the hazard of erosion are limitations for farm use. Seasonal wetness, slow permeability, low fertility, and strong slopes are limitations for many nonfarm uses. (Capability unit IIIe-4; woodland group 2)

Mardin channery silt loam, 15 to 25 percent slopes (MhD).—This is a well-drained soil that occurs on hillsides. It is deeper to the fragipan than the soil described as typical of the series, and it commonly lacks mottling. The areas are either oblong, or they occur as bands, several hundred feet in width, that encircle the middle of the hills. Slopes are smooth or distinctly convex. Included in mapping were small areas of the moderately deep Lordstown soils and the wetter Volusia and Chippewa soils.

This soil is suited to hay, pasture, or forest. The use of machinery, however, on these moderately steep slopes is difficult and hazardous. Erosion is a serious hazard. Seasonal wetness, slow permeability, and slope are the major limitations for many nonfarm uses. (Capability unit IVe-1; woodland group 2)

Mardin channery silt loam, 25 to 35 percent slopes (MhE).—This soil is well drained and lacks the mottles of the typical Mardin profile. It is on the sides of valleys where the slopes are smooth or convex. Included in mapping were moderately deep, well-drained Lordstown soils, reddish-colored Culvers soils, and Volusia, Morris, and Chippewa soils around seeps.

This soil is too steep for use of modern machinery and is difficult to manage or improve. It is suitable for pasture or forest.

Slope is the major limitation to many nonfarm uses. Some of the slopes are good for skiing. (Capability unit VIe-1; woodland group 3)

Mardin and Cattaraugus soils, 35 to 60 percent slopes (MrF).—These soils lack the drainage mottles that are typical of Mardin soils. They formed in deep till and have a texture of very stony or channery silt loam. They occur as small, oblong areas on valley walls or ravines. Either or both soils make up any mapped area, but the Mardin soil is predominant except in the eastern part of the county where the soils of this unit are mixed together because of the variable glacial till in which they formed. Included in mapping were small areas of the adjoining moderately deep, well drained Lordstown and Oquaga soils, a few areas of moderately well drained Culvers soils, and seep spots of somewhat poorly drained Volusia and Morris soils.

The soils of this unit are too steep for the use of modern machinery. They can be used for native pasture or forest, but they are droughty, and the erosion hazard is severe.

Slope is the major limitation to nonfarm use. (Capability unit VIIs-1; woodland group 4)

Mardin-Chenango channery silt loams, 5 to 15 percent slopes (MnC).—Mardin and Chenango soils are of about equal extent in this mapping unit. Included in mapping were areas that consist of an intergrade that has properties of both soils. In most areas of this intergrade, the properties of the Mardin soils are predominant in the surface layer and upper part of the subsoil.

These soils occur as small areas on the tops of large kames and on remnants of smooth kames on the lower part of valley walls (fig. 20). Most of the areas are hummocky or humpy in shape and generally nearly round. Other Mardin soils and Canaseraga and Volusia soils surround these areas, and well-drained gravelly Chenango and Howard soils occupy terraces at lower elevations on the valley floor.

These soils are suitable for crops, pasture, or forest. Droughtiness may be a limitation during dry summers. The hazard of erosion and the complex topography generally are limitations if row crops are grown. Some areas provide good sites for buildings. Some have good views and consequently are desirable sites for residences. (Capability unit IIIe-2; woodland group 2)

Mardin-Chenango channery silt loams, 15 to 25 percent slopes (MnD).—Mardin and Chenango soils are of about equal extent in this mapping unit. Included in mapping were areas that consist of an intergrade that has properties of both soils. In most areas of this intergrade, the properties of the Mardin soils are predominant in the surface layer and upper part of the subsoil.

Areas of these soils are nearly round and are 1 acre or more in size. They are on a complex of till and kame terraces on the lower parts of valley walls, such as those west of Ouaquaga. The kame terraces are hummocky or humpy. Surrounding these soils are Canaseraga, somewhat poorly drained Volusia, and other Mardin soils. Near them on nearly level terraces at lower elevations are well-drained gravelly Chenango and Howard soils.

The soils of this complex can be used for hay, pasture, or forest. Row crops are generally difficult to grow, as the slopes make the use of machinery difficult and hazardous. Erosion also is a hazard.

Slope is a limitation to nonfarm use, although these soils provide good support for buildings. They are not such good sources of sand and gravel as the Chenango soil in the Chenango and Howard mapping units. (Capability unit IVe-2; woodland group 2)

Mardin, Moderately Shallow Variant

Mardin channery silt loam, moderately shallow variant, 2 to 8 percent slopes (MmB).—Except for the depth to bedrock, this variant has a profile similar to that described for the Mardin series. It is moderately well drained and is only 20 to 40 inches deep over bedrock. It occurs as small, round or oblong areas on hilltops and valley sides where the slopes are smooth or slightly convex. These areas are generally surrounded by shallow Arnot and well-drained, moderately deep Lordstown soils. Spots of Lordstown soils and slightly deeper Mardin soils were included in mapping.

This soil is suited to crops, hay, pasture, or forest. It can be farmed much like the deeper Mardin channery silt loam, 2 to 8 percent slopes. Areas of it are generally small compared to those of the surrounding Lordstown soils, but they control the use of many fields. Slight wetness, low fertility, and the hazard of erosion are limitations, but under careful management that includes conservation, good crops can be grown.

Seasonal wetness and shallowness to bedrock are the major limitations to many nonfarm uses. (Capability unit IIe-2; woodland group 2)

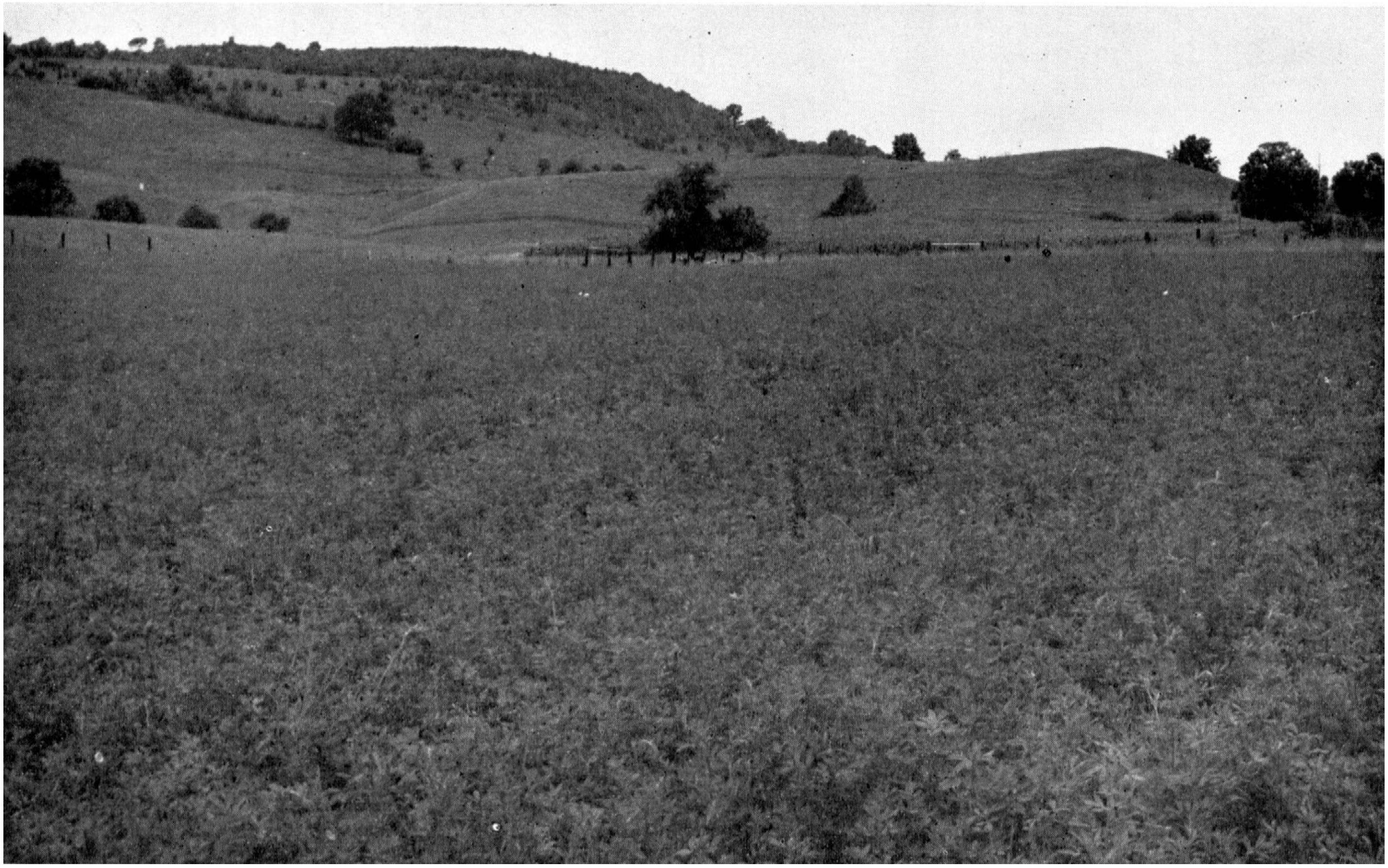

Figure 20.—**Kame terrace several miles southeast of Harpursville, occupied by Mardin-Chenango channery silt loams. These hummocky landforms were deposited by the glacier along valley sides.**

Middlebury Series

The Middlebury series consists of deep, moderately well drained silty soils formed in alluvium. These soils are on flood plains of rivers and smaller streams throughout the county and generally are flooded annually. They are medium acid to slightly acid.

A typical profile has a dark grayish-brown silt loam plow layer about 7 inches thick. Underlying this layer is the subsoil of very friable, brown silt loam that extends to a depth of 16 inches. Below the subsoil is the substratum, which is dark grayish-brown to gray silt loam distinctly mottled with dark yellowish brown. At a depth of about 23 inches, it is gray to grayish-brown, friable fine sandy loam distinctly mottled with yellowish brown. The substratum varies in texture and thickness.

Middlebury soils usually are flooded in spring and occasionally during the growing season. Roots extend 24 to 36 inches, depending on the depth to the water table. The permeability of the subsoil is moderate to moderately rapid. Early in spring free water sometimes lies at a depth of 12 to 18 inches, but it drops to a depth of 30 inches or more during long, dry periods. From 3 to 4 drying days are usually needed in May before cultivation. Crops on these soils seldom show signs of moisture deficiency during the growing season. The supply of nitrogen is moderately high, but it is released so slowly that crops show a marked response to nitrogen fertilization. The ability to supply potassium and phosphorus is medium.

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Flooding in spring is a moderate limitation to many uses, and the moderately good drainage slightly limits the selection of crops; nevertheless, Middlebury soils are among the best suited to the crops commonly grown in the county. Flooding and wetness are the major limitations to nonfarm uses.

Typical profile of Middlebury silt loam in a cultivated field:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; very weak, very fine and fine, granular structure; very friable; abundant fine and medium roots; slightly acid; abrupt, smooth boundary. 6 to 8 inches thick.

B2—7 to 16 inches, brown (10YR 5/3) silt loam; weak, very fine, granular structure within very weak, coarse prisms; very friable; abundant fine and medium roots; slightly acid; clear, wavy boundary. 8 to 11 inches thick.

C1—16 to 23 inches, dark grayish-brown (10YR 4/2) to gray (10YR 5/1) silt loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, granular structure within weak, medium plates; friable; abundant fine and medium roots in upper part, few roots in lower part; slightly acid; clear, wavy boundary. 6 to 10 inches thick.

C2—23 to 45 inches, gray (10YR 5/1) to grayish-brown (10YR 5/2) fine sandy loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; very weak, very fine, granular structure; friable; few roots; slightly acid.

The texture of the surface layer ranges from loam to silt loam. The profile, to a depth of about 36 inches, is free of gravel, but below this depth stratified layers of sand and coarse gravel occur.

The color of the plow layer ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 4/3). The color of the subsoil ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/4) in the upper part. There are faint mottles that have a chroma of 2 within 20 inches of the surface. At a depth between 20 and 40 inches, the soil is saturated with water for a considerable period.

The surface layer is friable to very friable. The subsurface horizons, to a depth of 36 to 40 inches, have granular structure or weak, subangular blocky or platy structure that easily breaks down to granules. These horizons have a texture of silt loam, loam, or fine sandy loam and contain less than 18 percent clay. The reaction ranges from medium acid to slightly acid.

Middlebury soils are in a drainage sequence with well-drained Tioga and poorly drained to somewhat poorly drained Wayland soils. Unlike Tioga soils, Middlebury soils have mottles at a depth of 15 to 20 inches. They do not have the distinctly mottled, gray subsoil immediately below the plow layer that is characteristic of Wayland soils.

Middlebury silt loam (0 to 5 percent slopes) (Ms).—This soil occupies entire alluvial flats or slight depressions on flood plains along with well-drained Tioga soils. In most years it is flooded in spring. The slope is generally less than 3 percent.

Included in mapping were spots of poorly drained to somewhat poorly drained Wayland soils and small knolls of well-drained Tioga soils.

This soil can be used for crops, pasture, hay, or forest. Flooding and slight wetness are the main limitations. Some areas need drainage. Erosion is not a hazard.

Because of flooding and a high water table, this soil is poorly suited to community development and some other nonfarm uses. (Capability unit IIw-2; woodland group 1)

Morris Series

The Morris series consists of deep, strongly acid, somewhat poorly drained loamy soils that formed in reddish-brown, very firm, acid till strongly influenced by red sandstone and shale. These are gently sloping to moderately steep soils on uplands in the eastern part of the county. They are in areas that have slow runoff or receive excessive runoff or seepage from higher areas.

A typical profile has a brown to dark-brown channery silt loam plow layer about 7 inches thick. The upper part of the subsoil is friable, brown channery loam with faint mottles. It extends to a depth of 13 inches and is separated from the lower part of the subsoil by a thin, leached layer. This layer consists of firm, pinkish-gray channery very fine sandy loam distinctly mottled with strong brown. The lower part of the subsoil occurs at a depth of 15 inches. It is a very firm, dense fragipan of channery and very channery silt loam. The upper part is reddish brown and faintly mottled. Below a depth of 25 inches it is reddish brown to dark reddish gray without mottles. Vertical streaks of pinkish-gray silty material surround coarse prisms in the fragipan. These streaks pinch out at a depth of about 49 inches. The substratum consists of extremely firm, dark reddish-brown channery silt loam till. Stone fragments of different sizes are prominent.

The root zone is confined largely to the 12 to 18 inches of soil above the very dense, slowly permeable fragipan. This amount of soil holds 2 to 3 inches of moisture available to plants. Although this is a low capacity, plants generally do not lack moisture in spring when the soil above the pan is saturated. In May, 4 to 7 drying days are usually needed before tillage. During dry periods plants usually begin to wilt after 8 to 12 days without rain. The nitrogen supply is moderately high, but it is released very slowly, and crops show a marked response to nitrogen fertilization. The ability to supply potassium and phosphorus is medium. The somewhat poor drainage, the nutrient deficiencies, and the strong acidity are major limitations to farming. Seasonal wetness and slow permeability are the major limitations to many nonfarm uses.

Typical profile of Morris channery silt loam, 2 to 8 percent slopes, in a cultivated field:

Ap—0 to 7 inches, brown to dark-brown (7.5YR 4/2) channery silt loam; weak, medium and fine, granular structure; very friable; abundant fine roots; strongly acid; abrupt, smooth boundary. 6 to 8 inches thick.

B2—7 to 13 inches, brown (7.5YR 5/4) channery loam; few faint, medium, dark-brown (7.5YR 3/2) and strong-brown (7.5YR 5/8) mottles; moderate, medium, platy structure; friable; plentiful fine roots; strongly acid; clear, wavy boundary. 4 to 8 inches thick.

A'2—13 to 15 inches, pinkish-gray (7.5YR 6/2) channery very fine sandy loam; many, distinct, medium and coarse, strong-brown (7.5YR 5/8) mottles; weak, medium and thin, platy structure; firm; few fine roots; strongly acid; abrupt, irregular boundary. 2 to 5 inches thick; tongues separate prisms of horizons below.

B'x1—15 to 25 inches, reddish-brown (5YR 4/3) channery silt loam; many, coarse, faint, brown to dark-brown (7.5YR 4/4) mottles and many manganese stains; very coarse (12 to 24 inches across) prisms coated with material from the A'2 horizon; weak, medium and coarse, subangular blocky structure; clay films discontinuous on ped surfaces but prominent in pores; very firm and brittle; few fine roots between prisms; strongly acid; diffuse, wavy boundary. 8 to 14 inches thick.

B'x2—25 to 49 inches, reddish-brown (5YR 5/3) to dark reddish-gray (5YR 4/2) very channery silt loam; very coarse prisms coated with material from the A'2; weak, medium and coarse, subangular blocky structure; clay films discontinuous on ped surfaces and prominent in pores; extremely firm and brittle; few fine roots between prisms; medium acid; diffuse, wavy boundary. 21 to 28 inches thick.

Cx—49 to 85 inches, dark reddish-brown (5YR 3/3) channery silt loam; weak, thick, platy structure within very coarse prisms with reddish-brown (5YR 4/3) coats; extremely firm and brittle; no roots; neutral at 80 inches.

Morris soils generally have a silt loam or channery silt loam surface horizon, and in places they are stony. The fragipan is at a depth of 12 to 18 inches; its range in thickness is about 3 to 10 feet. It has weak, platy structure or is massive. The basal till is very dense and is massive or has thick platy structure. It is difficult to separate from the fragipan above it. The Ap horizon is generally brown to dark brown. The color of the B horizon has hues of 7.5YR and 5YR. The fragipan (B'x and Cx horizons) is reddish brown to brown in a hue of 5YR to 2.5YR. The depth to bedrock is 10 feet or more in most places.

Morris soils are in a drainage sequence with well drained dark brownish to reddish Cattaraugus and moderately well drained Culvers soils. Cattaraugus and Culvers soils lack mottles immediately below the plow layer and are deeper to the fragipan than Morris soils. Chippewa and Alden soils in depressions and drainageways are the wetter associates of Morris soils. Volusia soils are olive-brown analogs of the Morris soils but are mostly in the central and western parts of the county. Tuller and Morris soils have similar upper horizons, but Tuller soils are shallow over bedrock and lack a fragipan.

Morris channery silt loam, 2 to 8 percent slopes (MtB).—This soil is in the Catskill foothills in the eastern part of the county. It has the profile described as typical of the series. The areas are slightly concave or very slightly convex. They are broad bands on lower seepage slopes around hills or on gently undulating uplands where water runs off very slowly. After rains these areas are waterlogged above the fragipan and receive large quantities of seepage water and runoff from higher areas.

Larger areas of steeper Morris soils and moderately well drained Culvers soils adjoin this soil. Spots of Culvers soils were included in mapping.

This soil can be used for hay, pasture, forest, or crops. Wetness, low fertility, and a slight erosion hazard are the main limitations. Wetness delays spring tillage and influences the selection of crops.

The slow permeability and a seasonal high water table are major limitations to many nonfarm uses. Many of the areas are good sites for ponds. (Capability unit IIIw–2; woodland group 5)

Morris channery silt loam, 8 to 15 percent slopes (MtC).—This soil occurs as curved bands at the base of steeper slopes on hillsides and foot slopes. Most of the bands have a series of shallow watercourses separated by slightly higher areas. All of the slopes are in the same direction, but the higher areas have a slight roll perpendicular to the direction of the slope.

Above this soil are steeper, well-drained Cattaraugus and shallow, well-drained Oquaga soils. Below it are less strongly sloping Morris soils. In spots where seepage water comes to the surface are poorly drained Chippewa or very poorly drained Alden soils. Included in mapping were moderately well drained Culvers soils on knolls.

This soil is suitable for crops, pasture, hay, or forest. Wetness, low fertility, and the hazard of erosion are limitations to these uses. Seasonal wetness, slow permeability, and slope are limitations to many nonfarm uses. (Capability unit IIIe–6; woodland group 5)

Morris and Tuller very stony soils, 3 to 25 percent slopes (MuD).—Except for stoniness, these soils have a profile typical of their series. Most areas of this mapping unit are in the eastern part of the county. Either or both soils may occur in any mapped area, but Morris soils are only in the eastern part of the county and Tuller soils are countywide. The stones range in size from 10 inches in diameter to slabs several feet long, and they are 2½ to 30 feet apart on the surface. Some areas of the Tuller soils have rock outcrops instead of stones.

These soils receive excessive amounts of runoff or seepage. They occur with well drained, reddish Cattaraugus, moderately well drained Culvers, very poorly drained Chippewa and Alden soils, and shallow Arnot and Oquaga soils, all of which were included in mapping. In some parts of the county Lordstown, Mardin, and Volusia soils were included in mapping with the very stony Tuller soil.

The soils of this unit are too stony for cultivation. Some areas provide pasture of poor quality. Forestry and some types of recreation are more practical uses. Stoniness, seasonal wetness, and shallowness to bedrock or fragipan are limitations to nonfarm uses. (Capability unit VIIs–1; woodland group 5)

Oquaga Series

The Oquaga series consists of well-drained, strongly acid loamy soils that formed in medium-textured till strongly influenced by underlying red sandstone and shale bedrock. Bedrock is at a depth of 20 to 40 inches, and there are many flat rock fragments of varying size in the soil mass. These gently to steeply sloping soils are in the eastern part of the county.

A typical profile has a dark-brown channery silt loam surface layer about 6 inches thick. This layer is underlain by a friable channery silt loam subsoil that grades from strong brown in the upper part to reddish brown below a depth of 16 inches. Sandstone, siltstone, or shale is at a depth of about 32 inches.

The root zone consists mostly of the 20 to 40 inches of moderately permeable soil over bedrock. In many of the shallower places the bedrock is fractured and interspersed with fines, and nutrients and moisture are available in the bedrock material. From 3 to 6 inches of moisture is available to plants. Plants begin to wilt after 10 to 20 days without rain. These soils can be tilled or grazed early in spring. The ability to supply nitrogen, potassium, and phosphorus is medium. The reaction is very strongly acid. The gently sloping areas are fairly productive if fertilized and limed.

Slope, shallowness to bedrock, and stoniness are limitations to many nonfarm uses.

Typical profile of Oquaga channery silt loam, 5 to 15 percent slopes, in an idle area:

Ap—0 to 6 inches, dark-brown (10YR 4/3) channery silt loam; weak, fine to medium, subangular blocky structure breaking to weak, fine, granular structure; friable; abundant fine roots; strongly acid; clear, wavy boundary. 5 to 6 inches thick.

B21—6 to 16 inches, strong-brown (7.5YR 5/6) channery silt loam; weak, fine to medium, subangular blocky structure breaking to weak, fine, granular structure; friable; abundant fine roots in upper part, a few roots in lower part; strongly acid; clear, wavy boundary. 9 to 12 inches thick.

B22—16 to 32 inches, reddish-brown (5YR 4/3) channery silt loam; weak, fine to medium, subangular blocky structure breaking to weak, fine, granular structure; friable; few roots; strongly acid; abrupt, smooth boundary. 14 to 18 inches thick.

R—32 inches +, acid sandstone bedrock.

The texture ranges from loam to silt loam. Channery fragments and flagstones make up 35 to 60 percent of the volume of the profile, and some areas are very stony. The color of the Ap horizon ranges from dark reddish brown (5YR 3/3) to dark brown (7.5YR 3/2 and 10YR 4/3) or brown (10YR 5/3). The color of the B horizon ranges from dark brown (7.5YR 5/4) to reddish brown (5YR 4/3 to 4/4). The structure of the Ap horizon is generally granular, and the consistence is friable to very friable. In places there is a lower B horizon or a C horizon immediately above the massive bedrock that consists mostly of shattered rock fragments interspersed with fines. Also, in places there is a 2-inch, mottled layer of soil directly above the bedrock that is waterlogged briefly during wet periods. The depth to bedrock ranges from 20 to 40 inches.

Oquaga soils occur with the soils of the Arnot and Tuller series that are less than 20 inches deep to bedrock. Arnot soils are the shallow analogs of Oquaga soils. Tuller soils are somewhat poorly drained and poorly drained and are distinctly mottled directly under the plow layer. Oquaga soils also occur with well drained Cattaraugus, moderately well drained Culvers, and somewhat poorly drained Morris soils, all of which have a well-expressed fragipan and a varying degree of mottling above the pan, depending upon the drainage. Other associated soils are the wetter Chippewa and Alden soils and the Lordstown soils, which have a yellowish-brown subsoil. In places Oquaga and Lordstown soils are mapped together as undifferentiated units.

Oquaga channery silt loam, 5 to 15 percent slopes (OuC).—This soil is like the one described as typical of the series. It has simple, slightly convex slopes and occurs as long, narrow strips on hillsides. Runoff is rapid, and very little of it is received from other areas. Large cracks in the bedrock enable rapid drainage.

Other Oquaga soils and shallow Arnot soils were included in mapping. Moderately well drained Culvers and somewhat poorly drained Morris and Tuller soils are nearby.

This soil is well suited to crops, pasture, hay, or forest. Low fertility and the hazard of erosion are the main limitations to these uses. Plant growth is generally better in the places that are deeper to bedrock. Flat stone fragments somewhat hinder tillage and harvesting.

Shallowness to bedrock is the main limitation to many nonfarm uses of this soil. Many areas have esthetic value for homesites and recreation. (Capability unit IIIe-1; woodland group 2)

Oquaga channery silt loam, 15 to 25 percent slopes (OuD).—Except for a more variable depth to bedrock, this soil has a profile similar to the one described as typical of the series. Within a few feet the depth ranges from 40 inches to rock outcrops on the surface.

Other Oquaga soils and shallow Arnot soils were included in mapping. Also included were deep, well drained Cattaraugus, moderately well drained Culvers, and somewhat poorly drained Morris soils.

This soil can be used for hay, pasture, or forest. The moderately steep slopes are hazardous to work with modern machinery and are very susceptible to erosion. Natural fertility is low.

Slope and shallowness to bedrock are the main limitations to many nonfarm uses of this soil. Many areas have esthetic value, and some of the slopes could be developed for skiing. (Capability unit IVe-1; woodland group 2)

Peat and Muck

Peat and Muck are wet organic deposits consisting of layers of well decomposed muck to partly decomposed peat. These organic deposits were derived from woody and fibrous plant material mixed in places with considerable sphagnum moss. They are in small kettle holes on outwash terraces and in small depressions on stream terraces and uplands.

Peat and Muck are ponded part of the year, and the water table stands at or near the surface the rest of the year. These areas have been little used for farming. Generally, Peat and Muck deposits are avoided or removed for community development. Onsite investigation is advisable for any farm or nonfarm use.

One of the more common profiles in an area of Peat and Muck in forest:

1—0 to 11 inches, very dark brown (10YR 2/2), decomposed organic material; weak, coarse, granular structure; very friable; some fine roots; slightly acid; clear, wavy boundary. 8 to 13 inches thick.

2—11 to 42 inches, very dark grayish-brown (10YR 3/2) to dark-brown (10YR 3/3), partly decomposed organic material; structureless; no roots; strongly acid.

These organic deposits are 18 inches to more than 10 feet deep. They consist of layers of muck, woody peat, disintegrated peat, sedimentary peat, and moss peat. The reaction ranges from very strongly acid to neutral.

Alden and Chippewa soils are common associates of Peat and Muck but have less than 12 inches of organic matter over mineral soil.

Peat and Muck (Pm).—This undifferentiated unit consists mostly of Peat, and it occurs throughout the county where old lakes have been filled with organic material. These areas are ponded or have ground water within a few inches of the surface. They are valuable as sites for hiking and nature study, and some of them should be preserved for these purposes (fig. 21). (Capability unit VIIw-1; woodland group 9)

Scio Series

The Scio series consists of deep, acid, moderately well drained soils that formed mainly in silty deposits on stream valley terraces.

A typical profile has a very dark grayish-brown silt loam plow layer about 7 inches thick. Underlying the plow layer is the upper part of the subsoil, which is friable silt loam about 9 inches thick. It is dark yellowish brown in the topmost 6 inches and yellowish brown and mottled in the lower 3 inches. At a depth of about 16 inches, the subsoil grades to dark-brown, firm very fine sandy loam, prominently mottled. It extends to the substratum, which is at a depth of about 26 inches. The

Figure 21.—**Pitcher plants, sphagnum moss, and other vegetation on Peat and Muck, 0.4 mile east of Chenango Valley State Park.**

substratum consists of firm layers of grayish-brown, light-gray, and gray very fine sandy loam and silt loam that are prominently mottled and extend to a depth of 70 inches or more. These layers vary in texture and thickness. In some places there are layers of gravel, sand, and clay.

The root zone consists of 24 to 30 inches of moderately permeable soil, the thickness depending upon the fluctuating water table. This amount of soil holds from 4 to 7 inches of water available to plants. Plants ordinarily do not lack moisture early in spring when the soil is saturated. In May, 3 to 4 drying days are needed before tillage. In summer plants may begin to wilt after 10 to 15 days without rain. The total nitrogen content is medium to high, but nitrogen is usually released slowly in spring, and plants respond to nitrogen fertilization. The ability to supply phosphorus and potassium is medium. The reaction is strongly acid to medium acid.

These are among the more productive soils in the county. Slight wetness and nutrient deficiencies are the main limitations to farming. Seasonal wetness is a limitation to many nonfarm uses.

Typical profile of Scio silt loam in a cultivated area:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium and fine, granular structure; very friable; abundant fine roots; slightly acid; abrupt, smooth boundary. 6 to 8 inches thick.

B21—7 to 13 inches, dark yellowish-brown (10YR 4/6) silt loam; weak, medium and fine, subangular blocky structure crushing to weak, fine, granular structure; friable; few fine roots; strongly acid; clear, wavy boundary. 2 to 6 inches thick.

B22—13 to 16 inches, yellowish-brown (10YR 5/4) silt loam; many, medium, prominent, strong-brown (7.5YR 5/8) mottles and few, fine, faint, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure crushing to weak, fine, granular structure; friable; few fine roots; strongly acid; clear, wavy boundary. 2 to 5 inches thick.

B23—16 to 26 inches, dark-brown (10YR 4/3) very fine sandy loam; common to many, fine and medium, prominent, brown to dark-brown (7.5YR 4/4) and grayish-brown (10YR 5/2) mottles; weak, thick, platy structure; firm, friable when crushed; few fine roots; strongly acid; clear, wavy boundary. 8 to 12 inches thick.

C1—26 to 42 inches, grayish-brown (2.5Y 5/2) very fine sandy loam; many, medium and coarse, prominent, strong-brown (7.5YR 5/8) mottles; weak, thick, platy structure; firm; few fine roots; strongly acid; clear, wavy boundary. 14 to 18 inches thick.

C2—42 to 59 inches, light-gray to gray (5Y 6/1) silt loam; many, medium, prominent, brown to dark-brown (7.5YR 4/2) and strong-brown (7.5YR 5/8) mottles; weak, thick, platy structure; firm; few fine roots; medium acid; clear, wavy boundary. 15 to 19 inches thick.

C3—59 to 70 inches, gray (5Y 5/1) very fine sandy loam; many, medium, prominent, dark yellowish-brown (10YR 4/4) mottles; weak, thick, platy structure; firm; few fine roots; medium acid.

The texture of the surface layer and subsoil ranges from very fine sandy loam to silt loam. The depth to gravelly, sandy, or unconforming clayey layers is more than 40 inches. The subsoil is dark yellowish brown, yellowish brown, and dark brown and is prominently mottled at a depth of 15 to 20 inches.

Scio soils are in a drainage sequence with Unadilla soils, which are well drained and lack mottles, and with Wallington soils, which formed in similar material but are somewhat poorly drained and have distinct mottles immediately beneath the plow layer. Wallington soils also have a fragipan, which is lacking in Scio soils. Other associated soils are Braceville, Canaseraga, Tioga, and Middlebury soils. Braceville soils are in locations similar to those of Scio soils and are moderately well drained but formed in gravelly outwash material and have a fragipan. Canaseraga soils are on uplands and have a surface layer and subsoil similar to that of Scio soils, but they also have a fragipan that formed in the silty mantle and underlying till or just in the till. Tioga and Middlebury soils are on flood plains and lack the bright colors in the subsoil common to Scio soils.

Scio silt loam (0 to 5 percent slopes) (Sc).—This soil is moderately well drained and generally occurs as long, narrow, slight depressions in backwater areas on old stream terraces. Most of these depressions are less than 5 acres in size. The slope is generally less than 3 percent.

Included in mapping were small areas of a similar silty soil that has a fragipan at a depth of 18 to 24 inches. Also included were areas in which the gravelly, sandy, or clayey substratum is at a depth of less than 40 inches. Well-drained Unadilla and somewhat poorly drained Wallington soils are minor inclusions. Other associated soils are well-drained Tioga and less well drained soils on lower alluvial flood plains and gravelly Chenango and Braceville soils on terraces.

This soil can be used for crops, pasture, or forest. Slight wetness in spring sometimes delays planting, and on rare occasions some areas close to major streams are flooded. This is a limitation to some nonfarm uses. (Capability unit IIw-1; woodland group 1)

Tioga Series

The Tioga series consists of deep, well-drained, medium-textured soils that formed in recent deposits of medium acid to slightly acid alluvium on flood plains.

These soils have a brown silt loam plow layer about 9 inches thick. Just below the plow layer is friable, pale-brown to light yellowish-brown silt loam that grades to very fine sandy loam at a depth of about 26 inches. The substratum is at a depth of about 35 inches. It generally consists of layers of very friable coarse sand and gravel, but it varies in texture and thickness.

The root zone consists of 40 inches or more of moderately to rapidly permeable soil that holds 6 to 8 inches of moisture available to plants. Normally, crops do not show signs of wilting during dry periods. Though these soils are usually flooded in spring, only 2 or 3 drying days are needed in May before tillage. The supply of nitrogen is moderately high, but nitrogen is released so slowly that plants respond to fertilization. The supplies of phosphorus and potassium are medium. The surface layer is medium acid to strongly acid.

These are among the most productive soils in the county. Nutrient deficiencies and occasional flooding are the main limitations to farming. Flooding is the main limitation to nonfarm use.

Typical profile of Tioga silt loam in a cultivated area (colors are for dry soil):

Ap—0 to 9 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; friable; abundant fine and medium roots; medium acid; abrupt, smooth boundary. 8 to 9 inches thick.

B21—9 to 26 inches, pale-brown (10YR 6/3) to light yellowish-brown (10YR 6/4) silt loam; moderate, medium, platy structure within very weak, coarse, prisms; friable; plentiful fine roots and distinct, dark yellowish-brown (10YR 4/4) root stains in channels; medium acid; clear, wavy boundary. 15 to 20 inches thick.

B22—26 to 35 inches, pale-brown (10YR 6/3) to light yellowish-brown (10YR 6/4) very fine sandy loam; moderate, medium, granular structure; friable; few fine roots and distinct, dark yellowish-brown (10YR 4/4) root stains in channels; medium acid; gradual, irregular boundary. 5 to 12 inches thick.

IIC—35 to 60 inches, dark-brown (10YR 4/3) coarse sand and gravel; structureless; few roots; very friable; medium acid.

Tioga soils generally have a silt loam, loam, or very fine sandy loam texture throughout the solum. The solum is generally free of coarse fragments in the upper part, but in places there are deposits of coarse sand and gravel within 30 inches of the surface.

The color of the Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3), or brown (10YR 5/3). The color of the B horizon is pale brown (10YR 6/3), light yellowish brown (10YR 6/4), dark brown (10YR 3/3), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), olive brown (2.5Y 4/4), or light olive (2.5Y 5/4).

The Ap horizon has granular structure and is friable to very friable. The structure of the subsurface layers is granular, platy, platy breaking to granular, or is subangular blocky breaking to granular.

Wormholes and prominent root stains are common. Faint mottling occurs below a depth of 24 inches in places. Reaction ranges from medium acid to slightly acid.

Tioga soils are in a drainage sequence with moderately well drained Middlebury and poorly drained and somewhat poorly drained Wayland soils. Tioga soils lack the prominent mottles within 24 inches of the surface that are characteristic of these wetter soils. They are also associated with Unadilla soils on older stream terraces, but in contrast they lack the well-developed subsoil and are seasonally flooded.

Tioga silt loam (0 to 5 percent slopes) (Ta).—This soil has the profile described as typical of the series. It is on flood plains of major streams. Included in mapping were gravel bars, sandbars, and small spots of wetter Middlebury and Wayland soils.

This is one of the most productive soils in the county for cultivated crops. It is also well suited to hay, pasture, and forest. Although it is usually flooded early in spring, floodwater recedes rapidly. Control of streambank erosion and channel gouging is a problem along some streams.

Flooding is the main limitation to many nonfarm uses. This soil is one of the best sources of topsoil in the county. (Capability unit I–2; woodland group 1)

Tioga gravelly silt loam, fan (0 to 5 percent slopes) (Tg).—This well-drained soil occupies fan-shaped, alluvial areas, from 10 acres to several acres in size, where streams from steep uplands pour out onto nearly level flood plains. Because of the rapid velocity of the water, rounded gravelly and channery fragments are the main components of the alluvium. The fragments are largest and the deposits deepest at the apex of the fan at the foot of the hill. The fan slopes gently toward the valley floor and spreads laterally along the foot of the hill. It is steepest near its apex and is wettest from seepage where the deposit is thinnest.

Associated alluvial soils are Tioga silt loam and less well drained alluvial soils. Well-drained Chenango soils are on nearby gravel terraces and valley fill.

This soil is suited to crops, pasture, or forest. Flooding, erosion, and nutrient deficiencies are the main limitations to farming. In some places the rock fragments interfere slightly with tillage.

In a few areas where the build-up of deposits has reduced the hazard of flooding, there are limited possibilities for nonfarm use. For example, most of the village of Maine is on this soil. Flooding is a continuing hazard, however, and should be considered in planning any nonfarm use. (Capability unit IIe–1; woodland group 1)

Tuller Series

The Tuller series consists of strongly acid, somewhat poorly drained and poorly drained loamy soils that formed in thin, acid till less than 20 inches deep over sandstone, siltstone, or shale bedrock. These soils occupy flat ridgetops and narrow, treadlike areas in stair-step topography where water accumulates.

A typical profile has a dark grayish-brown channery silt loam surface layer about 6 inches thick. Underlying the surface layer is the friable channery silt loam subsoil, which is grayish brown, prominently mottled with yellowish brown. Where these soils formed in reddish till, the subsoil is predominantly brown. It extends to a depth of about 15 inches and is underlain by a thin layer of fractured bedrock that has mottled gray and olive silty material in the cracks. In some places this thin layer is absent. The depth to gray siltstone bedrock is about 17 inches.

The root zone is confined to the 12 to 20 inches of soil material over the bedrock. It holds only 2 to 4 inches of moisture available to plants, but plants ordinarily do not lack moisture in spring, because the soil is saturated. From 4 to 8 drying days are usually needed before tillage in May. During midsummer these soils sometimes become very dry, and crops begin to wilt after 8 to 10 rainless days. Though the total nitrogen supply is moderately high, nitrogen is released very slowly. The supplies of phosphorus and potassium are medium. The reaction is strongly acid to very strongly acid.

Wetness early in spring, droughtiness in summer, shallowness to bedrock, and nutrient deficiencies limit the use of these soils for farming. Seasonal wetness and shallowness to bedrock are the main limitations to many nonfarm uses.

Typical profile of Tuller channery silt loam, 0 to 25 percent slopes, in an idle area:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) channery silt loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; abundant fine roots; many very fine pores; medium acid; abrupt, smooth boundary. 4 to 8 inches thick.

B2g—6 to 15 inches, grayish-brown (2.5Y 5/2) channery silt loam; many prominent, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; few fine roots; few fine pores; friable, slightly sticky and slightly plastic; strongly acid; abrupt, smooth boundary. 5 to 12 inches thick.

Cg—15 to 17 inches, fractured, gray siltstone bedrock; mottled gray and olive silty material in cracks. 0 to 3 inches thick.

R—17 inches +, gray siltstone bedrock.

The thickness of the solum ranges from 12 to 20 inches. The texture of the surface layer is channery silt loam or loam, and there are also very stony phases. The content of coarse fragments ranges from 15 to 50 percent. The surface layer has a hue of 10YR or 7.5YR, a value of 3 or 4, and a chroma of 2 or 3. The underlying horizons commonly have a hue of 2.5Y where they are influenced by gray sandstone and shale, but the hue ranges to 7.5YR where these horizons formed in red till. The color value is 4 or 5, the chroma is 2 or 3, and there are prominent or distinct mottles. The mottling is less distinct in the redder soil. In some places there is a thin, mottled, gray, leached A'2 horizon over the bedrock. In places the bedrock is not fractured. The reaction of the solum ranges from pH 5.0 to 5.8.

Tuller soils are associated with shallow, well drained and moderately well drained Arnot soils and moderately deep, well drained Lordstown and Oquaga soils, all of which lack the prominent mottles immediately below the plow layer. Somewhat poorly drained Volusia and Morris soils and poorly drained Chippewa and very poorly drained Alden are deeper soils associated with Tuller. Volusia and Morris soils, however, have a fragipan and have less gray mottling in the subsoil. Chippewa soils also have a fragipan. Alden soils are wetter than Tuller and have a thicker, darker colored surface layer and a grayer upper subsoil.

Tuller channery silt loam, 0 to 25 percent slopes (TuD).—This soil ranges from level to moderately steep, but generally the slope is less than 8 percent. Most areas are wet from seepage, and the steeper areas are generally seep spots within larger areas of well-drained soils that are shallow to bedrock. In the eastern part of the county, this soil is redder than is typical.

Well-drained Arnot, Lordstown, and Oquaga soils surround some spots of this soil. Moderately well drained Mardin soils adjoin it where the slopes are 2 to 8 or 8 to 15 percent. Included in mapping were the deeper Volusia, Morris, Chippewa, and Alden soils in the more steeply sloping areas.

This soil can be used for hay, pasture, or forest, but it is generally better suited to hay or pasture than to forest. Seasonal wetness, droughtiness, shallowness to bedrock, low fertility, and, in some places, slope are the limitations to farming. Seasonal wetness, shallowness to bedrock, and slope are also limitations to nonfarm use. (Capability unit IVw-3; woodland group 5)

Unadilla Series

The Unadilla series consists of deep, acid, well-drained silty soils that formed in glacial outwash or in postglacial deposits on stream terraces, mostly along the Susquehanna River.

These soils have a dark-brown silt loam plow layer about 10 inches thick. The underlying subsoil is about 22 inches thick. It is friable, yellowish-brown silt loam in the upper part and grades to very fine sandy loam below a depth of 19 inches. The substratum is at a depth of about 32 inches. It generally consists of layers of friable to loose, grayish-brown to light olive-brown very fine sandy loam, very fine sand, and gravelly sandy loam to a depth of 92 inches or more. It is extremely variable in texture and thickness.

Roots readily penetrate this well-drained, moderately permeable soil to a depth of 40 inches or more. This volume of soil holds from 5 to 7 inches of water available to plants. Usually only 1 or 2 drying days are needed in May before tillage. Plants grown on Unadilla soils begin to wilt after 10 to 14 days without rain in midsummer. The ability to supply nitrogen, phosphorus, and potassium is medium. The reaction is strongly acid. These are among the best soils in the county for farming. A few areas are occasionally flooded, and this is a minor limitation to nonfarm use.

Typical profile of Unadilla silt loam, 0 to 5 percent slopes, in a cultivated field:

Ap—0 to 10 inches, dark-brown (10YR 3/3) silt loam; weak, very fine, granular structure; very friable; abundant fine and medium roots; neutral; abrupt, smooth boundary. 6 to 10 inches thick.

B21—10 to 19 inches, yellowish-brown (10YR 5/6) silt loam; weak, very fine, subangular blocky structure; friable; abundant fine roots; strongly acid; clear, wavy boundary. 6 to 12 inches thick.

B22—19 to 32 inches, yellowish-brown (10YR 5/4) very fine sandy loam; weak, very fine, subangular blocky structure; friable; plentiful fine roots; strongly acid; clear, wavy boundary. 10 to 15 inches thick.

C1–32 to 52 inches, grayish-brown to light olive-brown (2.5Y) 5/3) very fine sandy loam; many reticulate ⅛-inch to ½-inch dark yellowish-brown (10YR 4/4) and brown to dark-brown (10YR 4/3) lamellae; weak, medium, platy structure; friable; few fine roots; strongly acid; gradual, wavy boundary. 18 to 24 inches thick.

IIC2—52 to 62 inches, grayish-brown to light olive-brown (2.5Y 5/3) very fine sand; many reticulate ⅛-inch to ½-inch dark yellowish-brown (10YR 4/4) and brown to dark-brown (10YR 4/3) lamellae; weak, medium, platy structure; friable; few fine roots; medium acid; clear, wavy boundary. 8 to 13 inches thick.

IIIC3—62 to 92 inches, dark grayish-brown to olive-brown (2.5Y 4/3) gravelly sandy loam; structureless; loose; few fine roots; medium acid.

The thickness of the solum ranges from 24 to 36 inches. The texture of the surface layer and subsoil is silt loam, loam, or very fine sandy loam that averages less than 18 percent clay and less than 15 percent material coarser than very fine sand within the uppermost 40 inches. In some places there are gravelly and sandy layers below a depth of 40 inches. The color of the B horizon ranges from yellowish brown (10YR 5/6) to dark yellowish brown (10YR 4/4) and brown (7.5YR 4/4). Thin, dark-brown lamellae are in the C horizon in some places. The reaction of the profile is strongly acid.

Unadilla soils are associated with moderately well drained Scio and somewhat poorly drained Wallington soils. All of these soils formed in similar materials, but Scio soils have distinct mottles at a depth of 15 to 20 inches, and Wallington soils are mottled immediately below the plow layer and have a fragipan at a depth of about 18 inches. Tioga soils and their wetter associates occupy flood plains adjoining Unadilla soils and have a less well developed subsoil. Gravelly Chenango and Howard soils are in positions similar to those of Unadilla soils and have similar profiles but lack the gravel-free, high silt content of Unadilla soils. Howard soils also have a more clayey lower subsoil. Canaseraga soils adjoin Unadilla soils on valley sides and have a silty upper subsoil but are underlain by a fragipan that formed in till and are mottled in places.

Unadilla silt loam, 0 to 5 percent slopes (UnB).—This soil has the profile described as typical of the series. It occupies broad and, in some places, narrow strips on terraces an eighth to half a mile back from streams. In rare instances some areas are flooded.

Included in mapping were a few spots of moderately well drained Scio and somewhat poorly drained Wallington soils. Also included, adjacent to Chenango soils, were areas in which there is a gravelly substratum at a depth of 24 to 36 inches. Well-drained Tioga soils and less well drained soils in alluvium occupy flood plains at lower elevations.

This soil is excellent for cultivated crops. Maintaining fertility is the main problem.

Except for some areas that are flooded on rare occasions, this soil is excellent for nonfarm use, which competes severely with farming. (Capability unit I–1; woodland group 1)

Unadilla silt loam, 5 to 15 percent slopes (UnC).—This soil has a profile similar to the one described as typical but generally occupies higher and older alluvial terraces. It has complex, undulating slopes that were formed by the erosion of level terraces. Most areas have not been flooded in recent times.

Included in mapping were moderately well drained Canaseraga soils, where the old alluvium grades to till deposits. Also included were small depressions of wetter Scio and Wallington soils and a few areas of gravelly Chenango and Howard soils.

This soil is suited to crops, pasture, hay, and forest, but it is extremely susceptible to erosion if used for crops. The natural fertility is low, but crops respond well to fertilizer.

Slope is the main limitation to many nonfarm uses. Most sites are on rolling foothills that offer fine views of the valley. (Capability unit IIIe–3; woodland group 1)

Volusia Series

The Volusia series consists of deep, strongly acid, somewhat poorly drained loamy soils that formed in very firm, dense glacial till. The till is acid or very low in lime. These are the most extensive soils on uplands in the county. They are nearly level to moderately steep. They have slow runoff, or they receive excessive runoff from higher areas.

A typical profile has a very dark grayish-brown channery silt loam surface layer about 6 inches thick. This layer is underlain by the upper subsoil, which is friable, olive-brown channery silt loam mottled with yellowish brown and olive gray. It extends to a depth of 13 inches and is separated from the lower subsoil by a 4-inch leached layer of gray, firm channery silt loam that is prominently mottled with yellowish brown. The lower subsoil is an extremely firm, dense fragipan of dark grayish-brown channery silt loam that is faintly to distinctly mottled. Vertical streaks of gray silty material surround very coarse prisms in the fragipan. These streaks pinch out at a depth of about 54 inches. The substratum consists of extremely firm, dense, olive-brown channery silt loam till that has some very faint mottles.

The root zone in uneroded areas is confined largely to the 15 to 18 inches of soil over the slowly permeable fragipan. This amount of soil holds 2½ to 4 inches of water available to plants. Plants ordinarily do not lack moisture in spring, because free water is within 5 to 10 inches of the surface much of the time. From 4 to 7 drying days are generally needed before tillage in mid-May. In summer, however, these soils are droughty, and plants begin to wilt after 7 to 10 days without rain. The nitrogen supply is moderately high, but nitrogen is released so slowly in spring that plants show a marked response to fertilization. The phosphorus and potassium supplies are medium. The reaction is strongly acid.

Slope in some areas, seasonal wetness and dryness, and nutrient deficiencies are the main limitations to farming. Seasonal wetness and shallowness to the dense, slowly permeable fragipan are limitations to many nonfarm uses.

Typical profile of Volusia channery silt loam, 8 to 15 percent slopes, in an idle area:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) channery silt loam; weak, medium and fine, granular structure; very friable; abundant fine roots; strongly acid; abrupt, smooth boundary. 6 to 9 inches thick.

B2—6 to 13 inches, olive-brown (2.5Y 4/4) channery silt loam; many, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles and few, fine, faint, olive-gray (5Y 5/2) mottles; weak, fine, subangular blocky structure; friable; plentiful fine roots; strongly acid; clear, wavy boundary. 4 to 8 inches thick.

A'2—13 to 17 inches, gray (5Y 6/1) channery silt loam; many, medium and coarse, prominent, yellowish-brown (10YR 5/8) mottles; weak, very fine, subangular blocky structure within weak plates; firm; few fine roots; strongly acid; abrupt, irregular boundary. 2 to 5 inches thick.

B'x1—17 to 35 inches, dark grayish-brown (2.5Y 4/2) channery silt loam; common, fine, faint, dark-brown (10YR 4/3) mottles; weak, coarse, subangular blocky structure within plates, arranged in very coarse, 12-inch to 24-inch prisms; the prisms are surrounded by ½-inch to 1-inch tongues of A'2 material; centers of these tongues are gray (5Y 6/1), and borders are strong brown (7.5YR 5/8); extremely firm and brittle; few patchy clay films in pores; few fine roots in tongues; strongly acid; diffuse boundary. 10 to 20 inches thick.

B'x2—35 to 54 inches, dark grayish-brown (2.5Y 4/2) channery silt loam; many, medium and coarse, distinct, dark yellowish-brown (10YR 4/4) mottles and common, very dark brown (10YR 2/2) to black (10YR 2/1) manganese stains; weak, very thick, platy structure arranged in 12-inch to 24-inch prisms; tongues of A'2 material surround the prisms but become finer with depth and terminate in an erratic pattern, in many places on large flags or stones; extremely firm and brittle; clay films prominent in pores; no roots; medium acid; diffuse boundary. 18 to 30 inches thick.

Cx—54 to 64 inches, olive-brown (2.5Y 4/4) channery silt loam; some very faint mottles; weak, thick, platy structure; extremely firm and brittle; no roots; slightly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The texture of the surface layer is dominantly channery silt loam or channery loam. In some places where Volusia soils intergrade to Dalton soils, there is a thin mantle of silt loam nearly free of coarse fragments. The texture of the B horizon is channery silt loam or channery loam, and the average clay content is 18 to 26 percent. Sandstone flags and stones are few to common throughout the solum.

The upper B horizon is olive brown (2.5Y 4/4) to olive (5Y 5/3) and mottled with yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), and olive gray (5Y 5/2). The A'2 horizon is dominantly gray (5Y 6/1) or olive gray (5Y 5/2) and prominently mottled with yellowish brown. The fragipan is dark grayish brown (2.5Y 4/2) to olive (5Y 4/3) with faint to distinct, common to many mottles.

The reaction of the upper solum is strongly acid. The fragipan is strongly acid to medium acid in the upper part and becomes less acid with depth. Calcareous material is at a depth of 8 feet in some places.

Volusia soils are in a drainage sequence with well drained and moderately well drained Mardin soils, poorly drained Chippewa soils, and very poorly drained Alden soils. Unlike Mardin soils, Volusia soils have distinct mottles immediately under the plow layer. They are not so wet as Chippewa and Alden soils and are olive-brown immediately below the plow layer rather than gray. Volusia soils occur with somewhat poorly drained Dalton soils on valley sides, but Dalton soils have a channery-free silty mantle at least 18 inches thick. Morris soils have a redder hue where they occur in the eastern part of the county. Volusia soils are like some of the shallower Tuller soils in the upper part of the profile but have a fragipan at a depth of 20 inches or less instead of bedrock.

Volusia channery silt loam, 0 to 3 percent slopes (VoA).—This soil is on broad hilltops, on seepy foot slopes, and in drainageways. It is wetter than the soil that is typical of the series and generally has more gray mottles in the upper subsoil. It receives seepage water on foot slopes and in drainageways. Water runs very slowly off the broad hilltops. The areas are slightly concave or convex. Most are less than 10 acres, but a few are as large as 20 acres in size. They are generally round, but some are like tongues extending between areas of wetter or drier soils.

Steeper Volusia soils and moderately well drained Mardin soils generally surround this soil at the slightly higher elevations. Poorly drained Chippewa and very poorly drained Alden soils adjoin it at the lower elevations and were included in mapping.

This soil is suited to crops, hay, pasture, and forest. Unless it is drained, however, seasonal wetness delays planting and affects the selection of crops. Natural fertility is low.

Seasonal wetness, slow permeability, and slow runoff are limitations to many nonfarm uses. Many areas are good sites for ponds. (Capability unit IIIw–1; woodland group 5)

Volusia channery silt loam, 3 to 8 percent slopes (VoB).—This soil is on rolling hilltops or on uniformly sloping hillsides. The slopes are generally smooth or slightly convex. The areas are 20 acres or more in size. They are generally round or oblong in shape, but they meander in many places to fit the landscape.

In some places this soil occupies entire fields. It is near moderately well drained Mardin and shallow, well drained Arnot and Lordstown soils, which, in many places, are at a higher elevation. It adjoins poorly drained Chippewa and very poorly drained Alden soils, which are in depressions and drainageways and were included in mapping. Also included were Dalton soils along valley sides.

This soil is suited to crops, hay, pasture, and forest. Wetness and low fertility are the main limitations, and there is a slight to moderate hazard of erosion.

Seasonal wetness and slow permeability are limitations to many nonfarm uses of this soil. Many areas are good sites for ponds. (Capability unit IIIw–2; woodland group 5)

Volusia channery silt loam, 8 to 15 percent slopes (VoC).—This soil has the profile described as typical of the series. It occurs mainly on long foot slopes where water accumulates from higher ground. A series of shallow watercourses marks the landscape. Areas are generally 20 acres or more in size. This is the most extensive soil in the county.

Included in mapping were small spots of Mardin soils on knolls and small, seepy spots of Chippewa and Alden soils in the watercourses. Also included were Dalton soils on valley sides. Shallow, well-drained Arnot soils, poorly drained Tuller soils, and moderately deep, well-drained Lordstown soils are nearby but were rarely included in mapping.

This soil is suited to crops, pasture, or forest. Hay crops that tolerate wetness can be grown. Seasonal wetness, erosion, and nutrient deficiencies are the main limitations. Midsummer drought is a hazard.

Seasonal wetness and shallowness to the slowly permeable fragipan are limitations to nonfarm use. Many areas are esthetic sites for buildings, and some areas could be developed for recreation and wildlife. (Capability unit IIIe–6; woodland group 5)

Volusia channery silt loam, 8 to 15 percent slopes, eroded (VoC3).—This soil is on long foot slopes where water from higher ground accumulates. It is dissected by a series of shallow watercourses. Most areas are less than 10 acres in size. From 60 to 90 percent of the mapped acreage has lost all or part of the surface layer through erosion. As a result, the supply of organic matter is depleted, and there are more stones on the surface than in uneroded areas. In many places the fragipan is exposed or is a part of the plow layer.

Included in mapping were small spots of Mardin soils on knolls and small, seepy spots of Chippewa and Alden soils in the watercourses. Also included were Dalton soils on valley sides. Shallow, well-drained Arnot and Lordstown soils and poorly drained Tuller soils are nearby but were rarely included in mapping.

This soil is suited to forest, pasture, and limited cropping. Wetness and continuing erosion are the main limitations, and midsummer drought is a hazard. The natural fertility is low as a result of erosion. The moisture-holding capacity is very low.

Seasonal wetness and shallowness to the slowly permeable fragipan are limitations to many nonfarm uses. There are good possibilities for reforestation and for development of recreation and wildlife areas. (Capability unit IVe–4; woodland group 5)

Volusia channery silt loam, 15 to 25 percent slopes (VoD).—This soil occupies areas less than 10 acres in size, generally around seep spots or along watercourses on hillsides and at the base of steeper slopes. It has a profile like the one described as typical, except for some erosion and a variable depth to bedrock.

The eroded spots that were included in mapping occur in an erratic pattern. Also included were well-drained, moderately deep Lordstown soils and small spots of the better drained Mardin soils on knolls. Seep spots of poorly drained Chippewa and very poorly drained Alden soils were included to a minor extent.

This soil is suited to hay, pasture, and forest. The slopes are hazardous to work with modern machinery. The erosion hazard, low fertility, and wetness are the main limitations, and droughtiness is a problem.

Slope, seasonal wetness, and slow permeability are limitations to most nonfarm uses. There is some potential for reforestation and for development of recreation and wildlife areas. (Capability unit IVe–3; woodland group 5)

Wallington Series

The Wallington series consists of deep, acid, somewhat poorly drained soils that formed in silt deposited on glacial outwash and stream terraces. These soils are in slight depressions, some of which are ponded.

A typical profile has a dark grayish-brown silt loam plow layer about 7 inches thick. This layer is underlain by the upper subsoil, which is friable and extends to a depth of about 18 inches. It grades from brown, faintly mottled silt loam to grayish-brown very fine sandy loam, prominently mottled with strong brown below a depth of 12 inches. The lower subsoil is a firm fragipan. It consists of brown and grayish-brown silt loam, distinctly mottled with gray. Vertical streaks of light-gray, slightly coarser material surround very coarse prisms in the fragipan. These streaks pinch out at a depth of about 38 inches. The substratum underlying the fragipan consists of firm, dark grayish-brown very fine sandy loam. It is generally layered and varies in texture and thickness. Gravelly and sandy layers are common.

The root zone is confined primarily to the 15 to 18 inches of soil above the slowly permeable fragipan. This amount of soil holds 3 to 4 inches of moisture available to plants. Plants ordinarily do not lack moisture in spring, because the soil is saturated, but they begin to wilt after 5 to 8 days without rain in midsummer. Though the nitrogen content is moderately high, it is released very slowly, and plants show a marked response to nitrogen fertilization. The supply of phosphorus is medium, and that of potassium is low. The reaction is strongly acid to medium acid.

Seasonal wetness, droughtiness, and nutrient deficiencies are the main limitations to farming. Seasonal wetness is the main limitation to many nonfarm uses.

Typical profile of Wallington silt loam in a cultivated field:

Ap—0 to 7 inches, dark grayish-brown (10YR 3/2) silt loam; weak, medium and fine, granular structure; very friable; abundant fine roots; medium acid; abrupt, smooth boundary. 6 to 9 inches thick.

B21—7 to 12 inches, brown (10YR 5/3) coarse silt loam; common, medium, faint (10YR 5/6) mottles; weak, medium and fine, subangular blocky structure; friable; plentiful fine roots; medium acid; clear, wavy boundary. 3 to 6 inches thick.

B22g—12 to 18 inches, grayish-brown (2.5Y 5/2) very fine sandy loam; many, prominent, medium and coarse, strong-brown (7.5YR 5/6) mottles; weak, medium and fine, subangular blocky structure; friable; few fine roots; strongly acid; clear, wavy boundary. 4 to 6 inches thick.

B'x1—18 to 29 inches, brown (10YR 5/3) silt loam; common, medium, distinct, gray (10YR 6/1) mottles; weak, medium, platy structure within 10-inch to 12-inch prisms that are surrounded by thin streaks of slightly coarser material with a light-gray (10YR 7/1) center and a yellowish-brown (10YR 5/8) border; firm and brittle; few clay films in pores; few roots along prism faces; strongly acid; gradual, wavy boundary. 8 to 12 inches thick.

B'x2—29 to 38 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, gray (10YR 6/1) mottles; moderate, medium, platy structure within 10-inch to 12-inch prisms; coarse-textured streaks surround the prisms as in the horizon above; firm and brittle; few clay films in pores; no roots; strongly acid; clear, wavy boundary. 7 to 12 inches thick.

C—38 to 45 inches, dark grayish-brown (10YR 4/2) very fine sandy loam; moderate, medium, platy structure; firm; no roots; medium acid.

The thickness of the solum ranges from 30 to 45 inches. The depth to the fragipan ranges from 15 to 20 inches. The texture of the solum is silt loam or very fine sandy loam, and the average clay content is less than 18 percent. The Ap horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2). The B horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4) in the upper part and is faintly mottled. In places there is a mottled gray A'2 horizon instead of the lower B horizon. The fragipan is distinctly or faintly mottled brown (10YR 5/3) or grayish brown (2.5Y 5/2). In some places the substratum consists of gravelly and sandy layers. The reaction ranges from strongly acid to medium acid.

Wallington soils occur with well drained Unadilla and moderately well drained Scio soils, but these soils do not have a fragipan, nor do they have mottles immediately below the plow layer. Wallington soils adjoin somewhat poorly drained Dalton, Volusia, and Morris soils on valley sides and in ponded areas. In places these soils resemble Wallington soils in the upper horizons, but their fragipan formed in dense channery glacial till. Wallington soils resemble somewhat poorly drained to poorly drained Wayland soils on flood plains, but Wayland soils do not have a fragipan and are grayer immediately below the plow layer.

Wallington silt loam (0 to 5 percent slopes) (Wa).—This soil is in depressions or nearly level areas, mostly on glacial outwash or stream terraces.

This soil is generally surrounded by better drained Scio soils, small areas of which were included in mapping. Where till underlies the silty deposits adjoining valley sides and in upland pockets, this soil intergrades to somewhat poorly drained Dalton soils. Also included were soils that have a gravelly subsoil and substratum.

This soil can be used for crops, pasture, or forest. Unless it is drained, however, it is suitable only for crops that tolerate seasonal wetness. Natural fertility is low.

Seasonal wetness, shallowness to the slowly permeable or moderately slowly permeable fragipan, and varying stability of the substratum are limitations to many nonfarm uses. (Capability unit IIIw-1; woodland group 5)

Wayland Series

The Wayland series consists of deep, poorly drained and somewhat poorly drained loamy soils that formed in slightly acid to neutral alluvial sediments on flood plains.

A typical profile has a very dark grayish-brown silt loam plow layer in which there are a few dark yellowish-brown mottles. This layer is about 8 inches thick. It is underlain by a friable, very dark grayish-brown silt loam upper subsoil that is distinctly mottled. The lower subsoil is at a depth of about 11 inches. It is very dark grayish-brown heavy silt loam with prominent, yellowish-brown mottles. The substratum is at a depth of about 25 inches. The upper part of it is gray, prominently mottled heavy silt loam. The part below a depth of 40 inches is dark-gray, stratified silt loam, fine sandy loam, and sandy loam. These layers vary in thickness and texture. The substratum is weakly calcareous at a depth of about 45 inches.

Wayland soils are usually flooded in spring and sometimes during the growing season if very heavy, prolonged rains occur. The depth of the root zone depends on the depth to the water table. In undrained areas the root zone is confined largely to the topmost 12 inches of soil. Plants ordinarily do not lack moisture. The supply of nitrogen is high, but nitrogen is released very slowly. The supplies of phosphorus and potassium are medium. The reaction is medium acid to slightly acid. Flooding and wetness are limitations to most nonfarm uses.

Typical profile of Wayland silt loam in a cultivated field:

Ap—0 to 8 inches, silt loam; very dark grayish brown (10YR 3/2) when moist, pale brown (10YR 6/3) when dry; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, granular structure; very friable; abundant fine and medium roots; slightly acid; abrupt, smooth boundary. 7 to 8 inches thick.

B21g—8 to 11 inches, silt loam; very dark grayish brown (10YR 3/2) when moist, pale brown (10YR 6/3) when dry; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak platy structure breaking to weak, fine, subangular blocky structure; friable; plentiful fine and medium roots; slightly acid; clear, wavy boundary. 1 to 5 inches thick.

B22g—11 to 25 inches, heavy silt loam; very dark grayish brown (10YR 3/2) when moist, pale brown (10YR 6/3) to grayish brown (10YR 5/2) when dry; many, medium, prominent, yellowish-brown (10YR 5/6) mottles; very weak, fine, subangular blocky structure breaking to very weak, fine and very fine, granular structure; firm; few roots; slightly acid; clear, wavy boundary. 12 to 16 inches thick.

C1g—25 to 40 inches, gray (10YR 5/1) heavy silt loam; many, medium, prominent, yellowish-brown (10YR 5/6) to light yellowish-brown (10YR 6/4) mottles; weak, fine, subangular blocky structure; firm, slightly sticky; no roots; neutral; abrupt, wavy boundary. 12 to 18 inches thick.

C2g—40 to 45 inches, dark-gray (10YR 4/1) stratified silt loam, fine sandy loam, and sandy loam; structureless; loose; no roots; neutral, weakly calcareous at depth of 45 inches.

The texture of the surface layer and subsoil is generally silt loam, but it ranges from loam to heavy silt loam. The profile is generally free of coarse fragments from the surface to the stratified layers, but channery fragments and pebbles are at a depth of 3 to 5 feet. The plow layer is very dark grayish brown. The subsurface horizons are very dark grayish brown (10YR 3/2) to grayish brown (10YR 5/2) and olive gray (5Y 5/2). The plow layer has granular structure and is friable to very friable. The B and C horizons have subangular blocky structure breaking to granular or have platy structure breaking to granular. In places there is a layer of gray (10YR 5/1) silty clay about 1 inch thick, generally directly under the B horizon. The reaction of the profile is generally neutral. The upper part of the profile described for this series is more acid than is typical.

Wayland soils occur with moderately well drained Middlebury and well drained Tioga soils, both of which lack mottles immediately below the plow layer. Wayland soils are similar to Wallington soils but do not have a fragipan and are subject to flooding.

Wayland silt loam (0 to 3 percent slopes) (Wd).—This soil is in low areas on flood plains along major rivers and streams. The areas are generally less than 5 acres in size; a few exceed 10 acres.

Small spots of Alluvial land and of better drained Middlebury and Tioga soils were included in mapping.

Wetness and flooding are the main limitations to farming. Undrained, this soil is better suited to pasture and forest than to row crops. The dominant vegetation consists of water-tolerant grasses, sedges, and trees. Where suitable outlets are available, some areas can be drained and used for row crops. Wetness and the hazard of flooding make this soil unsuitable for most nonfarm uses. (Capability unit IVw-1; woodland group 9)

Formation, Morphology, and Classification of Soils

This section discusses the major factors that affect the formation and morphology of the soils of Broome County and classifies the soils in higher categories.

Factors of Soil Formation

Soils are formed through the interaction of five major factors, namely parent material, climate, plant and animal life, relief, and time. The relative influence of each factor usually varies from place to place. In some places one factor may dominate in formation of a soil and determine most of its properties. Local differences in the soils are due largely to differences in parent material and relief.

Parent material

Parent material is the unconsolidated mass in which the soils formed. It determines the mineralogical and chemical composition of the soil and, to a large extent, the rate at which soil-forming processes take place.

In Broome County, the soils formed mainly in glacial till, glacial outwash, recent stream alluvium, and organic materials. Most of the soil materials were deposited or were influenced by the glaciers, which melted 15,000 to 18,000 years ago. Alluvial and organic materials are of recent origin and are being deposited now.

Soils that formed in glacial till are the most extensive and have a wide range of characteristics. They commonly have a firm substratum. Mardin, Volusia, Chippewa, Cattaraugus, Culvers, and Morris soils are a few examples.

Soils that formed in glacial outwash deposits are generally loamy textured and are commonly underlain by stratified sand and gravel. Chenango, Howard, and Braceville soils are examples.

Soils on flood plains formed in water-laid materials, or recent alluvium. They are medium textured and have little soil development. Examples of these are Tioga and Middlebury soils.

Soils that are formed from organic materials are called Peat and Muck.

Climate

Broome County has a humid, continental type of climate, marked by extreme seasonal changes in temperature. At Binghamton, the average annual temperature is 45° F. and the average annual precipitation is 36 inches. During the growing season, which extends from May through September, rainfall is fairly uniform and totals from 18 to 24 inches. The cool temperature in the county promotes the accumulation of organic matter in the surface layer of the soils. More detailed information on the climate is given in the section "General Nature of the County."

Plant and animal life

All living organisms in and on the soils influence soil formation. Organic matter from the vegetation generally is responsible for the dark color of the surface layer and is a source of plant nutrients in the soil. Bacteria and fungi release plant nutrients by decomposing organic materials. Animals, such as earthworms and woodchucks, help to keep the soil open and porous. In Broome County the native forests have had more influence on soil formation than any other living organisms. These forests consisted mainly of red maple, sugar maple, beech, white pine, and hemlock.

By clearing the forests and cultivating the land, man has also greatly influenced the changes that occur in soils. He has added fertilizers, mixed some soil horizons, and even moved soil materials from place to place.

Relief

Broome County is in the glaciated part of the Allegheny Plateau of New York State. This part of the dissected plateau is within the Susquehanna River drainage system. The walls of the Susquehanna Valley rise sharply to remnants of the plateau, and in places the difference in elevation is as much as 500 to 600 feet within less than a mile.

Across the plateau itself, there are differences of 200 feet or more between the top of the plateau and the lower areas. The elevation over much of the county is between 1,500 and 1,600 feet. Hills adjoining Delaware County have an elevation of 1,700 to 1,900 feet or more. Upland slopes are gently rolling over the broad summit areas, and side slopes are moderately sloping to steep. About 10 percent of the county is comprised of stream terraces or flood plains. On uplands the general features have been smoothed by glaciation. Thus, the landscape has smooth curves rather than sharp, abrupt features.

The shape of the land surface, or lay of the land, the slope, and the depth to the water table have had great influence on the formation of soils in the county. Soils that formed in sloping areas where runoff is moderate to rapid are generally well drained; have a bright-colored, unmottled subsoil; and in most places are leached to a greater depth than wetter soils in the same general area. In more gently sloping areas where runoff is slower, the soils generally exhibit some evidence of wetness, such as mottling in the subsoil. In level areas or slight depressions where the water table is at or near the surface for long periods of time, the soils show considerable evidence of wetness. They have a dark-colored, thick, organic surface layer and a strongly mottled or grayish subsoil. Some soils, however, are wet because of a high water table or because of their position on the landscape. Permeability of the soil material and the length, steepness, and configuration of the slope also influence the kind of soil that is formed. Local differences in the soils are largely the result of differences in parent material and relief.

Time

In the formation of soils, a considerable length of time is needed for changes to take place in the parent material. The soils of Broome County formed in the last 15,000 to 18,000 years since glaciation and are considered relatively young.

Soils that formed on the low bottom lands generally are subject to overflow and consequently may receive new sediments with each flooding. These soils have weak structure and a weak color differentiation between horizons. An example is the Tioga soil. Soils that have well-developed horizons, such as the Mardin soils, have been forming for a longer period of time than the Tioga.

Morphology of Soils

This subsection describes briefly horizon nomenclature and the processes involved in horizon development.

Major soil horizons

The results of the soil-forming factors can be distinguished by the different layers, or soil horizons, seen in a soil profile. The soil profile extends from the surface downward to materials that are little altered by soil-forming processes.

Most soils contain three major horizons, namely the A, B, and C horizons (*23*). These major horizons may be further described by the use of letters and numbers to indicate specific kinds of the major horizons. An example would be the B2t horizon, which represents a B horizon that contains an accumulation of clay. Part of the clay has moved downward from the A horizon.

The A horizon is the surface layer. An A1 horizon is that part of the surface layer with the largest accumulation of organic matter. The A horizon is also the layer of maximum leaching or eluviation of clay and iron. If considerable leaching has taken place and organic matter has not darkened the material, the horizon is called an A2. In some soils in Broome County, the A2 horizon is brownish in color because of the oxidation of iron.

The B horizon underlies the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation, or illuviation, of clay, iron, aluminum, or other compounds leached from the surface layers. In some soils, the B horizon is formed by alteration in place rather than by illuviation. The alteration may be caused by oxidation and reduction of iron or by the weathering of clay minerals. The B horizon commonly has blocky or prismatic structure, and it generally is firmer and lighter colored than the A1 horizon but darker colored than the C horizon.

The C horizon is below the A or B horizon. It consists of materials that are little altered by soil-forming processes but may be modified by weathering.

Processes of soil horizon differentiation

In Broome County, several processes are involved in the formation of soil horizons. Among these are the accumulation of organic matter, the leaching of soluble salts, the formation and translocation of clay minerals, and the reduction and transfer of iron. These processes are continually taking place and generally at the same time throughout the profile. Such processes have been going on for thousands of years.

The accumulation and incorporation of organic matter take place with the decomposition of plant residue. These additions darken the surface layer and help to form the

A1 horizon. Organic matter, once lost, normally takes a long time to replace. In Broome County the organic-matter content of the surface layer averages about 4.0 percent.

In order for soils to have distinct soil horizons, it is believed that some of the lime and other soluble salts are leached before the translocation of clay minerals. Among the many factors that affect this leaching are the kinds of salts originally present, the depth to which the soil solution percolates, and the texture of the soil profile.

Well drained and moderately well drained soils in Broome County have yellowish-brown or reddish-brown subsoil horizons. These colors are caused mainly by thin coatings of iron oxides on sand and silt grains, although in some soils like the Cattaraugus, the colors are inherited from the reddish glacial materials in which they formed. Weak to moderate development of subangular blocky structure has taken place, but the subsoil contains little or no more clay than the overlying surface horizons.

A fragipan has developed in the subsoil of most of the moderately well drained and somewhat poorly drained soils in the county. These horizons are very firm and brittle when moist, and they are very hard when dry. Soil particles are tightly packed so that bulk density is high and pore space is low. Genesis of these horizons is not fully understood, but studies show that swelling and shrinking take place in alternating wet and dry periods. This may account for the packing of soil particles and also for a gross polygonal pattern of cracks in the fragipan. Clay, silica, and oxides of aluminum are the most likely cementing agents that cause brittleness and hardness.

The reduction and transfer of iron is associated mainly with the wetter, more poorly drained soils. This process is called gleying. Moderately well drained to somewhat poorly drained soils have mottles of yellowish brown and reddish brown, which indicate the segregation of iron. In poorly drained to very poorly drained soils, such as the Alden, Chippewa, and Wayland soils, the subsoil and underlying materials are grayish colored, which indicates reduction and transfer of iron by removal in solution.

Classification of Soils

Soils are classified so that we may more easily remember their significant characteristics, assemble knowledge about them, see their relationships, and understand their behavior and their response to the whole environment. First through classification and then through the use of soil maps, we can apply our knowledge to specific fields and other tracts of land.

The classification of soils into series and lower categories is discussed in the section "How This Survey Was Made." Two systems of classifying soils above the series level have been used in the United States in recent years. The older system was adopted in 1938 (*22*) and revised later (*21*). The system currently used by the National Cooperative Soil Survey was adopted in 1965 and is under continual study. Readers interested in the development of this system should refer to the latest literature available (*18*, *24*). Table 9 shows the classification of the soil series in Broome County according to both systems.

The current system of classification has six categories. Beginning with the most inclusive, these categories are order, suborder, great group, subgroup, family, and series. The criteria for classification are soil properties that are measurable or observable, but the properties are selected so that the soils of similar genesis are grouped together. Placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available. Following is a brief description of each of the six categories.

ORDER.—Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to indicate kind and relative strength of the soil-forming processes. Entisols have weakly developed or no horizons, whereas Alfisols and Ultisols have horizons of marked clay accumulation. Inceptisols, Alfisols, and Histosols are the three soil orders represented in Broome County.

Inceptisols occur mostly on young, but not recent, land surfaces. In Broome County this order includes soils formerly classified as Alluvial soils, Humic Gley soils, Sols Bruns Acides, and Low-Humic Gley soils.

Alfisols have a clay-enriched B horizon that is high in base saturation. In Broome County this order includes soils formerly classified as Gray-Brown Podzolic soils.

Histosols formed in organic deposits under water. They are composed of peat or muck. In Broome County this order includes soils formerly classified as Bog soils.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that indicate genetic similarity. The suborders have a narrower climatic range than the orders. The criteria for suborders reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in the kind and sequence of genetic horizons.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) concept of the group, the others, called intergrades or extragrades, made up of soils that have properties mostly of one group but also one or more properties of another. Subgroups may also be recognized in those instances where soil properties intergrade outside the range of any other great group, suborder, or order.

FAMILIES.—Families are established within subgroups primarily on the basis of properties important to plant growth or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, consistence, and thickness of horizons.

SERIES.—The series is a narrower category within the family. All the soils of a given series formed from a particular kind of parent material and have genetic horizons that, except for the texture of the surface layer, are

TABLE 9.—*Soil series classified according to the current system of classification and the 1938 system with later revisions*

Series	Current classification			1938 system with later revisions
	Family	Subgroup	Order	Great soil group
Alden	Fine-loamy, mixed, nonacid, mesic	Mollic Haplaquepts	Inceptisols	Humic Gley Soils.
Arnot	Loamy-skeletal, mixed, mesic	Lithic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Braceville	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols	Sols Bruns Acides.
Canaseraga	Coarse-silty, mixed, mesic	Typic Fragiochrepts	Inceptisols	Sols Bruns Acides.
Cattaraugus	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols	Sols Bruns Acides.
Chenango	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Chippewa	Fine-loamy, mixed, mesic	Typic Fragiaquepts	Inceptisols	Sols Bruns Acides.
Culvers	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols	Sols Bruns Acides.
Dalton	Coarse-silty, mixed, mesic	Aeric Fragiaquepts	Inceptisols	Sols Bruns Acides.
Howard	Loamy-skeletal, mixed, mesic	Glossoboric Hapludalfs	Alfisols	Gray-Brown Podzolic soils intergrading to Sols Bruns Acides.
Lordstown	Coarse-loamy, mixed, mesic	Typic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Mardin	Fine-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols	Sols Bruns Acides.
Middlebury	Coarse-loamy, mixed, mesic	Aquic Fluventic Eutrochrepts.	Inceptisols	Alluvial soils.
Morris	Coarse-loamy, mixed, mesic	Aeric Fragiaquepts	Inceptisols	Sols Bruns Acides.
Muck	(1)	(1)	Histosols	Bog soils.
Oquaga	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Peat	(1)	(1)	Histosols	Bog soils.
Scio	Coarse-silty, mixed, mesic	Aquic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Tioga	Coarse-loamy, mixed, mesic	Dystric Fluventic Eutrochrepts.	Inceptisols	Alluvial soils.
Tuller	Loamy, mixed, acid, mesic	Lithic Haplaquepts	Inceptisols	Low-Humic Gley soils.
Unadilla	Coarse-silty, mixed, mesic	Typic Dystrochrepts	Inceptisols	Sols Bruns Acides.
Volusia	Fine-loamy, mixed, mesic	Aeric Fragiaquepts	Inceptisols	Sols Bruns Acides.
Wallington	Coarse-silty, mixed, mesic	Aeric Fragiaquepts	Inceptisols	Sols Bruns Acides.
Wayland	Fine-silty, mixed, nonacid, mesic	Fluventic Haplaquepts	Inceptisols	Low-Humic Gley soils.

[1] Histosols are not classified at the subgroup and family levels, because classification at these levels was provisional at the time the survey went to the printer. In this area Peat and Muck soils have not been classified into soil series.

similar in differentiating characteristics and in arrangement in the soil profile. Among the differentiating characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

A detailed description of each soil series in the county is given in the section "Descriptions of the Soils."

General Nature of the County

This section describes the climate in the county; discusses the geology and physiography, provides some general information about the county, and gives some important farming statistics. The statistics are from reports published by the U.S. Bureau of the Census.

Climate [10]

Broome County has a humid, continental type of climate. Summers are pleasantly warm. Winters are long and cold and have frequent periods of stormy, unsettled weather. The atmospheric flow is primarily from continental sources. Thus, the weather usually is cold and dry when the flow is from the north or northwest, and it is warm and occasionally humid when the flow is from the south or southwest. From time to time, air masses from maritime sources reach the county from well-developed storms and certain other pressure systems off the mid- or north-Atlantic coast. Such easterly airflow generally brings cloudy, damp, and relatively cool weather. The Great Lakes are too distant to have a strong, direct effect on the climate of this area.

The movement of most weather systems toward the northeastern part of the United States affects Broome County with variable weather over short periods of time. Seasonal weather varies appreciably from year to year. Temperatures and other climatic conditions may vary within short distances because of the differences in elevation, aspect of slope, and other topographic features in the county.

Table 10 gives temperature and precipation data compiled from records of the U.S. Weather Bureau Station at the Broome County Airport, near Binghamton. The airport is on a comparatively flat plateau that has an elevation of 1,590 feet. Unless otherwise stated, the information given in this subsection is based on these records. It is important to note that at the airport daytime temperatures are about 3 degrees F. cooler in winter and about 5 degrees cooler in spring and summer than the temperature in the river valleys and other areas where the elevation is less than 1,050 feet. On the other hand, from early in summer to late in autumn, night temperatures average 2 degrees warmer at the airport than in the valleys. There is little difference in night temperatures from December through March.

[10] By A. BOYD PACK, State climatologist, U.S. Environmental Science Services Administration, Weather Bureau.

Table 10.—*Temperature and precipitation at Broome County Airport, Binghamton*

[Elevation 1,590 feet]

Month	Temperature					Precipitation						
	Average daily maximum [1]	Average daily minimum [1]	7 years in 10 will have— Maximum equal to or higher than [1]—	7 years in 10 will have— Minimum equal to or lower than [1]—	Average heating degree days [1] [2]—	Average total [1]—	Record minimum [1]	3 years in 10 will have— More than [1]—	3 years in 10 will have— Less than [1]—	Average number of days with 0.10 inch or more [3]	Snow: Average total [1]	Snow: 7 years in 10 will have more than [1]
	°F.	°F.	°F.	°F.		In.	In.	In.	In.		In.	In.
January	30	17	46	−2	1,280	2.5	1.2	2.9	1.9	6	22	16
February	31	17	47	0	1,150	2.2	1.2	3.3	1.7	6	21	16
March	39	24	59	9	1,050	2.9	1.5	3.0	2.3	7	16	13
April	53	34	73	23	650	3.0	2.0	3.6	2.8	9	6	2
May	65	45	80	33	310	3.5	.8	3.6	2.8	7	(4)	(5)
June	73	54	86	44	100	3.8	1.2	3.9	2.6	7	0	----------
July	78	59	88	49	20	3.7	.8	4.3	2.5	7	0	----------
August	76	57	86	47	70	3.6	.6	4.3	2.6	7	0	----------
September	69	50	84	36	200	2.9	.7	3.2	2.4	6	0	----------
October	59	41	76	29	470	3.1	.3	3.0	1.4	5	(6)	(5)
November	45	31	62	19	810	2.5	1.0	2.8	1.9	7	7	3
December	33	21	52	2	1,180	2.6	.9	3.2	1.7	6	17	15
Year	54	37	89	−5	7,290	36.3	30.4	37.5	32.6	80	89	74

[1] Based on 16-year record.
[2] Base of 65° F. daily mean temperature.
[3] Based on 10-year record.
[4] Less than 0.5 but more than 0.
[5] 1 year in 10 will have more than 1 inch.
[6] Trace.

Temperature

Temperatures at the airport reach 90°F. or higher on an average of 2 to 4 days each year. The number of such days varies, however, from as many as 8 days or more in an unusually hot summer to none in about four summers out of 10. At the high elevations in the county, temperatures in the 90's occur almost entirely during the months of July and August. In the lower valleys, temperatures in the 90's occur on an average of 10 to 14 days each year. Temperatures in the county seldom reach 100° or higher.

A temperature of 0° or lower can be expected on 6 to 10 days in most winters. Such a temperature occurs on not more than 2 or 3 days in mild winters but ranges up to 15 days or more in abnormally cold winters. A temperature of −15° or lower occurs in about 1 year out of 5, but temperatures of −20° unusual. Temperatures of 0° or lower can be expected from early in December through the middle of March. In both the river valleys and on upland where the air drainage is good, the lowest temperature in most winters is between −5° and −15°. In areas where air movement is poor, or in cold pockets, lower temperatures are more common.

Temperatures do not exceed 32° on 60 to 70 days each year at the higher elevations and on 45 to 55 days in the main river valleys. Such cold days may be expected from late in November through March and occasionally in April. Continuous periods of subfreezing temperatures seldom last for more than 4 or 5 days.

Table 11 gives the probability of the last freezing temperature in spring and the first in fall. At the higher elevations in the county, where air drainage is good, and in the Susquehanna River valley, the average date for the last freeze in spring is about May 5, and the average date for the first freeze in fall is about October 5. It is unlikely that freezing temperatures will occur later than May 25 or earlier than September 20. In most years, the last freeze in spring is likely to occur between April 21 and May 16, and the first freeze in fall between September 26 and October 20. The occurrence of freezing temperatures may differ considerably within short distances because of the differences in elevation, aspect of slope, and air drainage.

The length of the freeze-free season on the uplands where air drainage is good, and in the principal river valleys, is commonly about 150 to 155 days. In about 7 years out of 10, the freeze-free season ranges from 140 to 165 days.

Additional information on freezing temperatures in Broome County and other sections of New York State can be found in literature citations (*7*) and (*8*).

Precipitation

The annual precipitation varies as much as 4 inches throughout the county. It ranges from 35 to 36 inches in the river valleys in the southwestern part to 39 to 40 inches near the Chenango and Delaware County lines in the northeastern and eastern parts. It is about 38 inches in the northern panhandle. Unless otherwise stated, the statistics given in this subsection are based on data compiled since 1951 at the Broome County Airport, an area of lighter precipitation.

The annual precipitation ranges from 31.5 to 39 inches in 7 years out of 10. The annual precipitation in a 30-year period has ranged from a minimum of 27.7 to a maximum of 45.5 inches. The climate is known to bring

TABLE 11.—*Probability of last freezing temperature in spring and first in fall at Broome County Airport, Binghamton*[1]

[Elevation, 1,590 feet]

Month	Dates for given probability and temperature					
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
Spring:						
1 year in 10 later than	April 8	April 10	April 21	May 11	May 22	May 27
3 years in 10 later than	April 2	April 4	April 16	May 2	May 14	May 21
5 years in 10 later than	March 25	March 28	April 10	April 22	May 4	May 15
7 years in 10 later than	March 18	March 23	April 5	April 12	April 24	May 9
9 years in 10 later than	March 11	March 18	April 1	April 3	April 15	May 3
Fall:						
1 year in 10 earlier than	November 1	October 28	October 24	September 30	September 23	September 11
3 years in 10 earlier than	November 19	November 7	October 31	October 9	September 29	September 17
5 years in 10 earlier than	November 27	November 18	November 9	October 20	October 6	September 24
7 years in 10 earlier than	December 5	November 29	November 17	November 1	October 13	October 1
9 years in 10 earlier than	December 12	December 9	November 25	November 10	October 19	October 7

[1] The following example illustrates how to use and interpret the data in this table. Take a temperature of 24° F. or lower. In 1 year out of 10 (10 percent probability), a temperature of 24° or lower can be expected to occur later than April 21; in 5 years out of 10 (50 percent probability), a temperature of 24° or lower can be expected to occur later than April 10. The fall dates are interpreted similarly for a given temperature, but the occurrence is earlier than the date given.

3 or 4 successive years of deficient or of heavy precipitation, but usually the annual precipitation varies only a few inches from year to year.

During the May-September part of the growing season, the total rainfall in the southwestern part of the county averages 17.5 inches. It averages slightly less than 19 inches in the northeastern and eastern parts. Although the total rainfall in this 5-month period has ranged from as little as 10 inches to as much as 25 inches or more, in most years from 15 to 22 inches can be expected.

Monthly precipitation gradually increases from an average of nearly 2.5 inches during the winter season to 3.7 inches during the summer season. Normally, the amount and the distribution of rainfall during the growing season are adequate for the growth of crops that are suited to the county. Short periods of deficient rainfall occur nearly every summer, but severe drought is not a serious hazard. In about 2 years out of 10, however, the periods of deficient rainfall are so prolonged that the growth and yield of crops are seriously affected.

Showers and thunderstorms provide most of the precipitation from May through the first part of October. Such storms may occur intermittently for as many as 3 days before cool, dry, more stable air masses arrive from the west or northwest. Precipitation in winter comes mostly in the form of snow but occasionally may fall as rain or drizzle.

Precipitation in amounts of 1 inch or more in 24 hours occurs on an average of 9 to 11 days each year. The frequency of such amounts tends to be somewhat greater during the months of May through October. Precipitation of more than 2 inches in 24 hours occurs once or twice nearly every year.

The average seasonal snowfall ranges from 55 to 70 inches in the lower areas and river valleys and from 85 to 95 inches on the uplands. The amount of snowfall varies considerably from year to year. At the higher elevations, the total snowfall ranges between 70 and 100 inches in most winters.

Snowfall is frequently heavy, both in terms of individual storms and in monthly amounts. Monthly amounts in excess of 20 inches are common from December through March. Occasionally, there is a monthly total of more than 30 inches. At least one storm each winter can be expected to yield 12 inches or more of snow. In about 1 year out of 3, a snowfall of more than 10 inches occurs in November and in April.

A snow cover of at least 1 inch can be expected much of the time from early in December to late in March, and a measurable snow cover can be expected for short periods in November and April.

The climate of the county favors a considerable amount of cloudiness, particularly late in fall and in winter. Ordinarily, there are about 215 cloudy days each year. About 20 cloudy days or more can be expected in each of the months from November through April. During the summer season, there are about 14 cloudy days each month. Each year about 100 days are partly cloudy, and 50 days are clear. The number of clear days increases from 2 or 3 per month in winter to about 7 clear days per month from late in summer to mid-autumn.

The percentage of possible sunshine in Broome County ranges from 60 to 70 percent in June, July, and August to about 30 percent in November and December.

The prevailing wind is generally westerly throughout the year, but there is a slight northwesterly tendency in winter and spring, and a slight southwesterly tendency in summer and fall. The wind velocity averages 9 miles per hour from June through September. It increases to 12 miles or more per hour in January, February, and March. Occasionally, there is some damage to property and crops during a locally severe thunderstorm or during the passage of a vigorous storm system.

Thunderstorms occur on 25 to 30 days each year. A few are accompanied by damaging winds, heavy rains, or both. Flooding and soil erosion may result if rainfall is intense. Hail accompanies some of the more violent storms but is not considered as a serious hazard to crops or property.

Five tornadoes have been recorded in Broome County since 1900. Storms that bring freezing rain occur nearly every winter, but only occasionally is there a storm that causes widespread damage to utility lines and trees. The county is not within the usual path of hurricanes, although on rare occasions the interior of the State is crossed by a hurricane that brings destructive winds and heavy rain to Broome County.

Dense fog occurs on about 50 days each year. Such occurrences are somewhat less in the lower areas of the county. Afternoon relative humidity in summer averages between 50 and 60 percent. Although a combination of high temperatures and relatively high humidity occur occasionally in summer, extended periods of such weather are infrequent.

Geology and Physiography [11]

Broome County is located in the glaciated Appalachian Plateau (*3*). The more rugged easternmost area is part of the Catskill Mountains. Millions of years of water erosion of the sedimentary rocks and some remodeling by Pleistocene ice sheets and their debris have produced a landscape with well-rounded, rolling hills. The floors of the large rivers are flat. The smaller streams divide the area into a network of smaller hills and ridges. Some valleys contain as many as three terrace levels, indicating several cycles of river entrenchment.

The highest elevations in the county are in the eastern part where hills rise to 2,000 feet above sea level. The lowest elevation of 800 feet occurs where the Susquehanna River flows westward out of the county. The elevation in the southern part of the county is consistently several hundred feet higher than that in the northern part because of the erosion-resistant sandstone that caps the hills.

The entire county is underlain at varying depths by sedimentary rocks of upper Devonian age. Shale and siltstone are commonly encountered at a depth of less than 40 inches under most Lordstown, Arnot, and Tuller soils and under the moderately shallow variant of the Mardin soils. On some of the higher hills in the southern and eastern parts of the county, the depth to sandstone is less than 40 inches. Oquaga soils are dominant in these areas, but smaller areas of Lordstown, Arnot, Tuller, and the moderately shallow Mardin soils also occur. Fragments of these underlying rocks are in all of the channery and stony soils in the county, regardless of depth. Oil test holes indicate that layered sequences of similar sedimentary rocks extend to a depth greater than 4,000 feet. The rocks are broken by three different sets of joints, or fractures, and they commonly are slightly folded, with axes that trend east.

Most unconsolidated surface deposits are the result of Pleistocene ice that covered Broome County during the glaciation stages. Some deposits in the major valleys are associated with the melt-water flow from a later ice sheet that existed north of Broome County. In recent times there has been some reworking and redeposition of older sediments on the present flood plains. These deposits are mostly water sorted in the valleys and unsorted on the uplands.

In the valleys most deposits are stratified. Adjacent to the Susquehanna River south of Endicott, such deposits have attained a width of more than a mile and a maximum thickness of about 200 feet. In addition to the more recent deposits on flood plains and stream terraces, glacial features such as kames, kame terraces, outwash plains, and eskers are present, as well as deltas and alluvial fans. Most of the valley deposits are interlayered and interfingered, and they contain various amounts of clay, silt, sand, and gravel. Single layers of clay range from half an inch to more than 100 feet in thickness, but they are commonly buried by 4 feet or more of coarser textured material. These clayey materials have not contributed directly to the soils that formed above them, but they must be considered if construction involving heavy loads is contemplated. Silty deposits occur mainly on the flood plains and on the higher lying, older alluvial stream terraces. Tioga, Middlebury, and Wayland soils formed on the silty flood plains. Unadilla, Scio, and Wallington soils formed on the silty stream terraces. Chenango, Howard, and Braceville soils formed in the stratified, gravelly and sandy material on glacial outwash terraces, eskers, and kames.

In the larger valleys where most of the larger gravel pits are located, siltstones and fine-grained sandstones make up about 70 to 80 percent of the gravel component in the upper 4 feet. The rest consists mainly of chert and metamorphic rocks. Below a depth of 4 feet, limestone gravel and cobblestones generally account for up to 25 percent (*6*) of the volume. In places, the dissolution of limestone has provided enough lime to cement some beds of gravel.

About 90 percent of the soils in the county formed in unsorted glacial till. Above 1,000 feet elevation, the till contains mainly angular fragments of siltstone and fine-grained sandstone of local origin (*12*). Below 1,000 feet, the till contains, in addition to local rocks, more rounded rocks not native to the area. These rocks are mainly limestone and crystalline rock (*11*). They do not occur in sufficient amounts to have influenced soil formation to any degree.

About 18 percent of the soils in the county formed in till that was less than 40 inches thick over the underlying siltstone, shale, and sandstone bedrock. Among these are the Lordstown, Oquaga, Arnot, and Tuller soils and the moderately shallow variant of Mardin soils. Soils that formed in till deposits more than 40 inches thick occupy about 72 percent of the county. Mardin, Volusia, Chippewa, and Alden soils formed in till influenced by gray siltstone and shale materials. Cattaraugus, Culvers, and Morris soils formed in till influenced by reddish sandstone and shale.

Some wind-deposited or water-deposited silts along the lower walls of the larger valleys are 20 to 36 inches thick over till. Canaseraga and Dalton soils formed in this material. Also, along the lower valley walls, the till

[11] From material furnished by DONALD R. COATES, Department of Geology, State University of New York, at Binghamton.

and outwash are intermixed. These are the materials in which the complexes of Mardin and Chenango soils formed.

Hill configuration has been greatly influenced and altered by glacial deposits. The larger hills have bedrock cores. They average 360 feet in height and have north slopes of 24 percent and south slopes of 12 percent. The surface asymmetry, however, is not an accurate reflection of the bedrock surface. By studying 400 water wells located on the hills of the county and by interpreting geologic mapping, north bedrock slopes are calculated to be 25 percent and south slopes 20 percent. Till deposits are about 12 feet thick on north slopes and 92 feet thick on south slopes. The average thickness of the till is 60 feet, but the thickness ranges from 0 to 248 feet (*4*).

History and Population

The first recorded settlement in the area that is now Broome County was a trading post and mission established by the Church of England near the present village of Windsor about 1750. The first settlers were New England veterans of Sullivan's army who, impressed by the country seen during the campaign, came back to make their homes in the area.

Broome County was formed in 1806. It was named after John Broome, Lieutenant Governor of New York. From a few settlers in 1790, the population of the county increased to 22,339 by 1840 and to 212,661 by 1960. In 1960, Binghamton, the largest city, had a population of 75,085.

Industries and Transportation

The major industries in the county are concentrated in the triple cities. Among the articles produced are shoes, electronic apparatus, aircraft trainers, aircraft armaments, cosmetics, furniture, cameras, and photographic supplies.

Binghamton is at the junction of two main highway systems. Interstate Highway No. 81 crosses the county from north to south, and State Highway No. 17 crosses the county from east to west. Early in the 1960's, the Erie and Lackawanna Railroads merged to form the Erie-Lackawanna system that now serves the county. Commercial airline service is available at the Broome County Airport near Binghamton.

Land Use

The 1964 Census of Agriculture shows that about 46 percent, or 210,846 acres, of Broome County is in farms. Dairying is the principal type of farming, but fruit, poultry products, and potatoes are also important.

The number of farms has steadily decreased since the latter part of the last century, but the size of farms has increased. In the 1880's, the farms averaged only 89 acres in size. The average size of the farms increased to 170 acres in 1959 and to 190 acres in 1964. Although the number of cows has increased only slightly, the quantity of milk produced has increased significantly. There were 155,400,200 pounds produced in 1959, and 157,183,850 pounds in 1964. The entire dairy production is now sold as fluid milk.

In 1944, there were 10,583 acres in alfalfa, 5,780 acres in corn (mostly ensilage), and 3,494 acres in oats. Corn production has greatly increased in recent years because of the introduction of improved varieties that are suited to a shorter growing season.

Water Resources [12]

The major rivers in Broome County are the Susquehanna, Chenango, and Tioughnioga. The Delaware River forms the county boundary south of Deposit, and the Otselic River enters the northern part of the county. Other large streams are Nanticoke Creek, Choconut Creek, Snake Creek, Little Snake Creek, and Oquaga Creek. Table 12 shows some characteristics of streamflow in the county.

Annual precipitation in the county averages 3 feet. A water analysis reveals that about 54 percent of the precipitation runs off. The rest either enters the ground or is lost through evapotranspiration.

Except for the city of Binghamton, which obtains its water from the Susquehanna River, the municipalities, industries, and private users depend mainly on wells for their water supply. Springs are a minor source of water. The annual water consumption in the county amounts to about 12 billion gallons, most of which is used by the metropolitan areas. Table 13 presents data for the quality of the water in the county.

The ground-water zone, which occurs below the water table, is the source of water for the wells and springs. In this zone, water collects in the openings that occur between grains of clay, silt, sand, and gravel and in the fractures and microcavities in shale, siltstone, and sandstone bedrock. Depth to the water table depends, in a general way, on the topography and commonly is greater on the hills than in areas near the valleys. In some areas the depth is more than 100 feet, but the average depth is about 40 feet. Drilling a well to the water table does not assure a plentiful supply of water. It is important

TABLE 12.—*Gaging records of streamflow*

[Based on data obtained from U.S. Geological Survey Water Supply Papers]

Source	Location of gaging station	Drainage area	Mean annual flow in cubic feet per second	Cubic feet per second per square mile
		Sq. mi.		
Susquehanna River	Conklin	2, 240	3, 654	1. 63
Susquehanna River	Vestal	3, 960	6, 451	1. 63
Chenango River	Chenango Forks.	1, 492	2, 452	1. 64
Tioughnioga River	Itaska	735	1, 250	1. 70
Otselic River	Upper Lisle	216	394	1. 82
Oquaga Creek	Deposit	66	113	1. 71

[12] This section prepared by DONALD R. COATES, Department of Geology, State University of New York, at Binghamton.

TABLE 13.—*Typical water analysis*

[Based on data obtained from water supervisors of the municipalities]

Item	Municipality and source of water			
	Binghamton (Susquehanna River)	Vestal (wells)	Endicott (wells)	Whitney Point (wells)
Iron p.p.m.[1]	0.03	0.04	0.14	0.02
Chloride p.p.m.	2.8	16.0	3.5	15.0
Hardness as $CaCO_3$ p.p.m.	56.0	116.0	170.0	235.0
Alkalinity p.p.m.	62.0	91.0	150.0	174.0
Nitrite p.p.m.	--------	.002	.006	.001
Nitrate p.p.m.	.16	.08	.18	.6
Magnesium p.p.m.	17.6	8.1	--------	--------
Sodium p.p.m.	1.98	4.3	--------	--------
Bicarbonate p.p.m.	75.6	99.6	--------	--------
Reaction pH	7.5	7.9	7.6	7.4
Temperature ° F	33.0	49.0	53.0	--------

[1] Parts per million.

that the well encounter materials that contain the number and type of openings through which water can move freely.

The largest producing wells in the county are those located in sandy and gravelly material, such as that underlying the Susquehanna, Chenango, and other major rivers. For example, Endicott, Johnson City, and Vestal have wells capable of producing more than 1,000 gallons of water a minute. These wells average about 150 feet in depth and encounter aquifers with the capacity to produce about 70,000 gallons of water per day per foot of drawdown. The water table in the area of these large producing wells, however, has been declining at a rate of about 1 foot per year during the 5-year period from 1960 to 1965. The erratic nature of the aquifers is revealed by test drilling programs to develop new well sites. In some places, wells drilled within 200 feet of high-producing wells had a maximum yield of less than 150 gallons per minute. Wells cannot be developed if the only materials encountered are stratified clays and silts. The movement of water through such material is slow.

Wells drilled on hillsides generally encounter glacial till that, even if saturated, will not release water freely. These wells must be drilled into bedrock. Even then, the bore of the well must encounter a sufficient number of fractures and other openings that will permit water to flow rapidly.

The movement of water in bedrock is largely restricted to fracture systems and to bedding planes where the strata change from sandstone to shale. Thus, the best bedrock wells are those that have penetrated intersecting joints and several changes in rock types. The average bedrock well is 150 feet deep, 90 feet of which is in bedrock, and 60 feet in till. The average yield is about 12 gallons of water per minute. Some wells, however, yield less than 2 gallons per minute at a depth greater than 350 feet, and others encounter large amounts of water in fractured zones immediately beneath the till. About one out of 30 rock wells is a flowing well. Most flows are less than 3 gallons a minute. Consequently, pumping is still necessary. Such wells generally are located in valleys or on the south side of hills. Although the water from bedrock wells generally is potable, in places the content of iron, sulfur, gas, or salt reaches objectionable proportions.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available moisture capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity, or about one-third bar of tension, and the wilting coefficient, or about 15 bars of tension.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catena. A sequence, or "chain," of soils on a landscape, developed from one kind of parent material but having different characteristics because of differences in relief and drainage.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clean tillage. Cultivation to prevent the growth of all vegetation except the particular crop desired.

Congeliturbate till. Frost-worked glacial till material.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Cover crop. A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Esker (geology). A narrow, winding ridge or mound of stratified gravelly and sandy drift that was deposited by a subglacial stream.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Graded stripcropping. Growing of crops in strips that are graded toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, and covered by grass for protection against erosion; used to conduct surface water away from cropland.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Kame. Short ridge, hill, or hillock of stratified glacial drift.

Leached layer. A layer from which the insoluble or soluble materials have been washed away by percolating water.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material (soil). The disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		pH
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Runoff. The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil variant. A soil having properties sufficiently different from those other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C or R horizon.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Varves. Distinctly marked annual deposits of sediment, regardless of their origin.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Estimated yields, table 1, page 15.
Woodland suitability groups, table 2, page 20.
Wildlife habitat elements and classes of wildlife, table 3, page 22.
Engineering uses of the soils, tables 4, 5, and 6, pages 28 through 49.
Nonfarm uses of the soils, table 7, page 52.
Acreage and extent, table 8, page 59.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group
			Symbol	Page	Number
AcA	Alden and Chippewa soils, 0 to 3 percent slopes-------	58	IVw-2	13	8
Ad	Alluvial land---	58	Vw-1	14	9
ArD	Arnot channery silt loam, 0 to 25 percent slopes------	60	IVs-1	14	6
Br	Braceville gravelly silt loam-------------------------	61	IIw-1	9	1
CaB	Canaseraga silt loam, 3 to 8 percent slopes-----------	62	IIe-3	9	2
CaC	Canaseraga silt loam, 8 to 15 percent slopes----------	62	IIIe-5	11	2
CcC	Cattaraugus channery silt loam, 5 to 15 percent slopes---	63	IIIe-1	10	2
CcD	Cattaraugus channery silt loam, 15 to 25 percent slopes---	63	IVe-1	13	2
CcE	Cattaraugus channery silt loam, 25 to 35 percent slopes---	63	VIe-1	14	3
ChA	Chenango and Howard gravelly loams, 0 to 5 percent slopes---	65	I-1	8	1
ChC	Chenango and Howard gravelly loams, 5 to 15 percent slopes---	65	IIIe-2	11	1
ChD	Chenango and Howard gravelly loams, 15 to 25 percent slopes---	65	IVe-2	13	1
ChE	Chenango and Howard gravelly loams, 25 to 40 percent slopes---	66	VIe-1	14	3
CpB	Chippewa channery silt loam, 3 to 8 percent slopes----	67	IVw-2	13	8
CuB	Culvers channery silt loam, 2 to 8 percent slopes-----	68	IIe-2	8	2
CuC	Culvers channery silt loam, 8 to 15 percent slopes----	68	IIIe-4	11	2
CuD	Culvers channery silt loam, 15 to 25 percent slopes---	68	IVe-1	13	2
Cv	Cut and fill lands, gravelly materials----------------	68	--	--	9
Cw	Cut and fill lands, loamy materials-------------------	68	--	--	9
Cy	Cut and fill lands, silty materials-------------------	68	--	--	9
DaB	Dalton silt loam, 2 to 8 percent slopes---------------	69	IIIw-3	12	5
DaC	Dalton silt loam, 8 to 15 percent slopes--------------	69	IIIe-7	11	5
LdB	Lordstown channery silt loam, 0 to 5 percent slopes---	71	IIs-1	10	2
LdC	Lordstown channery silt loam, 5 to 15 percent slopes--	71	IIIe-1	10	2
LdD	Lordstown channery silt loam, 15 to 25 percent slopes-	71	IVe-1	13	2
LoE	Lordstown and Oquaga channery silt loams, 25 to 35 percent slopes------------------------------------	71	VIe-1	14	3
LrF	Lordstown and Oquaga soils, 35 to 60 percent slopes---	71	VIIs-1	14	4

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group
			Symbol	Page	Number
LsE	Lordstown and Oquaga extremely stony and rocky soils, 0 to 35 percent slopes-------------------	72	VIIs-1	14	7
Mf	Made land, sanitary land fill-------------------------	72	--	--	9
MhB	Mardin channery silt loam, 2 to 8 percent slopes---	73	IIe-2	8	2
MhC	Mardin channery silt loam, 8 to 15 percent slopes--	73	IIIe-4	11	2
MhD	Mardin channery silt loam, 15 to 25 percent slopes-	74	IVe-1	13	2
MhE	Mardin channery silt loam, 25 to 35 percent slopes-	74	VIe-1	14	3
MmB	Mardin channery silt loam, moderately shallow variant, 2 to 8 percent slopes-------------------	74	IIe-2	8	2
MnC	Mardin-Chenango channery silt loams, 5 to 15 percent slopes------------------------------------	74	IIIe-2	11	2
MnD	Mardin-Chenango channery silt loams, 15 to 25 percent slopes------------------------------------	74	IVe-2	13	2
MrF	Mardin and Cattaraugus soils, 35 to 60 percent slopes---	74	VIIs-1	14	4
Ms	Middlebury silt loam-------------------------------	76	IIw-2	9	1
MtB	Morris channery silt loam, 2 to 8 percent slopes---	77	IIIw-2	12	5
MtC	Morris channery silt loam, 8 to 15 percent slopes--	77	IIIe-6	11	5
MuD	Morris and Tuller very stony soils, 3 to 25 percent slopes------------------------------------	77	VIIs-1	14	5
OuC	Oquaga channery silt loam, 5 to 15 percent slopes--	78	IIIe-1	10	2
OuD	Oquaga channery silt loam, 15 to 25 percent slopes-	78	IVe-1	13	2
Pm	Peat and Muck---------------------------------------	78	VIIw-1	14	9
Sc	Scio silt loam--------------------------------------	79	IIw-1	9	1
Ta	Tioga silt loam-------------------------------------	80	I-2	8	1
Tg	Tioga gravelly silt loam, fan-----------------------	80	IIe-1	8	1
TuD	Tuller channery silt loam, 0 to 25 percent slopes--	81	IVw-3	13	5
UnB	Unadilla silt loam, 0 to 5 percent slopes----------	81	I-1	8	1
UnC	Unadilla silt loam, 5 to 15 percent slopes---------	82	IIIe-3	11	1
VoA	Volusia channery silt loam, 0 to 3 percent slopes--	83	IIIw-1	11	5
VoB	Volusia channery silt loam, 3 to 8 percent slopes--	83	IIIw-2	12	5
VoC	Volusia channery silt loam, 8 to 15 percent slopes-	83	IIIe-6	11	5
VoC3	Volusia channery silt loam, 8 to 15 percent slopes, eroded---------------------------------------	83	IVe-4	13	5
VoD	Volusia channery silt loam, 15 to 25 percent slopes---	83	IVe-3	13	5
Wa	Wallington silt loam-------------------------------	84	IIIw-1	11	5
Wd	Wayland silt loam----------------------------------	85	IVw-1	13	9

353-032 O - 71 (Face O.P. Maps) No. 1

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