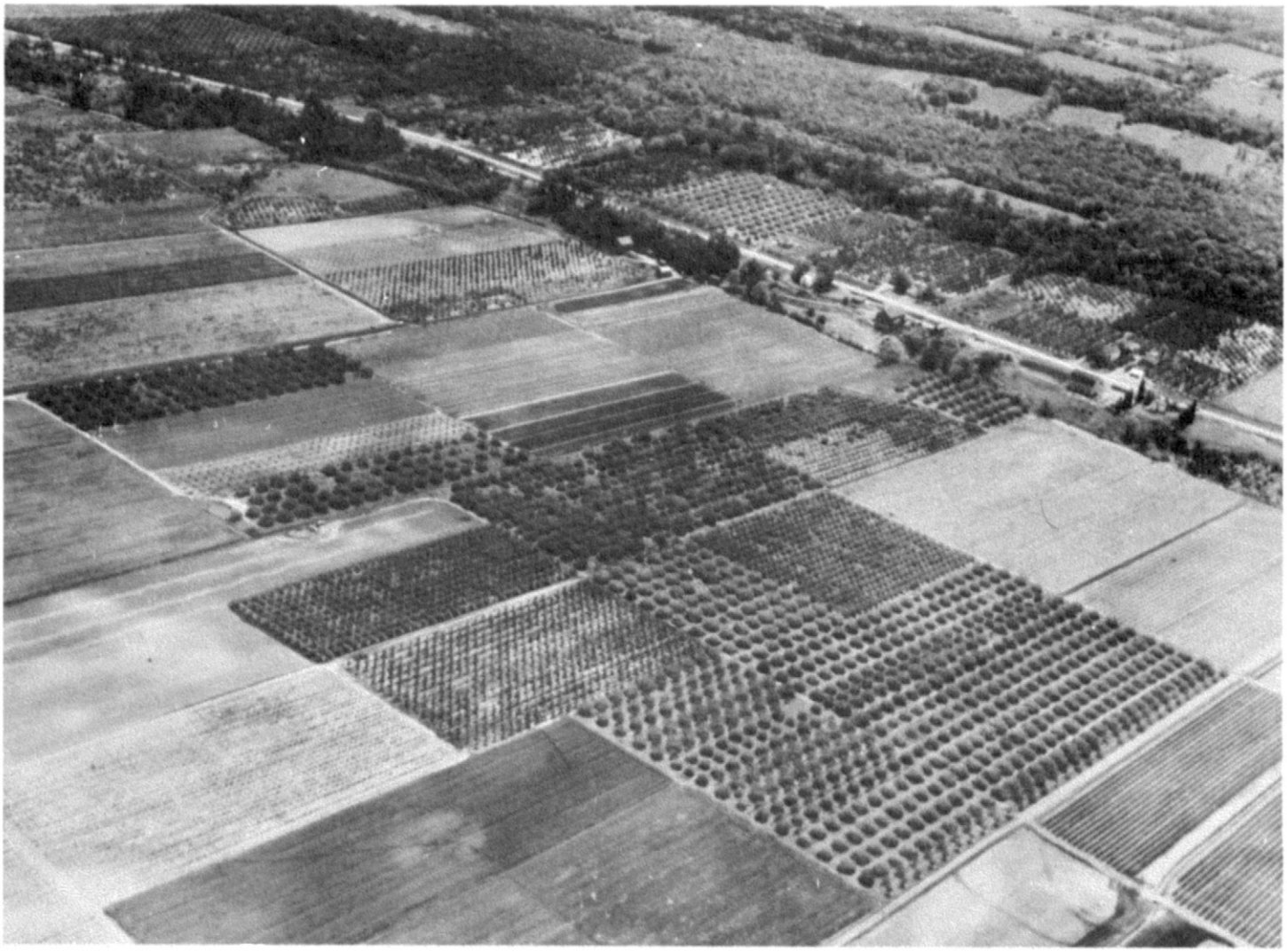
SOIL SURVEY OF

Niagara County, New York



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

Issued October 1972

Major fieldwork for this soil survey was done in the period 1964-67. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1968.

This survey was made cooperatively by the Soil Conservation Service and the Cornell University Agricultural Experiment Station. It is part of the technical assistance furnished to the Niagara County Soil and Water Conservation District. Part of the funding for the survey was provided by the Niagara County Board of Supervisors through the Niagara 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, USDA, 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 judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

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

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

Finding and Using Information

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

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

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

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

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

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

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

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

Newcomers in Niagara 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 information about the county given in the section "General Nature of the County."

Cover picture: Typical area of soils in the Rhinebeck-Ovid-Madalin association in the northern part of Niagara County.

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SOIL SURVEY OF NIAGARA COUNTY, NEW YORK

BY BRADFORD A. HIGGINS, P.S. PUGLIA, R.P.LEONARD, T.D. YOAKUM
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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

NIAGARA COUNTY borders the southern shore of Lake Ontario in the extreme northwestern corner of New York State (fig. 1). The county is bounded by Lake Ontario on the north, Tonawanda Creek on the south, Orleans and Genesee Counties on the east, and the Niagara River on the west.

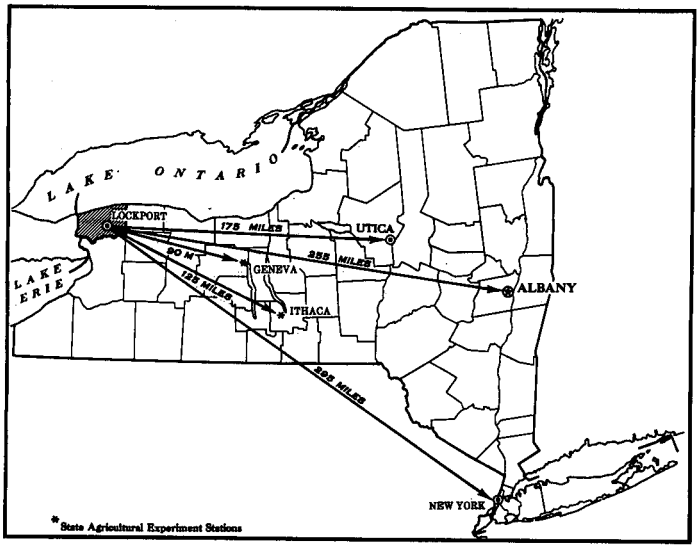

Figure 1.--Location of Niagara County in New York.

The county extends about 18 miles from north to south and about 30 miles from east to west. It has a total area of 341, 120 acres, or 533 square miles. Lockport, the county seat, is 20 miles northeast of Buffalo and 55 miles west of Rochester (8).

The Niagara Escarpment divides the county into two plains, the Ontario Plain on the north and the Huron Plain on the south. Drainage of the Ontario Plain is northward into Lake Ontario. The streams have crooked channels, and these meander through comparatively narrow flood plains that are not deeply cut. The Niagara Escarpment consists of a steep northward slope, along which perpendicular bluffs are exposed in places. Drainage of the Huron Plain is southward into Tonawanda Creek, which flows westward into the Niagara River.

Niagara County has a humid, continental climate. The flow of atmospheric air is dominantly from continental sources. Summers are pleasantly warm, but winters are fairly long and cold, and there are frequent spells of cloudy, unsettled weather in winter. Precipitation generally is evenly distributed during the year, though it is slightly less in winter than in other seasons. The climate is greatly influenced by the close proximity of Lake Ontario and Lake Erie.

The growing of fruits and vegetables is confined mainly to the Ontario Plain, where the tempering influence of Lake Ontario on climate is most pronounced. The Huron Plain is used mostly for hay and grain crops. Other important farm enterprises on the plain are dairying and raising livestock for beef.

About half the county is in farms. The dominant kinds of farming are dairying and fruit growing. A large amount of fluid milk is sold. The principal crops grown are hay, corn, small grains, and many kinds of fruits and vegetables. The acreage in woodland is only a small percentage of the total area. The woodland consists mainly of scattered farm woodlots.

Developments of water power has led to the establishment at Lockport and Niagara Falls of many industries that use electrical power. Niagara Falls, Lockport, and North Tonawanda are the principal manufacturing centers. Some of the smaller villages, such as Middleport, Barker, and Newfane, also contribute to the total manufacturing in the county.

1/ Others who participated in the field survey were J.P. WULFORST, W.E. HANNA, D.D. MONTS, J.H. JOHNSON, and T. FEDAK, Soil Conservation Service.

HOW THIS SURVEY WAS MADE

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

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and soil phase (13) 2/ are the categories most used in a local survey.

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

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Ontario loam, 2 to 8 percent slopes, is one of several phases within the Ontario series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. The one such kind of mapping unit shown on the soil map of Niagara County is the undifferentiated group. An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes, is an example.

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

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

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

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

2/ Underscored numbers in parentheses refer to Literature Cited, p.

GENERAL SOIL MAP

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

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The eleven soil associations in Niagara County are discussed in the following pages. They are grouped according to the nature of the material in which the dominant soils formed.

Areas Dominated by Soils Formed in Glacial Till

These associations make up about 33 percent of the county. The soils are deep to moderately deep and well drained to very poorly drained. They have a medium-textured to fine-textured subsoil. Glacial lake sediments have modified the soils in these associations to some extent. Dairying is the major farm enterprise. A large acreage is idle, and a large acreage is in nonfarm use.

1. Appleton-Hilton-Sun association

Deep, moderately well drained to very poorly drained soils having a medium-textured subsoil

This association occupies nearly level to gently sloping glacial till areas (fig. 2). About 10 percent is slightly depressional. Most of this association is located in the central parts of Wilson and Newfane, the southern part of Somerset, and the northern part of Hartland. More than 95 percent of the acreage is north of U. S. Highway No. 104 (Ridge Road).

This association occupies about 14 percent of the county. About 37 percent of this is Appleton soils.

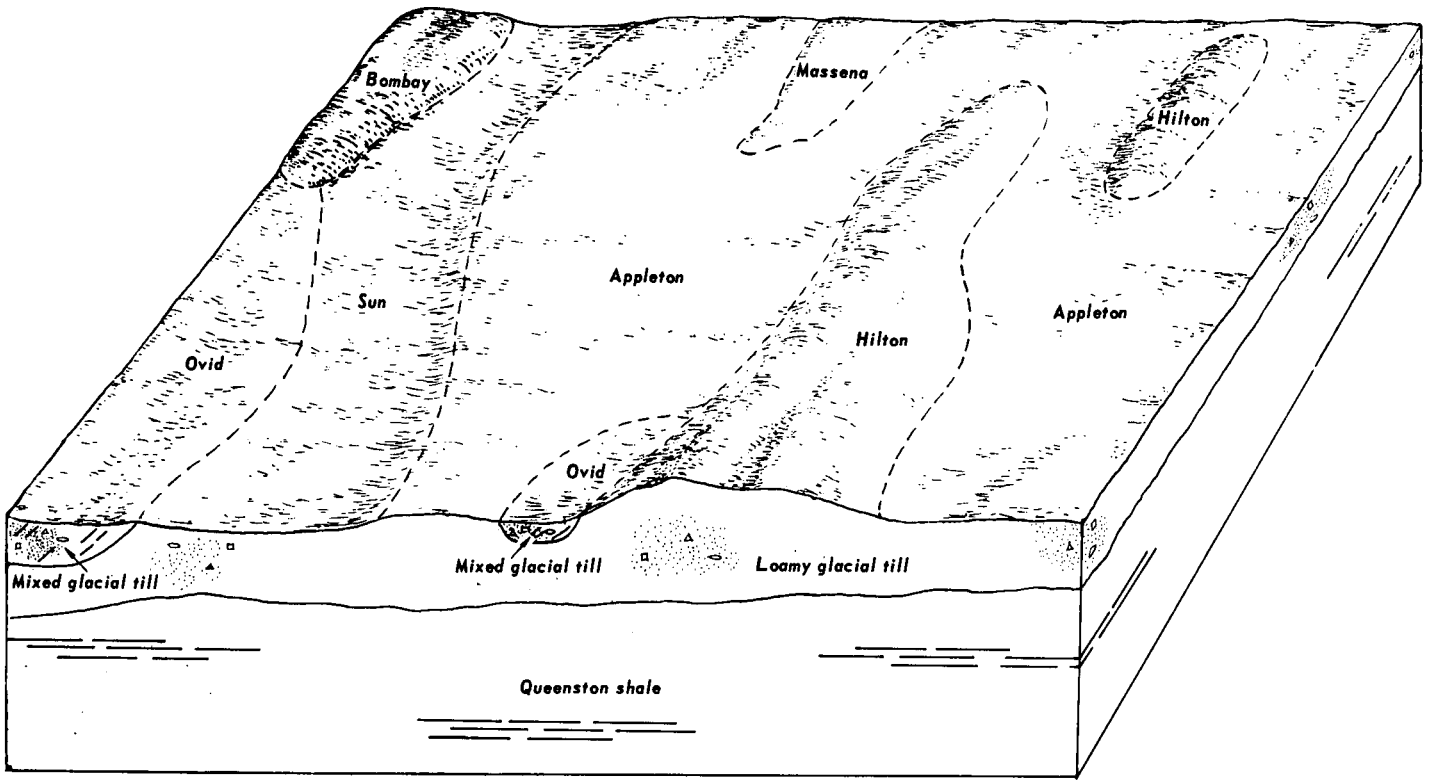

Figure 2.--Typical cross section of the Appleton-Hilton-Sun association.

12 percent is Hilton soils, and 11 percent is Sun soils. Minor soils make up the remaining 40 percent.

The Appleton soils are deep, somewhat poorly drained, and medium textured. They typically have a gravelly loam or silt loam surface layer and a heavy loam subsoil. They are underlain by calcareous, loamy glacial till. Appleton soils occupy the broad, nearly level areas.

The Hilton soils occupy the slightly elevated areas in the glacial till plain. They are better drained than the Appleton soils but otherwise are similar. In many places Hilton soils contain more gravel than Appleton soils and generally are slightly coarser textured, especially in the uppermost 20 inches.

The Sun soils occupy the level to depressional, swampy areas in the glacial till plain. They are similar to the Appleton and Hilton soils except that they are poorly drained or very poorly drained. The surface layer generally has been modified by ponding and consequently contains a smaller amount of coarse fragments than the better drained Hilton and Appleton soils.

The minor soils are mainly of the Ovid, Massena, and Bombay series. These soils are intermingled on till landscapes with the major soils of the association. Also in the association are small areas of soils formed in lacustrine sediments on lower landscapes and alluvial soils along the small streams that dissect the association.

This association has a medium value for farming. In much of the association, the soils are idle, in part-time farms, in nonintensive dairy or livestock farms, and in woods. A small acreage is used intensively for fruits and vegetables. The 1958 Conservation Needs Inventory indicated that about 85 percent is cropland or other open land (6). Much of the idle land, however, is reverting to native hardwoods.

Adequate drainage is the biggest management need. Because the association is nearly level, group projects or town ditches are needed to obtain outlets for individual landowners. In most of the association, the soils can be drained readily by using tile and open ditches. Stones and excess gravel are limitations in local areas.

If adequately drained, the soils in this association have a good to excellent potential for dairy and livestock farming. Also, they have an excellent potential for part-time or general farming. The areas that are relatively free of stones and other coarse fragments have a good potential for vegetable crops. The potential for most fruit crops is fair. The main limitations for fruits, other than drainage, are the depth and compactness of the underlying glacial till.

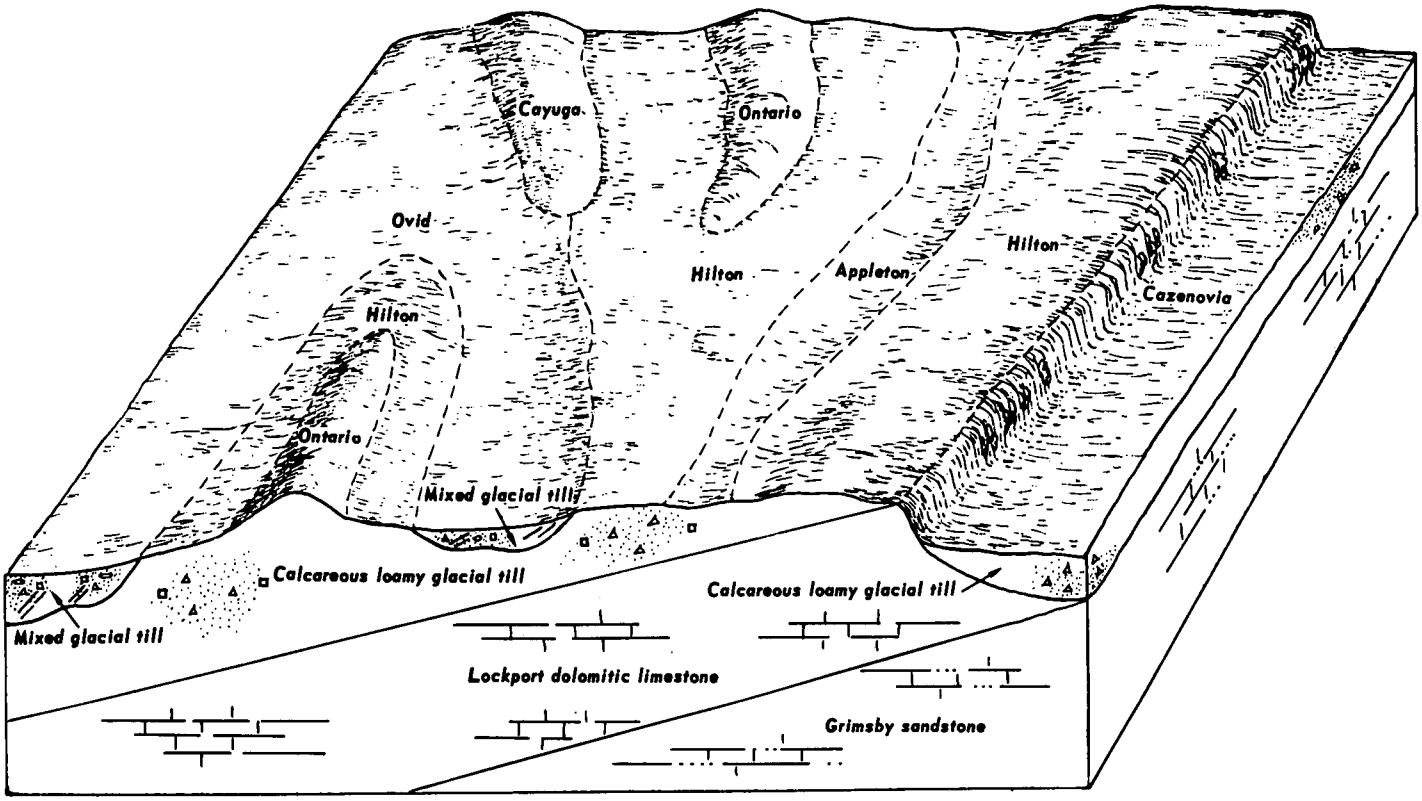

Figure 3.--Typical cross section of the Hilton-Ovid-Ontario association.

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and an adequate drainage system are needed. Because the soils in most of this association are underlain by firm glacial till, bearing strength and soil stability are generally favorable for foundations.

About 75 percent of the association is open land. The remaining 25 percent is scattered farm woodlots or idle land that is reverting to forest. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife species. The potential for wetland wildlife is good. Many dug-out ponds are in this association. Marsh occurs in the northern part of Hartland. Recreation consists mostly of hunting and fishing. Scenic areas are few.

2. Hilton-Ovid-Ontario association

Deep, well-drained to somewhat poorly drained soils having a medium-textured or moderately fine textured subsoil

This association occurs in nearly level to strongly sloping areas in which till deposits are dominant (fig. 3). One continuous area occupies the central part of the county. The association crosses the county in a general east-west direction. A limestone escarpment is prominent, and there is a sandy delta in an area that begins near the city of Lockport and extends eastward to the village of Gasport.

The Hilton-Ovid-Ontario association occupies about 15 percent of the county. About 24 percent of this association is Hilton soils, 14 percent is Ovid soils, 7 percent is Ontario soils, and the remaining 55 percent is soils of minor extent.

The Hilton soils are deep, moderately well drained, and medium textured. They have a gravelly loam or silt loam surface layer, have a heavy loam or silt loam subsoil, and are underlain by calcareous loamy glacial till. In some areas limestone bedrock is at a depth of 3 1/2 to 6 feet. These areas have large stones above the bedrock in many places. Hilton soils are nearly level or gently sloping. They commonly are at intermediate elevations on the glacial till plain. In a few places, they are on fairly large lateral moraines or small drumlins.

The Ovid soils are deep and somewhat poorly drained, and they have a moderately fine textured subsoil. Typically, they have a silt loam surface layer, have a silty clay loam subsoil, and are underlain by heavy loam glacial till. They are nearly level to gently sloping and occur at a slightly lower elevation than the Hilton soils. In some places Ovid soils are along drainageways. Some areas of Ovid soils are underlain by limestone bedrock at a depth of 3 1/2 to 6 feet.

The Ontario soils are deep, well drained, and medium textured. Typically, they have a loam surface layer, have a heavy loam subsoil, and are underlain by calcareous loamy glacial till. Ontario soils are nearly level to strongly sloping. They occupy the higher elevations, such as the tops and sides of drumlins or lateral moraines. In places the Ontario soils have limestone bedrock at a depth of 3 1/2 to 6 feet. In these areas they are nearly level or gently sloping and contain some large stones.

The minor soils are mainly of the Appleton, Cazenovia, Cayuga, Churchville, Sun, and Arkport series. The Appleton and Cazenovia soils are intermingled with the major soils on the till plain. The Cayuga and Churchville soils are along the fringes of the till plain where lacustrine sediments cap the till. Sun soils are in depressions, and Arkport soils are mainly on the sandy delta between the city of Lockport and the village of Gasport. Also, Rock land occurs in small areas.

This association has a medium value for farming. In much of the area, farming competes with nonfarm uses. Most of the city of Lockport and the villages of Sanborn, Gasport, and Middleport are in this association. Many estate-type homes are near the limestone escarpment.

Dairying is the major farm use. In the sandy area along the escarpment between Lockport and Gasport, fruit growing is fairly intensive. The 1958 Conservation Needs Inventory indicates that about 50 percent of the association is cropland, 15 percent is forest or woodland, 10 percent is urbanized, and the remaining 25 percent is pasture and miscellaneous open land.

In places stones and bedrock are limitations for farming and urban development. Natural drainage is a limitation in the wetter areas. Slope and erosion are concerns, mainly near the escarpment. In many places installing artificial drainage is difficult because of stones and underlying bedrock.

This association has a high potential for dairying, raising livestock, and part-time farming. Stones and depth to bedrock are limitations to use locally. Lime needs generally are low. Vegetable growing is mostly restricted to the relatively stone-free, level or nearly level soils. Fruit is more susceptible to frost damage than in areas closer to Lake Ontario.

Wet areas, stones, and bedrock near the surface are the most limiting factors for urban development. Sanitary sewers are needed for concentrated housing developments. In many places underground installations are costly. Most soils in this association have adequate strength for building foundations. The association contains some of the most scenic sites for homes in the county.

This association contains five county parks and most of the Tuscarora Indian Reservation. Also, there are several municipal parks and playgrounds. Some of the most scenic views in the county are in this association. Especially near the scenic escarpment, there is a potential for more hiking, nature, and horseback-riding trails.

3. Lockport-Ovid association

Moderately deep and deep, somewhat poorly drained soils having a fine textured or moderately fine textured subsoil

This association consists mainly of nearly level soils and is in areas where the underlying bedrock is Queenston shale (see pl. I, top). The size of the six separate areas in the county ranges from 280 acres near the village of Newfane to 4,530 acres near the village of Barker. Except for the area near Purdy Road, all of this association is north of U.S. Highway No. 104 (Ridge Road).

This association makes up about 4 percent of the county. About 51 percent of this is Lockport soils, 10 percent is Ovid soils, and the remaining 39 percent is soils of minor extent.

The Lockport soils are moderately deep and are somewhat poorly drained. They typically have a silt loam surface layer, have a silty clay subsoil, and are underlain by red Queenston shale at a depth ranging from 20 to 40 inches. Lockport soils are nearly level and occupy the broad areas. In most places granite erratics occur, and local coarse fragments are scattered over the surface.

The Ovid soils are deep and somewhat poorly drained. They typically have a silt loam surface layer, have a silty clay loam or clay loam subsoil, and are underlain by glacial till. They are level to gently sloping and generally are near the boundaries of the dominant Lockport soil. In most places coarse fragments are scattered over the surface of Ovid soils.

The minor soils are mainly of the Cazenovia, Appleton, Claverack, and Lairdsville series. Cazenovia soils are the drier associates of Ovid soils and formed in similar materials. They commonly are more sloping and are above the Ovid soils. The Appleton soils are somewhat poorly drained and are coarser textured than Ovid soils. Appleton soils are scattered throughout the association on landscapes similar to those of Ovid soils. The Claverack soils occupy sandy knolls, mainly in broad areas of the Lockport soils. Lairdsville soils are the better drained associates of Lockport soils and are commonly on the steeper breaks between different elevations of the Lockport soils.

This is the poorest soil association for farming in the county. The soils in most areas are idle or are reverting to native hardwoods. A fairly small acreage near Model City is used intensively for grapes.

The depth of the soils to bedrock, natural drainage, a fine-textured subsoil, and slow permeability are the major limitations for both community and farm development. The soils are usually wet in spring but are often droughty in dry periods. This soil association has a limited potential for farming, but the growing of grapes is a possibility.

This soil association is poorly suited to most community development. Sanitary sewers are needed for residential development. Also needed is an adequate drainage system. Establishment and maintenance of lawns is difficult because of the soil limitations. In most places the shale is not difficult to excavate to a depth of 4 feet, but deep excavations may be expensive.

The soils in much of this association are idle or are reverting to woods. The association has a fairly good potential for wildlife. Two clubs for sportsmen are in this association; the 3F Club is in the town of Lewiston and the North Forest Club in the town of Lockport. Recreation is mainly hunting. Natural scenic areas are few.

Areas Dominated by Soils Formed in Gravelly Glacial Outwash or in Beach and Bar Deposits

These associations make up about 6 percent of the county and occur in the northern half. The soils are deep, are excessively drained to poorly drained, and have a medium-textured to coarse-textured subsoil. Producing fruits and vegetables are the major farm enterprises. These associations contain the best areas in the county for obtaining sand and gravel.

4. Howard-Arkport-Phelps association

Deep, somewhat excessively drained to moderately well drained soils having a medium-textured to moderately coarse textured subsoil, over gravel and sand

This association consists of nearly level to strongly sloping soils that occur in areas near the village of Olcott (see pl. I, bottom). Part of it is a deltaic deposit that formed in postglacial Lake Iroquois. The association extends east and west of the village of Olcott. Lake Ontario forms the northern boundary. Lakeshore bluffs are prominent in these areas.

This association makes up about 2 percent of the county. About 27 percent of this is Howard soils, 17 percent is Arkport soils, and 17 percent is Phelps soils. The remaining 39 percent is soils of minor extent.

The Howard soils are deep and well drained to somewhat excessively drained. They typically have a gravelly loam surface layer, a gravelly loam subsoil, and stratified sand and gravel underlying material. They are nearly level to moderately sloping and occupy beach or outwash landforms.

The Arkport soils occupy the areas bordering Lake Ontario. They are nearly level to strongly sloping soils that formed in sandy deltaic deposits. They are deep and well drained. They typically have a very fine sandy loam surface layer and a loamy fine sand and very fine sandy loam subsoil. Arkport soils are underlain by stratified or banded sand and silt.

The Phelps soils are nearly level and are associated with the Howard soils. Except that they are moderately well drained, Phelps soils are similar to the Howard soils. In many places Phelps soils

are underlain by lacustrine silt and clay or glacial till at a depth below 40 inches.

The minor soils are mainly of the Fredon, Galen, Colonie, Minoa, and Claverack series. Fredon soils are the wetter associates of the Howard and Phelps soils and commonly occupy small depressions in larger areas of those soils. The more sandy Galen, Colonie, Minoa, and Claverack soils are commonly intermingled with the Arkport soils in delta areas. Also, there are small areas of alluvial soils along the small streams that dissect the association.

This association contains some of the best fruit farms in the county. Peaches and cherries are especially well adapted to the soils. Communities have been developed in part of the association. The association contains the village of Olcott and one of the county parks. Most of the association is used for growing fruit and vegetables. The association is the most intensively farmed area in the county. In very little if any of the association are the soils idle.

The dominant management needs are control of erosion and drainage. Most wet areas can be readily drained by tile. Erosion is generally serious where moderately sloping or strongly sloping soils are cultivated. Soil blowing is a hazard in large cultivated fields and in some cultivated orchards. Management practices, such as fertilizing, liming, contouring, and the growing of cover crops, help to control erosion. The Howard and Arkport soils tend to be droughty, so irrigation is desirable in some places.

The soils in this association are used intensively. They have a high potential for various uses if wet areas are drained and other good management practices are followed. For farm use, the potential for fruits and vegetables is highest.

The hazard of pollution and the slopes are the two most limiting factors for community development. Also limiting is the wetness of some of the minor soils. Wet basements can be a problem. Sanitary sewers are needed where homes are concentrated. The soils in a large part of this association are underlain by silt and clay or glacial till at a depth of more than 40 inches. Cottages and summer homes are well established along the lake frontage. Part of this association is dissected by creeks and drainageways. Erosion is a hazard along the lakeshore where there are steep bluffs. These lakeshore bluffs are eroded by ice and wave action and by excess runoff that occurs in rainstorms and when snow melts. Some areas lose as much as 1 foot of soil per year.

Most of this association is used for farming and community development. Wildlife is not plentiful. Some fish live in the streams that dissect the area, but most streams are polluted. Eighteen Mile Creek is severely polluted. Scenic areas occur in this association, and the part bordering the lake is the most scenic. Blossoming fruit provides scenic beauty during parts of the year.

5. Otisville-Altmar-Fredon-Stafford association

Deep, excessively drained to poorly drained soils having a dominantly medium-textured to coarse-textured subsoil, over gravel and sand

This association occupies gently sloping to nearly level areas associated with a glacial beach ridge where U.S. Highway No. 104 (Ridge Road) extends (fig. 4). Two major areas occur in Niagara County. The largest area is at Wrights Corners and Ridgewood, and it has a northern extension along Hess Road. The other large area is in the vicinity of North Ridge and German Road. A small area is located near Ewings Road and Chestnut Street.

This association occupies about 4 percent of the county. About 15 percent of this is Otisville soils, 11 percent is Altmar soils, 10 percent is Fredon soils, and 10 percent is Stafford soils. The remaining 54 percent is made up of minor soils.

The Otisville soils are deep and excessively drained. They typically have a gravelly fine sandy loam surface layer, a gravelly loamy sand subsoil, and underlying material of stratified sand and gravel. They occupy the beach ridge of postglacial Lake Iroquois and some of the offshore bars.

The Altmar soils occupy the offshore bars. They are similar to the Otisville soils, except that they are moderately well drained to somewhat poorly drained and generally contain more sand. The sand and gravel deposit is generally not so thick as that of the Otisville soils. In most areas finer textured material is below a depth of 40 inches.

Fredon soils are deep and somewhat poorly drained to poorly drained. They have a gravelly loam surface layer and subsoil and are underlain by stratified sand and gravel. Fredon soils occupy low, nearly level areas near deposits on beaches and offshore bars. They also are underlain by finer textured material below a depth of 40 inches in many places.

The Stafford soils are nearly level and occupy the areas associated with areas of glacial beach and bar deposits. They typically have a loamy fine sand surface layer and subsoil. In many places they are underlain by gravel and finer textured material at a depth of more than 36 inches.

The minor soils are mainly of the Lamson, Minoa, and Elnora series. Small areas of poorly drained and very poorly drained Lamson soils occupy depressions and swamps of the association. The somewhat poorly drained Minoa soils and the moderately well drained Elnora soils are intermingled with the major soils where they are nearly level to gently sloping.

This association generally has a medium value for farming. Value is high for crops such as peaches and cherries in parts of the association. The well-drained Otisville soils are used intensively for fruit and vegetables in many places.

Along U.S. Highway No. 104 (Ridge Road), roadside stands are numerous. Growers in this area can obtain

good prices on the early market. In a large part of the association, the soils are used for fruits and vegetables. Most of the community development is along U.S. Highway No. 104 in the form of homes on both sides of the highway. In part of the association, the soils are idle. A small part consists of scattered farm woodlots.

Natural drainage is the biggest limitation to community and farm development. On the main beach ridge the soils are dominantly well drained, but the offshore sand and gravel areas are not. The wet areas can be drained readily with tile if there is a suitable outlet. Group projects are needed to provide individual landowners with suitable outlets.

If drainage is adequate, the soils in this association have a good potential for fruits and vegetables. Because the soils are generally coarse textured, have rapid percolation, and are low in lime, management other than drainage is needed. Some of the important management needs are adequate fertilization, additions of lime, weed control, additions of organic matter, and the use of irrigation during dry periods.

The soils in most of this association have a fairly good potential for community development. Natural drainage is the biggest limitation, and artificial drainage is needed in most areas. Sanitary sewers are needed where houses are concentrated. Pollution of wells is a problem in some areas. The 1958 Conservation Needs Inventory indicated that about 85 percent of this association is open land (6). The forested areas are mostly scattered farm woodlots. Pheasants, rabbits, and other openland wildlife are fairly plentiful. In part of the association, areas of shallow muck occur, and these areas can be developed for wetland wildlife. A few abandoned gravel pits have been turned into swimming and camping areas. This association is a fairly good source of sand and gravel. U.S. Highway No. 104 (Ridge Road) has many historic points of interest because it extends along a well-worn Indian trail that also was used by the early white settlers. It is also a collecting area for arrowheads and other historical artifacts. Not many areas are scenic.

Areas Dominated by Soils Formed in Lake-laid Sands

These associations make up about 8 percent of the county. They occur in the northern half of the county. The soils are deep, moderately well drained and somewhat poorly drained, and nearly level or gently sloping. They have a medium-textured to coarse-textured subsoil. Fruit and vegetable growing are the major farm enterprises.

6. Minoa-Galen-Elnora association

Deep, somewhat poorly drained and moderately well drained soils having a medium-textured, moderately coarse textured, or coarse textured subsoil, over fine and very fine sand

This association consists of nearly level to gently sloping soils on lake plains in areas north

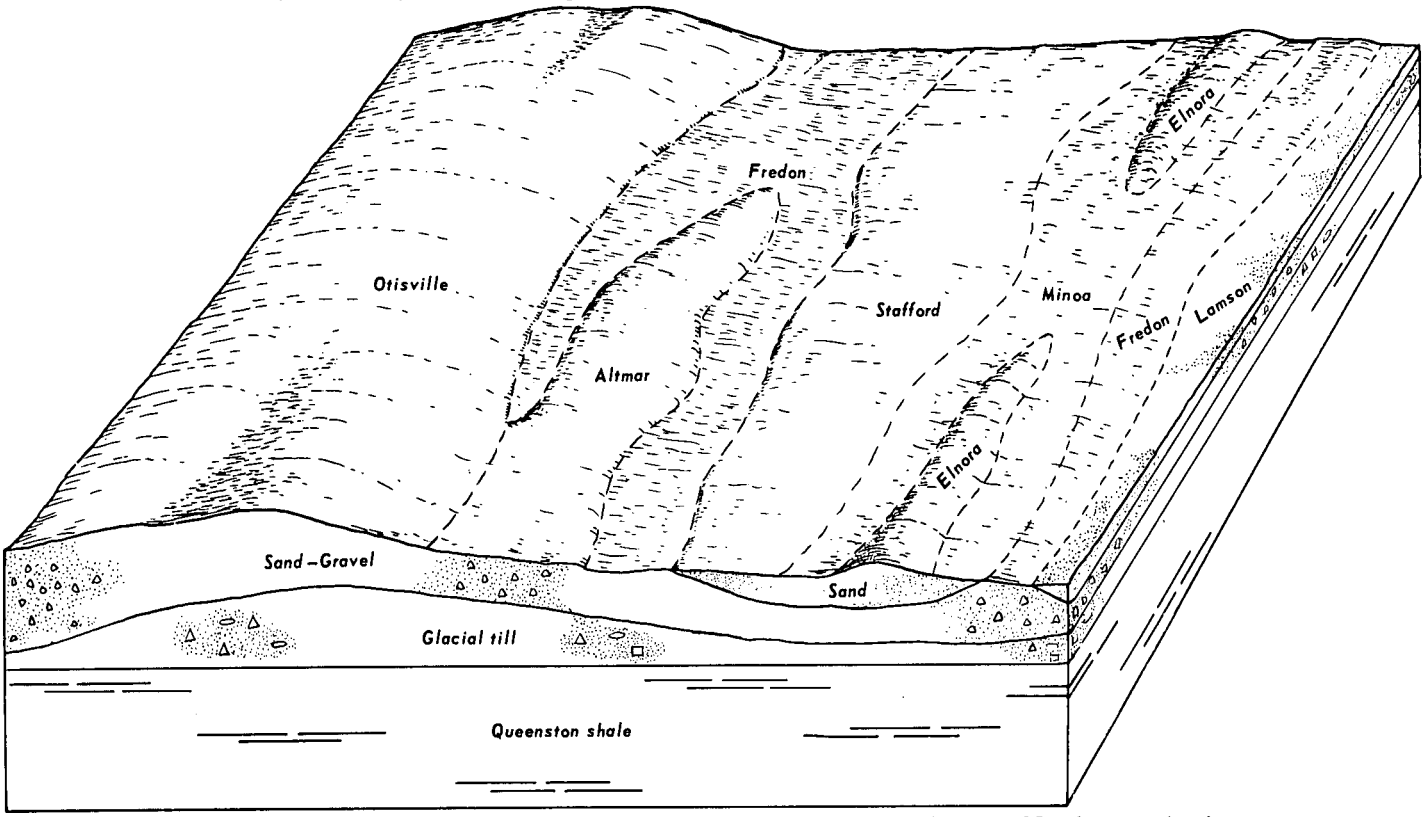

Figure 4.--Typical cross section of the Otisville-Altmar-Fredon-Stafford association.

of U.S. Highway No. 104 (Ridge Road) (see pl. II, top). The largest areas are near Chapman Road in the town of Hartland and near Hatter Road in the town of Newfane. Two smaller areas also occur in this association.

This association makes up about 4 percent of the county. About 15 percent of this is Minoa soils, 14 percent is Galen soils, and 13 percent is Elnora soils. The remaining 58 percent is made up of minor soils.

The Minoa soils are deep and somewhat poorly drained. They typically have a very fine sandy loam surface layer and a very fine sandy loam and loamy fine sand subsoil. They are underlain by sand and silt. Minoa soils occupy the level or nearly level areas in the association. In a few areas, they occupy small drainageways and are associated with better drained sandy soils.

The Galen soils occupy the slightly elevated landscape. In some areas they occur as small mounds or knolls in generally level areas. Galen soils are deep and moderately well drained. They typically have a very fine sandy loam surface layer and a very fine sandy loam and loamy fine sand subsoil. The underlying material is sand and silt.

The Elnora soils occupy the slightly elevated landscapes. In some places these soils occur as small mounds or knolls in generally level areas. They are deep and moderately well drained. They typically have a loamy fine sand surface layer and subsoil and are underlain by fine sand. In many places finer textured material is below a depth of 40 inches.

The soil pattern is complex, and many kinds of soils of minor extent are intermingled with the major soils of this association on similar landscapes. These include the moderately well drained Collamer soils, the somewhat poorly drained Niagara soils that formed in silty lake-laid sediments, the Lamson soils that are the wetter associates of the Galen and Minoa soils, and the moderately well drained to poorly drained Altmar and Fredon soils that formed in gravel and sand deposits.

The soils in this association have a fairly high value for farming. They are dominantly moderately well drained and somewhat poorly drained, deep, sandy soils containing some silt. Most areas are free of stones and easily cultivated. Much of the association is used for vegetables. The 1958 Conservation Needs Inventory indicated that in about 20 percent of this association the soils are idle or are reverting to native hardwoods, and about 5 percent is not used for farming (6). Most of the nonfarm and idle acreage is near the village of Newfane.

Natural drainage is the chief limitation to use. The flatness of the area is the biggest factor to consider in drainage. In most of this association the soils are readily drained with tile if suitable outlets are available. Group drainage projects are normally needed to provide suitable outlets.

If drainage is adequate, the soils in this association have a high potential for farming, especially intensive growing of vegetables. Other management needed is adequate fertilization, weed control, additions of organic matter, practices that prevent excessive compaction, and the use of irrigation during dry periods. The need for lime is moderate.

Community development is limited mostly by natural drainage and instability of the soils. Sanitary sewers are needed where houses are concentrated. Drainage by tile and surface ditches is needed in most areas.

About 90 percent of this association is open land. The forested areas consists mostly of scattered farm woodlots. Some of the idle land is reverting to native hardwoods. Openland wildlife, such as pheasant and rabbit, are plentiful in most areas. Hunting and fishing are the most common types of recreation. Scenic areas are few.

7. Claverack-Cosad-Elnora association

Deep, moderately well drained and somewhat poorly drained soils having a coarse-textured subsoil, over clay or fine sand

This association consists of nearly level to gently sloping soils on the lake plains. Four separate areas occur in the county, and all four are north of U.S. Highway No. 104 (Ridge Road). The largest single area is near Ransomville.

This association makes up about 4 percent of the county. About 18 percent of this is Claverack soils, 13 percent is Cosad soils, and 10 percent is Elnora soils. Minor soils make up the remaining 59 percent.

The Claverack soils are deep and moderately well drained. They typically have a loamy fine sand surface layer and subsoil and are underlain by silty clay material at a depth of 20 to 40 inches. These soils occupy the slightly elevated areas. In some places they occur as small mounds or knolls in generally level areas.

The Cosad soils are nearly level or level. In some places they occur along small drainageways. These soils are in deep lacustrine deposits and are poorly drained in some places. They typically have a fine sandy loam surface layer, have a loamy fine sand subsoil, and are underlain by fine-textured lacustrine material. The sand cap is generally somewhat thinner than that in the Claverack soils.

The Elnora soils occupy sandy knolls within this association. These soils are similar to the Claverack soils in the upper part but do not have the contrasting fine-textured substratum within a depth of 40 inches. They typically have a loamy fine sand surface layer and are underlain by loamy fine sand or fine sand to a depth of 40 inches or more.

The soil pattern in this association is complex, and many kinds of soils of minor extent are intermingled with the major soils on similar lake-plain landscapes. Among these are the somewhat poorly drained Minoa soils and the moderately well drained Galen soils. These soils are slightly less sandy than the major soils. The somewhat poorly drained Rhinebeck soils and their wetter and drier associates formed in clayey lacustrine sediments and are

commonly adjacent to Claverack and Cosad soils in areas where the sandy cap is lacking. The somewhat poorly drained Niagara soils and their wetter and drier associates are scattered throughout the association where soils formed in silty deposits are intermingled with the coarser textured soils.

The soils in this association have a medium value for farming. The main crops are vegetables and fruit. The soils in part of the association are idle. Areas along Pletcher Road and near Ransomville are undergoing some community development. Woodland makes up a small part of the association.

Natural drainage and the complex soil pattern are the main concerns in planning land use. The soils generally are level, and many landowners do not have suitable outlets for drainage. The complex pattern of soils contributes to the problem of drainage. The sands are drained readily with tile, but the underlying silt and clay are not. A combination of tile and surface drainage would benefit many areas. Group drainage projects are needed to provide suitable outlets.

If drainage is adequate and land is leveled, the soils in this association have an excellent potential for vegetables. The soils are generally free of stones and easily tilled. The need for lime is moderate.

Natural drainage and slow permeability of the underlying fine-textured material are the principal limitations for community development. Sanitary sewers and an adequate drainage system are needed. Because the soils in most of this association formed in deep lake deposits, soil stability can be a problem where structures are heavy.

Most of this association is open land. The forested areas consist mostly of scattered farm woodlots. Some of the idle land is reverting to natural hardwoods. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife. Marsh and ponded areas have a potential for wetland wildlife. Recreation consists mostly of hunting and fishing. Scenic areas are few.

Areas Dominated by Soils Formed in Lake-laid Silts and Very Fine Sands

These associations make up about 17 percent of the county. The soils are nearly level to gently sloping, are moderately well drained to very poorly drained, and have a medium-textured to fine-textured subsoil. Natural drainage of the soils is the principal limitation to farm use. A fairly large part of the area is cropland that is not intensively used. The soils in these associations are generally free of stones and have a fairly high potential for growing vegetables.

8. Niagara-Collamer association

Deep, somewhat poorly drained and moderately well drained soils having a medium-textured to moderately fine textured subsoil

This association consists of nearly level to gently sloping soils in the lake plain areas (see pl. II, bottom). Four major areas are in the county. More than half the total acreage occurs near Slayton Settlement and Wheeler Roads.

This association occupies about 6 percent of the county. About 23 percent of this is Niagara soils and 23 percent is Collamer soils. The remaining 54 percent is made up of minor soils.

The Niagara soils are deep and somewhat poorly drained. They typically have a silt loam surface layer, a silt loam or silty clay loam subsoil, and underlying material of varved silt, very fine sand, and a small amount of clay. The Niagara soils are nearly level and occupy broad areas of the lake plain. A small part is gently sloping and occurs in dissected areas.

The gently sloping Collamer soils occupy areas in the lake plain. They normally are very susceptible to erosion. Many areas are slightly dissected. The major area of Collamer soils is near the Slayton Settlement Road. Collamer soils have a silt loam surface layer and a silt loam or silty clay loam subsoil. They are deep and moderately well drained. They are similar to the Niagara soils, except that they are better drained.

The soil pattern is complex in this association of the lake plain, and several soils of minor extent are included. Canandaigua soils, the wetter associates of the Niagara and Collamer soils, are commonly in depressions within larger areas of the Niagara and Collamer soils. The somewhat poorly drained Minoa soils and the moderately well drained Galen soils are coarser textured than the Niagara and Collamer soils but are intermingled with them on the same kinds of landscape. Also scattered throughout areas of this association are areas of the somewhat poorly drained Rhinebeck soils, their wetter and drier associates formed in clayey lacustrine sediments, and Claverack and Cosad soils that have a sandy surface layer. Alluvial soils occupy small areas along the streams that dissect the association.

This association has a high value for farming. The soils are mostly cultivated. Vegetables are grown extensively, but some areas are used intensively for fruit and some areas are in dairy farms.

Adequate drainage is the principal need where the soils are level or nearly level. Erosion control is the biggest need where the soils are sloping. Tile drainage generally works well if a suitable outlet is available. Group drainage projects normally are needed in the larger areas that are more difficult to drain. Since these soils are generally free of stones, compaction is likely in the intensively cultivated areas.

The soils in this association have an excellent potential for vegetables and fruit and a good potential for other kinds of farming. With adequate drainage and other good management, these soils are well suited to most crops grown in the county. They are generally free of stones and easy to cultivate. The need for lime is generally medium,

Community development is limited mostly by drainage, permeability, erosion, and instability of the soils. Sanitary sewers are needed for small lots or where houses are concentrated. Surface and

Typical area of the Lockport-Ovid association near Drum Road in the town of Hartland.

Typical area of the Howard-Arkport-Phelps association between villages of Olcott and Wilson.

Typical area of the Minoa-Galen-Elnora association.

Typical area of the Niagara-Collamer association near Slayton Settlement Road.

subsurface drainage is needed in most areas. Erosion is a hazard where the soils are sloping.

Most of this soil association is farmed. The included alluvial soils along creeks and drainageways are mostly idle or in woods. Openland kinds of wildlife, especially pheasants, are plentiful. Small woodlots and hedgerows provide cover. Recreation in this association consists mostly of hunting and fishing. Scenic areas and swimming and boating areas are confined mostly to the parts of the association that border Lake Ontario.

9. Canandaigua-Raynham-Rhinebeck association

Deep, somewhat poorly drained to very poorly drained soils having a dominantly medium-textured to fine-textured subsoil

The soils in this association are level and occur in areas that border Tonawanda Creek in the extreme southern part of the county. The association includes the city of North Tonawanda and part of Tonawanda Indian Reservation.

This association makes up about 11 percent of the county. About 26 percent of this is Canandaigua soils, 23 percent is Raynham soils, and 17 percent is Rhinebeck soils. The remaining 34 percent is made up of minor soils.

The Canandaigua soils are deep and poorly drained to very poorly drained. They typically have a silt loam to silty clay loam surface layer, a silty clay loam subsoil, and underlying material of silt, clay, and fine sand. They are level and occupy broad areas.

The Raynham soils occupy the slightly higher elevations and normally are closely associated with the Canandaigua soils. They are deep and somewhat poorly drained to poorly drained. They typically have a silt loam surface layer, a silt loam to loamy very fine sand subsoil, and underlying material of silt and very fine sand.

The Rhinebeck soils are nearly level and occupy broad areas. They are deep and somewhat poorly drained. They typically have a silt loam or silty clay loam surface layer, a silty clay or silty clay loam subsoil, and underlying material of varved silt and clay. These soils generally become coarser textured as depth increases, and in many places they have sandy layers below a depth of 40 inches.

The minor soils are mainly of the Lakemont, Madalin, Odessa, Niagara, Minoa, and Lamson series. The poorly drained and very poorly drained Lakemont and Madalin soils are commonly in depressions adjacent to the Rhinebeck soils. The somewhat poorly drained Odessa soils are intermingled with the Rhinebeck soils on the same kind of landscape in the lake plains. The somewhat poorly drained, silty Niagara soils are slightly higher than, and are adjacent to, the Canandaigua soils. Coarser textured Minoa and Lamson soils are intermingled with Canandaigua and Raynham soils on the same kind of landscape in the lake plains.

This association has medium to low value for farming. The 1958 Conservation Needs Inventory indicated that 59 percent is cropland, 2 percent pasture, 15 percent woodland, 12 percent urban or built-up areas, and 12 percent other open land.

Community or farm development is limited mainly by natural drainage. The flatness of the area is the main consideration in planning drainage. Group drainage projects are needed in most places to provide suitable outlets.

Most of the farmed areas are not farmed intensively. With adequate drainage, the potential is good for hay, grain, and certain vegetable crops. In most places the soils are free of stones. Vegetables could be grown intensively in many areas, but maintaining soil tilth is difficult. The need for lime is generally low.

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and an adequate drainage system are generally needed. The soils in this association formed in deep lacustrine deposits that normally contain wet, compressible, unstable layers. Care is needed in constructing foundations and in developing a road base.

Most of this association is open land. The forested areas consist mostly of scattered farm woodlots. Some of the idle land is reverting to ash, soft maple, and other native hardwoods. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife, and the potential for wetland wildlife is good. Some of the association is in the New York State Tonawanda Reservation. Besides hunting and fishing there is a potential for camping, athletic fields, and picnic areas. Scenic areas are few.

Areas Dominated by Soils Formed in Lake-laid Clays and Silts

These associations make up about 36 percent of the county. The soils are nearly level to gently sloping, deep, and somewhat poorly drained to very poorly drained. They have a moderately fine textured or fine textured subsoil. These associations have a medium to low value for farming. Much of the area is idle or in cropland that is not intensively used. Natural drainage is the major limitation to use. The moderately fine textured and fine textured subsoil presents problems for farming and for town and country planning.

10. Rhinebeck-Ovid-Madalin association

Deep, somewhat poorly drained to very poorly drained soils having a fine textured or moderately fine textured subsoil that is dominantly brown or olive in color

This association consists of nearly level to gently sloping soils on the lake plain north of the limestone escarpment. The largest single areas are

in the northwestern part of the county near the village of Youngstown. Three smaller areas also occur.

This association makes up about 15 percent of the county. About 32 percent of this is Rhinebeck soils, 10 percent is Ovid soils, and 9 percent is Madalin soils. The remaining 49 percent consists of minor soils.

The Rhinebeck soils are deep and are somewhat poorly drained. These soils typically have a silt loam surface layer, a silty clay or silty clay loam subsoil, and underlying material of varved silt and clay. They occupy the broad areas within the association and are slightly dissected by erosion in a few places, especially in areas that border Lake Ontario.

The Ovid soils occupy the slightly elevated areas where there has been some reworking of the fine-textured lake deposits and the glacial till or glacial beach deposits. The Ovid soils are deep and somewhat poorly drained. They typically have a silt loam surface layer and a silty clay loam subsoil and are underlain by loamy glacial till. Some coarse fragments are generally in and below the surface layer.

The Madalin soils occupy the more nearly level, more depressional areas within the broad, level lake plain. They are deep and poorly drained to very poorly drained. Madalin soils typically have a dark silt loam surface layer that is high in organic-matter content, a silty clay subsoil, and underlying material of varved silt and clay.

The minor soils are mainly of the Collamer, Hudson, and Niagara series. These soils are intermingled with the major soils in this association. The Collamer and Hudson soils occupy knolls or higher elevations and are intermingled with the Ovid soils. The Niagara soils are mainly nearly level.

This association has a medium value for farming. Much of it is idle or is cropland that is not used intensively. A fairly small acreage that is close to Lake Ontario is used intensively for fruit. The area near Youngstown is in community development, mostly for rural homes. The acreage in grapes is increasing, especially near the Model City area in the town of Lewiston.

Natural drainage is the principal concern in town and country planning and in farm development. The flatness of the area is the biggest factor to consider in planning artificial drainage. The soils in most of the association can be drained readily by installing adequate surface ditches. Tile lines help in draining some of the wet, coarser textured inclusions. The major need is group drainage projects that provide suitable outlets.

If drainage is adequate, this association has a good potential for apples, grapes, pears, and other fruit. Peaches and cherries normally are not suited. Some vegetables can be grown intensively, but maintaining soil tilth is difficult. Grain and hay crops are suited if drainage is adequate. The need for lime is generally small.

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and adequate surface drainage are needed. In many places the soils are unstable because they formed in deep lake deposits.

About 85 percent of the acreage is in open land. The forested areas consist mostly of scattered farm woodlots. Some of the idle land is reverting to ash, soft maple, and other native hardwoods. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife species, and there is a potential for wetland wildlife. Recreation in this association consists mostly of hunting, fishing, camping, and golfing. Scenic areas are confined mostly to the part of the association that borders the Niagara River and Lake Ontario.

11. Odessa-Lakemont-Ovid association

Deep, somewhat poorly drained to very poorly drained soils having a fine textured or moderately fine textured subsoil that is dominantly reddish in color

This is the largest soil association in Niagara County. It consists of level or nearly level soils on lake plains south of the limestone escarpment (fig. 5). There are two large areas that are dotted with small knolls and ridges of till. The largest area is west of the Barge Canal, and the other area is in the same topographical position as the larger area but is east of the Barge Canal.

This association makes up about 21 percent of the county. About 24 percent of this is Odessa soils, 14 percent is Lakemont soils, and 11 percent is Ovid soils. The remaining 51 percent consists of minor soils.

The Odessa soils are deep and somewhat poorly drained. They typically have a silty clay loam surface layer, a silty clay subsoil, and clay and silt underlying material. These soils are level and occupy the broad areas between the poorly drained, depressional areas and the slightly elevated till ridges.

The Lakemont soils are level to slightly depressional and are generally adjacent to the better drained Odessa soils. Lakemont soils typically have a silty clay loam surface layer, a silty clay subsoil, and underlying material of clay and silt. They have a darker surface layer than the Odessa soils and show more indications of wetness.

The Ovid soils are nearly level to gently undulating and are on till landscapes at slightly higher elevations above the lake plain. They are deep and somewhat poorly drained. Ovid soils typically have a silt loam surface layer, a silty clay loam subsoil, and underlying material of loamy glacial till.

The minor soils are mainly of the Churchville, Cayuga, Cazenovia, Fonda, and Hilton series. Also included are some areas of shallow muck. In many places the moderately well drained Hilton and Cazenovia soils occupy the higher parts of the knolls and

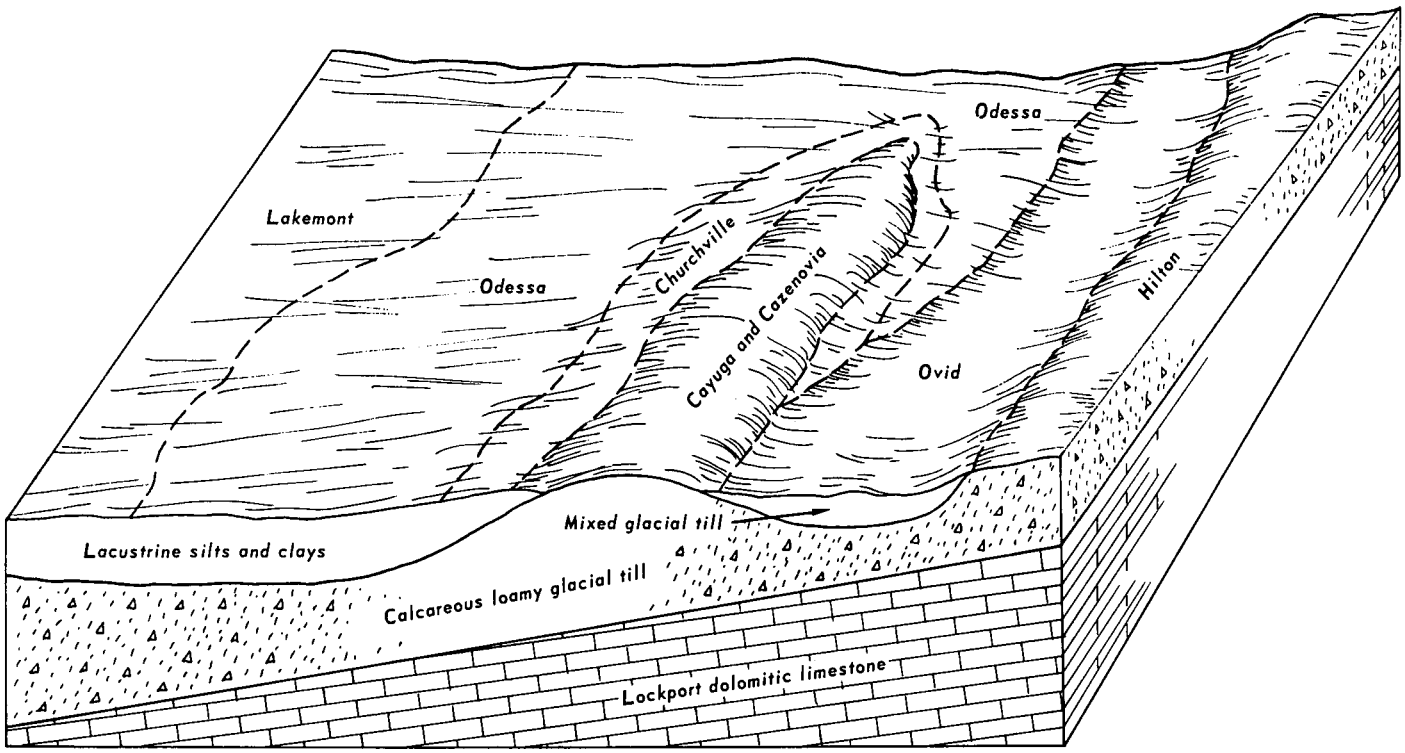

Figure 5.--Typical cross section of the Odessa-Lakemont-Ovid association.

till ridges that are scattered throughout the association. Around the fringes of these areas, where lacustrine clays overlap the till, are the somewhat poorly drained Churchville soils and the moderately well drained Cayuga soils. The very poorly drained Fonda soils and the shallow muck occupy some of the deeper depressions in the lake plain.

This association has a fairly low value for farming. Much of it is idle or cropland that is not intensively used. Communities are being rapidly developed in the western part of the association near Niagara Falls and in areas south of Lockport. The Conservation Needs Inventory for 1958 indicated that 58 percent of this association is cropland, 6 percent is pasture, 4 percent is forest, 14 percent is urban or built-up areas, and 18 percent is open land (6).

Natural drainage is the main concern in town and county planning and in agricultural development. The flatness of the area and the generally fine texture of the soils are the main factors to consider before installing artificial drainage. The biggest need is for group drainage projects that provide suitable outlets.

If adequately drained, the soils in this association have a good potential for grain and for dairy cattle and other livestock. The texture of the soils is generally too fine for most vegetable crops. If the soils are cultivated intensively, they are difficult to till because they crust, clod, and compact. Most fruit crops are damaged by frost in this association. The need for lime is small.

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The first part of this section discusses general management of soils used for farming in Niagara County. In the second part, groups of the soils called capability units, or soils that have been grouped according to their relative suitability for farming, are described and management of the soils in each unit is discussed. The third part gives estimates of the yields that are obtained from each of the soils at different levels of management. The fourth part groups the soils according to their suitability for use as woodland and gives information that is useful in the management of woodland. In the fifth part, soil interpretations for wildlife habitat are discussed. Each soil is rated as to its suitability for eight habitat elements and three classes of wildlife. In the sixth part soil properties that are important to engineers and builders are estimated and interpreted for engineering use. The seventh part rates the soils for selected nonfarm uses on the basis of their properties so as to aid planners, developers, and others. Information in one part of this section commonly is useful as supplementary information in the other parts.

General Management for Farming [3/]

This section is designed to help farmers and those who advise farmers to choose combinations of soil, water, and crop management practices that are suited to the soils on a farm and are appropriate for conditions prevailing at the time the choices are made. The user of this soil survey should modify his choices to take advantage of rapid advances in knowledge of soil, water, and crop management that results from agricultural research.

New research findings are reported currently in annually revised editions of "Cornell Recommends for Field Crops." Cornell Miscellaneous Bulletins and current editions of other applicable publications on soil and crop management should also be consulted. A great amount of constantly revised, published and unpublished, information is available on request from the Cooperative Extension Service, the Soil Conservation Service, and other agencies. Currently applicable information concerning soil and crop management is also available to the user of this survey from industry representatives who serve farmers.

In the following paragraphs, soil characteristics that affect general management are discussed.

Acidity.--The natural lime content of the soils in Niagara County ranges from low to high, but in most places it ranges from medium to high. Figure 6 illustrates the relationship of the different

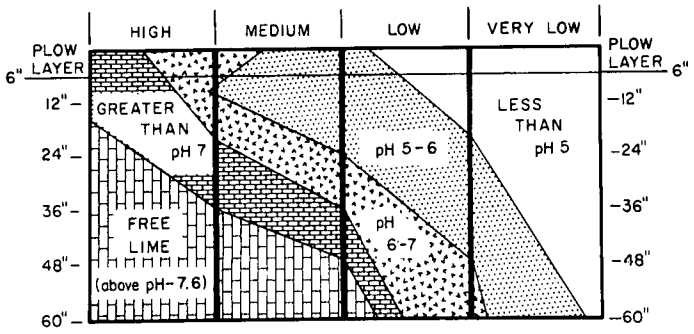

Figure 6.--Lime level of different soil profiles in Niagara County.

lime levels to a depth of 60 inches in four different profiles.

High-lime soils, such as the Rhinebeck, Ovid, Odessa, and Schoharie, are neutral or slightly acid in the upper part and become less acid as depth increases. They generally have free lime at a depth of 16 to 36 inches. Medium-lime soils, such as the Hilton and Ontario, are medium to slightly acid to a depth of more than 12 inches, but become less acid with depth. Free lime generally occurs below a depth of 30 to 40 inches. Low-lime soils are medium acid to a depth of approximately 30 inches, but they have slightly acid or neutral material below that depth and free lime deep in the substratum. Low-lime soils are practically nonexistent in Niagara County. In some areas of the Arkport, Colonie, Elnora, and Otisville soils, small included areas are of soils low in lime content.

The average rate of downward movement of lime in a silt loam, a common surface-layer texture in the county, is about one-half inch per year. The removal of lime by crops is minor compared to loss by erosion and leaching. The periodic application of lime, therefore, usually once in every 4 to 5 years, is necessary to maintain the desired pH in the plow layer of the medium-lime soils, and in some places the plow layer of high-lime soils.

Effect of subsoil on root growth.--The subsoil characteristics of the various soils have to be considered when choosing the crops to be grown. Some soils, such as the Dunkirk, Ontario, and Howard, have a subsoil that permits, to some depth, the easy penetration of roots in quest of nutrients and water. Other soils have impeding layers, such as a heavy, dense clay subsoil, or they have a seasonal high water table or are shallow to bedrock. All of these inhibit root penetration. The Cayuga, Lamson, Niagara, and Farmington soils are examples of soils that have these characteristics.

3/ Prepared from material furnished by ERNEST L. McPHERRON, conservation agronomist. Unless otherwise noted, the material is based on the results of research studies performed at the Aurora and Mount Pleasant Research Farms by staff members and associates of the New York State College of Agriculture at Cornell University.

Many of the high-lime and medium-lime soils have a subsoil that has blocky structure. Crops can root readily in these soils if drainage is good. Tile drainage is effective in moderately well drained to very poorly drained, medium-textured to moderately fine textured soils that have blocky structure in the subsoil. Open ditches are more effective than tile in soils having a fine-textured subsoil. Figure 7 shows the effect of soil drainage on root development.

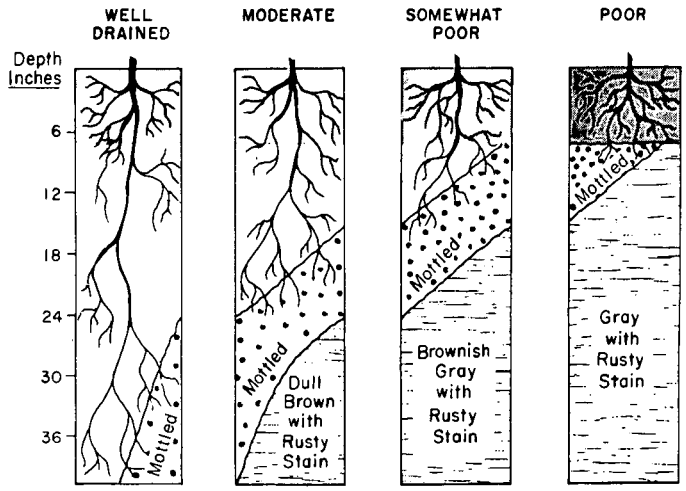

Figure 7.--Effect of soil drainage on root growth.

Nitrogen.--In most soils of Niagara County, the plowed layer contains 3 to 6 percent organic matter. In these soils, the annual release of nitrogen from the organic matter ranges from 40 to 160 pounds per acre. On well-managed soils in Niagara County, the need for additional nitrogen fertilizer to supplement nitrogen available from the soil from crop residues and manure is greatest during the cool months early in spring.

Phosphorus.--The soils of Niagara County are naturally low to medium in content of phosphorus, and the addition of appropriate amounts of phosphates in the form of commercial fertilizers is essential for maximum crop yields. The moderately fine textured and fine textured soils can supply about 20 pounds of phosphate annually, and the medium-to coarse-textured soils about 10 pounds or less. (To convert phosphorus to phosphate, multiply by 2.3; to convert phosphate to phosphorus, multiply by 0.43).

Potassium.--In the section "Description of the Soils," each soil series in the county is rated high, medium, or low in inherent potassium level. Soils rated high can supply approximately 70 to 120 pounds of potash annually; soils rated moderate can supply approximately 25 to 70 pounds, and soils rated low generally can supply less than 25 pounds. Clayey soils, such as the Odessa soils, can supply a large amount of potassium. (To convert potassium to potash, multiply by 1.2. To convert potash to potassium, multiply by 0.83).

Medium-textured soils that have a clay accumulation in the subsoil, such as the Cazenovia and Schoharie soils, can supply a large amount of potassium. This has been confirmed by extensive research trials at the Aurora Research Farm in Cayuga County.

Crop adaption.--The choice of an adapted crop variety depends largely on the climate, depth and character of the root zone, natural drainage class, or the degree of artificial drainage. Changes will be suggested as new crop varieties are developed and results of new research and observations are put into use.

The annually revised "Cornell Recommends" publications, prepared by the staff of the New York State College of Agriculture at Cornell University, are designed to keep New York farmers and those who advise farmers abreast of the latest applicable research findings in soil and crop management. The user of this soil survey is strongly urged to use current editions of these publications.

Capability Grouping [4/]

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 forest trees or engineering.

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

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife. (There are no class VII soils in Niagara County)

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

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

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-3. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by Capability Units

In the following pages the capability units in Niagara County are described and suggestions for use and management of the soils are given. The names of the soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series appear in the unit. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

Cut and fill land and Made land have not been placed in capability units, because they generally are not used for crops. Onsite inspection of each location is needed to determine practical uses and suitability for plants. Nevertheless, all disturbed areas should have stabilizing cover restored immediately following construction or other earth moving. Plantings can be a part of uses such as recreation and wildlife. In many places these plantings can be designed to add beauty by stabilizing the land and screening undesirable scars in the landscape.

Capability Unit I-1

Ontario loam, limestone substratum, 0 to 3 percent slopes, is the only soil in this unit. This soil is nearly level, well drained, and medium textured. Limestone bedrock underlies this soil, generally at a depth of 3 1/2 to 6 feet. Stones are a problem in places. This soil has good tilth and high available moisture capacity. Lime content and natural fertility are medium to high. Permeability is moderate in the surface layer and moderately slow in the subsoil.

This soil is well suited to all crops grown in the county. Row crops can be grown year after year, but if no sod crops are included, care must be taken in maintaining good soil structure. Surface stones may interfere with planting and cultivation of fine-seeded crops. Lime is needed to maintain a neutral surface layer. Good tilth can be kept by using cover crops, crop residues, and, wherever possible, minimum tillage to keep the soil surface open.

Irrigation water can be applied at a moderate rate without damage to the soil. Irrigation may be needed to establish stands early in spring if the surface layer is dry. Application of water during prolonged dry periods helps to maintain needed growth and high quality of crops.

Capability Unit IIe-1

This unit consists of gently sloping, well-drained, medium-textured soils in the Ontario series. These soils are generally deeper than 6 feet, but in places hard rock occurs at a depth of 3 1/2 to 6 feet. Stones are a problem in some places. These soils have good tilth. Natural fertility and content of lime are medium to high. Permeability is moderate in the surface layer and moderately slow in the subsoil. The available moisture capacity is high. Erosion is a moderate hazard.

These soils are suited to all crops commonly grown in the county. Crops grow well and respond to good management. Additional lime is needed to maintain a neutral surface layer. Stones interfere with the operation of farm machinery in some places.

Where the soils in this unit are more nearly level and slopes are short, nearly continuous row crops can be grown if farming is on the contour and management includes minimum tillage, use of cover crops, and return of crop residue as often as possible. On the longer or steeper slopes, contour stripcropping, keeping crop residue on the surface through winter, and other erosion control measures are required where row cropping is moderately intensive. Diversions can be used to shorten the effective slope length, but downslope they may cause seep spots that require tile drains.

These soils take in irrigation water at a moderate rate. Additional water may be needed to maintain good crop growth.

Capability Unit IIe-2

This unit consists of deep, gently sloping, well drained to moderately well drained soils. These soils are in the Dunkirk, Collamer, and Hudson series. They have a silty surface layer and a medium-textured to fine-textured subsoil. Natural fertility is moderate to high, but the organic-matter content is low in many places. The content of lime is medium to high. Permeability is moderate in the surface layer and moderately slow to slow in the subsoil. The available moisture capacity is high. These soils are susceptible to erosion, and erosion is the main management concern. Maintaining tilth is difficult in intensively cultivated fields.

If properly managed, these stone-free soils are suited to all crops commonly grown in the county. Careful management is needed, however, to reduce crusting, erosion, and compaction below the surface. Good soil structure is difficult to maintain. Plowing and preparing these soils for seeding should not be done when the soils are wet.

The moderately slowly permeable subsoil in the Collamer and Hudson soils causes wetness in spring and delay planting. Drainage of wet spots by land shaping and random tile systems improves the use of these soils for all crops.

For best crop growth, applications of lime and fertilizer are needed.

Good management practices, including use of cover crops, crop residues, and minimum tillage, are satisfactory for controlling erosion on the more gentle slopes. Needed on the steeper and longer slopes is a combination of practices, such as terracing, contour stripcropping where topography permits, and maintaining year-round surface cover. If cultivated areas of these soils are not protected, the cropping system should not be more intensive than 1 year of a row crop, 1 year of grain, and 3 years of sod.

Irrigation efficiency is reduced by the moderagely slow permeability of the subsoil and by crusting of the surface layer.

Capability Unit IIe-3

This unit consists of gently sloping, moderately well drained to well drained, medium-textured to moderately coarse textured soils. These soils are in the Bombay, Cayuga, Cazenovia, and Hilton series. Lime content and natural fertility range from medium to high. Except for the Bombay and gravelly Hilton soils, the soils in this unit have moderate permeability in the surface layer. Permeability of the subsoil ranges from moderate in the Bombay soil to slow in the Cayuga soil. The available moisture capacity is high except in the Bombay soil, which has low to moderate available moisture capacity. Some of the soils have solid rock between depths of 3 1/2 to 6 feet, but most of them are deeper than 6 feet to rock. Except for the Cayuga soil, the soils in this unit have gravelly fragments on the surface and in the profile. The fragments interfere with cultivation only for the gravelly Hilton and Cazenovia soils. The soils in this unit are moderately susceptible to erosion.

If properly managed, these soils are well suited to all crops grown in the county. Wetness early in spring in the Bombay and Hilton soils may delay planting, and wetter inclusions of other soils require tile drainage to permit more uniform management. Surface stones may limit use of some crops that require of with farm machinery.

Lime is needed on the Bombay and Hilton soils to neutralize their acidity. The other soils in this unit may need applications of lime to maintain a neutral surface layer, but their ability to hold and supply nutrients is good.

Long slopes are common, and on them the soils in this unit erode where water concentrates. Unless erosion control practices are applied, the maximum intensity of cultivation should not exceed 2 years of row crops followed by a sod crop. Contour stripcropping and grassed waterways control erosion in most places, and if these are combined with diversions or terraces, use can be more intensive. These soils are also suited to intensive use for row crops that are adapted to a system of management in which the soils are not plowed. Direct planting into crop residues protects the soil surface.

On all slopes, management that includes minimum tillage, plowing when wet, and return of crop residues is essential where a rotation that has more than 2 years of a row crop is used.

These soils are easily eroded if irrigation water is applied too rapidly. Cultivation before irrigation is needed to break up any crust that has formed.

Capability Unit IIe-4

This unit consists of gently sloping, moderately well drained to well drained soils that have a

moderately fine textured to fine textured subsoil. These soils are in the Lairdsville and Schoharie series. The Lairdsville soil is underlain by red shale rock at depths between 20 and 40 inches. The Schoharie soil is deeper than 40 inches to rock. Permeability of both soils is moderate to moderately slow in the surface layer and slow in the subsoil. Available moisture capacity is moderate to high. Keeping the soils in good tilth is difficult. Erosion control is the main management need. Lime needs are low, and natural fertility is medium to high.

These soils are suited to most crops commonly grown in the county. The heavy subsoil restricts water movement, and this results in slight wetness that briefly delays planting or grazing in spring. Very severe management requirements may limit the use of these soils for intertilled crops such as vegetables, but the soils are well suited to alfalfa hay that is properly fertilized and harvested. Relatively small amounts of lime are needed to maintain the desired level of acidity in the surface layer.

Working these soils when the plow layer is too wet may cause puddling and crusting that requires a grass and legume sod to correct. It also compacts the upper part of the subsoil. Growing deep-rooted crops helps to offset this compaction. Since areas of wet soils are in most depressions, random tile or grassed waterways are required in many places.

For erosion control, cropping systems should not be more intensive than 1 year of corn, 1 year of grain, and 2 years of sod unless a safe system for disposing of surface water is established. Where erosion control is established, these soils should not be cultivated for many successive years without the use of close growing crops, crops high in residues, and year-round cover occasionally. The effectiveness of irrigation is reduced by crusting, puddling, and increased runoff and erosion.

Capability Unit IIs-1

This unit consists of deep, nearly level, well-drained to somewhat excessively drained, medium-textured and moderately coarse textured soils that are generally medium to low in content of lime. These soils are in the Arkport and Howard series. They have low to medium natural fertility. The Arkport soil has a fine sandy loam surface layer and is dominated by sand, whereas the Howard soil has a gravelly loam surface layer and is dominated by gravel. Permeability of both soils is moderately rapid to rapid in the surface layer and rapid in the subsoil. The available moisture capacity ranges from low to moderate in the Howard soil and from moderate to high in the Arkport soil. Tilth is easily maintained for both of these soils. Water erosion is not a hazard. Soil blowing can be a hazard on the Arkport soil if it is clean cultivated.

The soils in this unit are easy to work and are suited to all crops grown in the county. These soils warm up early in spring, and transplanted special crops such as vegetables and fruits grow well. Stones on the surface of the Howard soil interfere with the use of farm machinery. Crop stands may be adversely affected by soil blowing, droughtiness, and low to medium natural fertility. Deep-rooted crops should be favored. Lime is needed for maintaining a neutral soil, but crop response to lime is good. Crops also respond well to annual topdressings of needed fertilizer. Because these soils are leached easily, it is important to apply fertilizer at a time when plants are ready to use it.

Where vegetables crops are grown or cropping is continuous, an occasional sod crop, the return of crop residue, and careful attention to winter cover are vital. Land smoothing to fill low, wet depressions permits more efficient operation of farm machines. Minimum tillage and light tillage to break crusts combined with use of cover crops and crop residues are important supporting practices for controlling soil blowing and water erosion and maintaining good tilth. These soils take in irrigation water readily. Supplemental water is needed where these soils are used intensively for high-value crops.

Capability Unit IIs-2

This unit consists of deep, gently sloping, well-drained to somewhat excessively drained, medium textured and moderately coarse textured soils that normally are medium to low in content of lime. These soils are in the Arkport and Howard series. They have low to medium natural fertility. The Arkport soils have a fine or very fine sandy loam surface layer and are dominated by sand. The Howard soil has a gravelly loam surface layer and is dominated by gravel. Permeability of all the soils is moderately rapid to rapid in the surface layer and rapid in the subsoil. The available moisture capacity ranges from low to moderate in the Howard soil and from moderate to high in the Arkport soils. Tilth is easily maintained. These soils are moderately susceptible to water erosion and soil blowing.

The soils in this unit are easy to work, can be worked early in spring, and are suited to all crops grown in the county. Deep-rooted perennial crops are preferred. These soils are also well suited to specialized fruit and vegetable crops if management is good. Stones in the surface layer of the Howard soil interfere with the use of precision machinery, but transplanted crops grow well. Crop stands on the soils of this unit are adversely affected by erosion, droughtiness, and low to medium natural fertility.

Lime is needed for some crops, and fertilizer is needed on all crops. Annual applications of fertilizer are needed to maintain stands. Also important is applying fertilizer at the time when plants are ready to use it because these soils are leached easily.

Contour tillage and surface protection by plant cover are important so as to keep soil blowing and water erosion to a minimum. Where these soils are

used for cultivated crops, the return of crop residues and careful attention to winter cover are vital. Under such management, and on short complex slopes, minimum tillage combined with use of cover crops and crop residues on the surface are important supporting practices for controlling soil blowing and water erosion and maintaining good tilth. These soils are well suited to management in which plowing is not used and row crops are directly planted into crop residues on the soil surface.

These soils take in irrigation water readily. Irrigation is needed for good crop growth and should be a part of a complete management system for high-value crops.

Capability Unit IIw-1

This unit consists of deep, nearly level to gently sloping, well-drained to somewhat poorly drained, mainly sandy soils that are medium to low in content of lime. These soils are in the Altmar, Claverack, Elnora, and Galen series. Except for the Claverack soils, which have fine-textured material at depths between 20 and 36 inches, these soils are deep sand and gravel deposits. Unless the soils in this unit are artificially drained, a high water table occurs during winter and early in spring and in prolonged wet periods. Permeability is moderately rapid to rapid in the surface layer. Except for the Claverack soils, permeability is moderately rapid to rapid in the subsoil. Except for Altmar gravelly fine sandy loam, these soils are generally free of gravel in the surface layer. Maintaining tilth is not difficult. Organic-matter content is low in many places. Lime and fertilizer needs are high. The available moisture capacity is low to moderate. Erosion is a slight to moderate hazard. Seasonal wetness is the main concern in management.

If properly managed, these soils are well suited to most crops, including specialized crops such as vegetables. The seasonal wetness may delay planting in spring. The sandy soils are susceptible to soil blowing if they are left bare. Protection from damage by soil blowing is particularly needed on broad exposed areas.

All the soils in this unit need lime to maintain the level of acidity desired for optimum plant growth. The underlying clay in the Claverack soils helps to make heavy fertilization and maintenance of a high level of fertility more practical. On the sandy soils, which are leached easily, sidedressing with fertilizer during the growing season is a good practice for crops requiring high fertility levels.

These soils can be intensively cultivated if management is at a high level and includes minimum cultivation and use of crop residues and cover crops. Organic matter is difficult to maintain where farming is intensive. Crop residues should be maintained on the soil surface to control soil blowing. Erosion can also be controlled by using a system of management in which the soils are not plowed and row crops are planted directly into crop residues.

Random tile drainage of low wet spots of included soils increases the use of the soils in this unit. Sand and silt must be excluded from tile lines by wrapping the tile. High-value vegetable crops grown on the sandy soils may need frequent irrigations before optimum growth can be obtained.

Capability Unit IIw-2

This unit consists of nearly level, moderately well drained to well drained soils that have some clay accumulation in the subsoil. These soils are in the Bombay, Cayuga, Cazenovia, Collamer, Hilton, and Phelps series. In some places the Cazenovia, Cayuga, and Hilton soils have solid rock at depths between 3 1/2 feet and 6 feet. The other soils are generally deeper than 6 feet to rock. Except for Collamer and Cayuga soils, the soils in this unit contain stone fragments in the surface layer and subsoil. All of these soils are medium to high in lime content and natural fertility. Permeability is moderate to slow in the subsoil and moderate to rapid in the surface layer. Except for the Bombay soil, the available moisture capacity is high. On the Cayuga, Cazenovia, and Collamer soils, tilth may be difficult to maintain. Erosion normally is not a hazard. Seasonal wetness is the main concern.

The soils in this unit are well suited to all commonly grown crops. If these soils are properly managed, midseason vegetable crops grow well. In some places stones in the surface layer of Bombay, Hilton, and Phelps soils interfere with precision machinery used for tilling truck crops. Although seasonal wetness may delay planting briefly in spring, the soils in this unit are relatively easy to work if regular additions of organic matter are supplied.

The Bombay, Collamer, and Hilton soils require more lime than the other soils to maintain the level of acidity desired for optimum plant growth.

Random drainage of wet spots by surface and tile systems is necessary in many places. Frequently these small areas are caused by the partial failure of old drains. Frost heaving may be a problem, and there may be some winterkill of perennial deep-rooted crops.

Crops on these soils respond to extra nitrogen in spring because the soils tend to be cold and wet. A cropping system that includes a sod crop every 4 to 5 years helps to maintain good soil structure. Minimum tillage is important. Supplemental irrigation may be needed in some years to maintain optimum growth and the high quality of crops.

Capability Unit IIw-3

Hamlin silt loam is the only soil in this unit. This soil is nearly level, well drained, and medium textured. It is naturally fertile and has a high organic-matter content. Flooding is likely early in spring and in other excessively wet periods.

Areas are generally small and, in many places, are dissected by cross channeling that occurs during floods. Permeability is moderate, and the available moisture capacity is high. Erosion by stream cutting is a problem along some streambanks. The size and shape of individual areas makes cultivation difficult in many places. Seasonal wetness is the main concern in management.

The soil in this unit is suited to all crops grown in the county, including deep-rooted crops. Flooding is the main limitation to use. Where flooding has been prevented, this soil is well suited to crops and can be used for continuous row crops if management is good. Crops respond well to added lime and fertilizer. Generally it is not difficult to control erosion and maintain the organic-matter content. Although planting in spring may be briefly delayed because of wetness, this soil is easy to work. In some places land shaping is needed for surface drainage. Winter cover is desirable on this soil. Where needed, the improvement and maintenance of existing stream channels and levees are helpful in controlling floods. This soil is well adapted to irrigation because of its location in relation to water sources and its depth and permeability. Where the flood hazard cannot be eliminated, the best use may be sod crops tolerant of flooding and fertilized annually with nitrogen so that forage is produced.

Capability Unit IIIe-1

This unit consists of deep, moderately sloping, well drained to moderately well drained soils that have a medium-textured to fine-textured subsoil. These soils are in the Cayuga, Cazenovia, and Ontario series. Permeability is moderate in the surface layer and moderately slow to slow in the subsoil. Runoff is rapid. The available moisture capacity is moderate to high. These soils are medium to high in lime content and in natural fertility. Operating machinery, maintaining good tilth, and controlling erosion are the main problems.

These soils are suited to all crops commonly grown in the county. Good management is required for cultivated crops, but slopes may restrict use. Unless slopes are protected by erosion control practices, cultivated crops should not be grown.

Maintaining tilth on the Cayuga soil is difficult in some places, but measures to control erosion increase infiltration and offset the shortage of moisture. Contour stripcropping, used with diversions and grassed waterways, allows these soils to be cultivated safely. If the soils are protected, 1 year of a cultivated crop, a grain crop, and 2 years of sod is a suitable cropping system. Row crops can be grown more frequently if they are used in a management system in which the soils are not plowed and planting is directly into crop residues on the soil surface.

Crop residues and cover crops to stabilize the surface and the use of minimum tillage are also needed with conventional tillage methods. Wet spots and waterways should be tiled. Stoniness and slope may make the use of precision farm machinery difficult and also reduce the practicality of irrigating specialized crops. It is normally important to intercept both seepage and surface runoff before the water gets to the more nearly level, poorly drained soils on the lower slopes.

Capability Unit IIIe-2

Howard gravelly loam, 8 to 15 percent slopes, is the only soil in this unit. This soil is deep, moderately sloping, and well drained. Permeability is moderately rapid in the surface layer and rapid in the subsoil. The available moisture capacity is low. Lime content and natural fertility are medium to low. The organic-matter content is low in many places. The hazard of erosion and droughtiness are the main problems.

This soil is well suited to all crops commonly grown in the county, but slope and gravel may limit the intensity of use. The soil is well suited to tree fruits and forage crops that require good drainage and deep rooting. This soil can be planted early, and where erosion is controlled, fruit and vegetables can be grown. Lime and fertilizer are needed on this soil.

This soil cannot be safely cultivated where it is unprotected. Practices that conserve soil and moisture are important management needs on this soil. Where the longer slopes can be contoured or stripcropped, they can be used more intensively. Winter cover is essential on this soil if it is cultivated. Minimum tillage and return of crop residues to the soil are needed to maintain the organic-matter content. This soil is well suited to row crops that are adapted to a system of management in which plowing is not used. In a system of this kind, maintaining crop residues on the soil surface is essential for controlling erosion. Because of slope and gravel, this soil is not suited to fine-seeded crops or crops that require heavy or precision farm machines. Because of the erosion hazard, this soil is not well suited to irrigation.

Capability Unit IIIe-3

The only soil in this unit is Arkport very fine sandy loam, 6 to 12 percent slopes. This is a deep, moderately sloping, well-drained, medium-textured soil in which fine sand is dominant. It is rapidly permeable in the surface layer and subsoil. The available moisture capacity is moderate. Lime content is medium to low, and the organic-matter content and natural fertility are low in most places. Slopes are complex in many places. Erosion by water and soil blowing are major problems.

The soil in this unit is well suited to cropping systems that provide deep-rooted hay and pasture crops. All crops can be grown, but the cropping intensity should not be more than 1 year of cultivation and 4 or 5 years of sod. Contoured slopes

and slopes less than 100 feet long can be cultivated for 1 year if cultivation is followed by 2 years of sod. This soil is well suited to tree fruits and vegetables, though slopes should be protected from erosion where fruit is grown.

Lime is needed for some crops, and fertilizer is needed for all crops. It is important to apply fertilizer at the time plants are ready to use it because this soil is leached easily. Annual applications are needed to maintain stands.

Where this soil is used for cultivated crops, the return of crop residues and careful attention to winter cover are vital. On short complex slopes, minimum tillage, combined with use of cover crops and crop residues on the surface, are important supporting practices for controlling soil blowing and water erosion. This soil is well suited to row crops planted into crop residues maintained in a system of management that does not use plowing.

This soil takes in water readily, but care must be taken to protect the slopes from erosion. Irrigation is needed for good crop growth. For high-value crops it should be a part of the complete treatment.

Capability Unit IIIs-1

This unit consists of deep, nearly level to gently sloping, well-drained to excessively drained, moderately coarse textured to coarse textured soils. These soils are in the Colonie and Otisville series. They are dominated by sand and gravel. Organic-matter content is low in most places. Permeability is rapid, and the available moisture capacity is low to moderate. Lime content is medium to low. These soils are droughty during dry periods. Droughtiness and low natural fertility are the main limitations.

These soils are suited to all crops commonly grown in the county. They are well suited to truck crops if they are irrigated and additions of fertilizer are adequate. These soils can be planted early in the growing season and are easy to work. Crops respond well if management is at a high level. Gravel in the surface layer of the Otisville soils interferes with the use of precision machines. In some places the soils in this unit can be used for selected field crops, but without irrigation, crop growth is only moderate because moisture content and fertility are not high. Tilth is easy to maintain if crop residues are used for soil protection. Deep-rooted crops provide some crop insurance against dry weather.

Because nutrients are rapidly leached from these soils by the water from normal rainfall or irrigation, complete fertilizer based on needs of the crop grown should be applied during the growing season to provide an adequate supply of nutrients. Lime applied on a regular schedule is needed. Frozen soils are eroded if left bare through winter without cover crops or crop residues on the surface. A combination of control measures for soil blowing is needed to protect crops and to reduce the loss of soil, moisture, and plant nutrients. Living windbreaks, cover crops, and careful use of crop residues are important supporting practices. These soils are well suited to row crops adapted to planting directly into crop residues left on the soil surface in a system of management that does not use plowing. Irrigation water can be applied frequently at a rapid rate on these soils.

Capability Unit IIIs-2

Farmington silt loam, 0 to 8 percent slopes, is the only soil in this unit. This soil is shallow, well drained, and medium textured. The depth to rock ranges from 10 to 20 inches. Lime content is medium to high, and natural fertility is medium. Permeability is moderate to moderately rapid. The available moisture capacity is low. Stones are a limitation on the surface in some areas, but depth of soil and droughtiness are the main limitations.

This soil is better suited to short-season crops that mature early than to long-season crops because the lack of depth limits the amount of moisture reserve during dry periods. Good use of available moisture can be obtained by applying a complete fertilizer each year in amounts that meet the requirements of the crop. Response of grass sod is good if nitrogen is applied early in spring.

A suitable cropping system is 1 year of a row crop, 1 year of a grain crop, and 1 year of sod. More intense use requires careful management. Supporting conservation practices are important in keeping soil and water losses to a minimum. The uses of contour cultivation, crop residue, and cover crops reduces loss of soil and water. This soil is suited to row crops planted into crop residues in a system of management that does not use plowing. Crop residues used in this system help to control erosion and to make more efficient use of available moisture. During dry seasons frequent irrigation is needed for crops of high value, though water may not be available in some places.

Capability Unit IIIw-1

This unit consists of nearly level, somewhat poorly drained to poorly drained soils. These soils are in the Appleton, Fredon, Massena, Minoa, Niagara, and Raynham series. A high water table is present in winter, early in spring, and in other excessively wet periods. Some areas may be ponded for short periods. Except for the Massena soil, the available moisture capacity is moderate. The Massena soil has a low available moisture capacity. The soils of this unit have moderate to moderately rapid permeability in the surface layer. In Appleton and Niagara soils, permeability is moderate to moderately slow in the subsoil. The Massena, Fredon, and Raynham soils have moderate to moderately rapidly permeability in the subsoil. Lime content is generally medium to high, and natural fertility is low to high. The Massena and Minoa soils, which contain more sand in the surface layer than the other soils, have a surface layer that is low in

content of lime in some places. Wetness is the principal limitation for the soils of this unit.

The soils in this unit have a high potential for growing all common field crops and most vegetables, if the soils are effectively drained and have adequate applications of lime and fertilizer. Some lime is needed in some places for selected crops.

In some places the Appleton, Fredon, and Massena soils have stones on the surface that influence the choice of crops. Continuous row crops can be grown, but returning all crop residues is important. Minimum tillage and a cropping system that includes a sod of green-manure crop help to maintain good soil structure.

Excess water must be removed from these soils before they can be successfully cultivated. Both tile and open surface drains can be used, but careful design and installation are necessary. This is especially true of soils that contain more sand and silt in the surface layer. The silt and sand grains flow readily if saturated and plug both open and closed drains. In most areas land smoothing to remove shallow depressions is an effective supporting measure. Irrigation needs to be carefully controlled to avoid soil damage and the sealing of the soil surface. Where they are not drained, these soils are better suited to birdsfoot trefoil, timothy, and other hay and forage crops than to cultivated crops, because these grasses and legumes can tolerate some wetness.

Capability Unit IIIw-2

This unit consists of nearly level, somewhat poorly drained soils that have a fine textured or moderately fine textured subsoil. These soils are in the Brockport, Churchville, Lockport, Odessa, Ovid, and Rhinebeck series. The Brockport and Lockport soils have shale rock at depths between 20 and 40 inches. The other soils are deeper than 40 inches to rock. A perched water table is common in winter, spring, and other excessively wet periods. Permeability is generally moderate to moderately slow in the surface layer and slow in the subsoil. The available moisture capacity is moderate. Maintaining favorable tilth is a constant problem in these soils. These soils are medium to high in lime content. Natural fertility is medium to high. Because of the slowly permeable subsoil and shallow rooting depth, these soils are often droughty during extended dry periods. Wetness and tilth are the main limitations to use.

These soils, if carefully managed, are suited to common field crops. Artificial drainage is essential if crops are grown. Where drainage is impractical, these soils produce good forage crops if planted to water-tolerant varieties and fertilized annually with a complete fertilizer that is high in nitrogen content. Stoniness may interfere with some machine operations on the Lockport and Ovid soils. Unless annual cover cropping is practiced, the soils in this unit should not be plowed for more than 3 successive years before 1 year or more of sod is used. Pattern systems of closely spaced tile for internal drainage or adequate surface drainage are necessary and, in most places, are justified for producing crops. Runoff from higher soils should be diverted and channeled to safe outlets. Smoothing of surface depressions is needed to supplement tile systems, and other land smoothing is effective in places.

Careful management for good tilth is essential if use of these soils is moderately intensive. Plowing should be done only when soil moisture is moderate or low. Plowing in fall is desirable on some of the more nearly level areas. All crop residues should be returned to the soil. Minimum tillage, including disking stubble before plowing and pulling a pulverizer behind the plow, is desirable.

Irrigated areas of these soils tend to crust rapidly, and the rate of water application should be moderate. Traffic must be restricted when these soils are wet.

Capability Unit IIIw-3

This unit consists of deep, nearly level, poorly drained to very poorly drained soils. These soils are in the Canandaigua, Cheektowaga, and Lamson series. The Canandaigua soils are dominated by silt, the Lamson soils by fine and very fine sand, and the Cheektowaga soil by fine sand that is 20 to 40 inches thick over clay and silt. All of these soils have a prolonged high water table unless they are artificially drained. Many areas are ponded in winter, spring, and other excessively wet periods. These soils are medium to high in content of lime and generally have a high organic-matter content. Natural fertility ranges from low to high. Permeability of the surface layer is moderate to moderately rapid except for Canandaigua silty clay loam. Permeability of the subsoil in the Lamson soils is moderately rapid to rapid. The other soils have a moderately slowly permeable or slowly permeable subsoil. Good tilth is fairly easy to maintain, except in the finer textured Canandaigua soils. Wetness is the main limitation to use.

These soils are naturally too wet for cultivation, but they can be drained. Response to tile drainage is excellent where outlets are available. Where adequately drained, these soils are suited to all crops grown in the county.

In drained areas, row crops can be grown year after year. Supporting practices, such as use of cover crops, minimum tillage, and returning all crop residues, help to maintain the organic-matter content and a friable surface layer. Where tile is installed, special care is needed to prevent plugging with silt and fine sand. In undrained areas, water-tolerant forage species can be planted, but these areas generally grow up in native hardwoods if the soils are not managed.

Capability Unit IIIw-4

This unit consists of deep, nearly level, somewhat poorly drained soils. These soils are in the Cosad and Stafford series. The Stafford soils are dominated by fine sand, and the Cosad soil is fine sand that is 2 to 40 inches to clay and silt. The soils of this unit have moderately rapid to rapid permeability in the surface layer. The subsoil in the Stafford soils is rapidly permeable. The clayey substratum in the Cosad soil is slowly permeable. The available moisture capacity is low in all the soils of this unit. Unless these soils are drained, the water table is at or near the surface in winter, early in spring, and in other excessively wet periods. Some areas are ponded for short periods. These soils are medium to low in content of lime. Their capacity to hold nutrients is low. Wetness is the main limitation.

These soils are suited to common field crops if drainage is improved and fertilizer is added. In undrained areas, crops that mature late or forage plants tolerant of wetness are the most dependable. Although these soils do not dry out early, they are easy to work. Vegetables can be grown in adequately drained areas. Continuous row crops are suited if all crop residues are returned to the soil.

Lime is needed for selected crops. Excess water must be removed from these soils before they can be successfully cultivated. Both tile and open ditches can be used, but careful design and installation are required. This is especially true of the sandy Stafford soils because sand grains flow readily if saturated and plug both open and closed drains. Where ponding occurs, land smoothing is an effective measure for either kind of drainage. Cover crops and an occasional year of sod are needed to help reduce damage from soil blowing on exposed fields that are drained.

Irrigation of special high-value crops is needed to maintain quality and growth of crops. Also, fertilizer should be applied during the growing season when plants can make most use of it.

Capability Unit IIIw-5

This unit consists of gently sloping, somewhat poorly drained, high-lime soils that have a medium- to fine-textured subsoil. These soils are in the Churchville, Niagara, Odessa, Ovid, Raynham, and Rhinebeck series. In all except the Raynham soil, permeability is moderate to moderately slow in the surface layer and moderately slow to slow in the subsoil. The Raynham soil has moderate to moderately rapid permeability in the subsoil. Available moisture capacity is moderate. The soils of this unit erode if they are cultivated intensively. They puddle easily when wet and crust or form hard clods when they dry. Wetness and maintaining good soil tilth are the main concerns in management.

If drainage, erosion control, and management for good tilth are adequate, these soils are moderately suited to all common crops. Undrained areas are limited to sod crops that tolerate wetness and to small grain or short-season row crops. Response to lime, where needed, and to fertilizer is good.

The maximum intensity of cropping should not exceed 1 year of row crops, 1 year of grain, and 2 years of sod unless erosion control practices are used. In a few places, long slopes need terraces or graded strips, sodded waterways, and winter cover crops for erosion control. Each year these soils are cultivated, they need careful management for good tilth, including not plowing when soils are wet, disking stubble before plowing, minimum tillage, and returning all crop residues. In some places the Ovid soil has surface stones that interfere with the operation of precision machinery.

Response to tile drainage is variable. In some places random draining of wet spots may be desirable. Irrigation needs careful control to avoid erosion damage and puddling.

Capability Unit IIIw-6

Wayland silt loam is the only soil in this unit. This soil occurs on flood plains and is nearly level, poorly drained to very poorly drained, and medium textured. It is a naturally fertile soil that is high in organic-matter content. The content of lime is medium to high. Permeability is moderate, and the available moisture capacity is moderate. This soil is frequently flooded, and drainage is difficult to establish. Most areas are small and, in most places, are dissected by cross channeling during floods. Areas are also susceptible to damaging deposition. Flooding and wetness are the main limitations.

In its natural condition, this soil is suited only to permanent cover. Forage plants for pasture must be tolerant of poor drainage and frequent flooding. Where drained and protected from flooding, this soil can be cultivated intensively. Land smoothing and tiling greatly improve the efficiency of machine operations.

On this stone-free soil, hazards other than flooding and wetness are few. The need for irrigation is limited. Irrigation water cannot be applied too rapidly, because permeability of the subsoil is restricted.

Capability Unit IVe-1

Ontario loam, 8 to 15 percent slopes, eroded, is the only soil in this unit. This soil is deep and well drained. The organic matter has been depleted, and a rill and gully pattern of erosion persists in many of the areas. Permeability is moderately slow, and runoff is rapid. The available moisture capacity is moderate to high. Good tilth is difficult to maintain because of the low organic-matter content and erosion. Lime content is medium to high. Slope and a continuing hazard of erosion are the main limitations.

This soil needs a protective surface cover all year, and therefore it is best suited to hay or pasture and an occasional year of winter grain. If properly treated with complete fertilizer, this soil produces good forage, including deep-rooted legumes. In cultivated areas complete erosion control is necessary, including crop residue management or growing a winter grain to protect the surface layer. Erosion can be controlled by planting row crops into killed sod or crop residues in a system of management that does not use plowing. Care is needed to maintain favorable tilth. Stones interfere with cultivation in some places.

Where small areas of this soil are in large fields of other soils, this soil should be protected with crop residues or other protective materials applied to the surface. Unless the surface layer can be kept open, erosion is severe and there is little available soil moisture. Irrigation on this soil can be hazardous if the surface is bare.

Capability Unit IVe-2

This unit consists of deep, moderately sloping, well drained to moderately well drained, eroded soils. These soils are in the Dunkirk and Hudson series. Past erosion has depleted the organic matter, and a rill and gully pattern persists in many of the individual areas. The Hudson soil has a finer textured surface layer than it would have if it were not eroded. The soils of this unit have moderate to moderately slow permeability in the surface layer and slow permeability in the subsoil. Runoff is rapid. The available moisture capacity is medium to high. These soils are medium to high in lime content. The maintenance of good tilth is difficult in most places because of low organic-matter content and erosion. The continuing hazard of erosion is the main limitation.

These soils need protective cover all year and therefore are best suited to permanent hay or pasture. They produce good forage, including deep-rooted legumes, if properly treated with complete fertilizer. In cultivated areas, complete erosion control is necessary, including crop residue management or growing winter grain to protect the surface layer. These soils should not be plowed repeatedly, because they crust severely when overworked and crop growth is restricted. Extreme care is needed to maintain tilth. Where small areas of these soils are in large fields of other soils, these small eroded areas should be protected with crop residues or other protective materials applied to the surface. These soils can be used for row crops in a management system that does not use plowing and maintains year round cover on the soil surface. Row crops must be those adapted to planting directly into killed sod or crop residues. Irrigation on these soils causes severe erosion in some places.

Capability Unit IVw-1

This unit consists of deep, nearly level, poorly drained and very poorly drained soils. These soils are in the Fonda, Lakemont, Madalin, and the Sun series and the Madalin series, loamy subsoil variant. Except for the Sun soil, they have a moderately fine textured to fine textured subsoil. Except for the Lakemont soil, which has a silty clay loam surface layer, these soils have a silt loam or mucky silt loam surface layer. Permeability is moderate in the surface layer and moderately slow to slow in the subsoil or substratum. The available moisture capacity is moderate. Unless these soils are drained, they have a prolonged high water table. Many areas are ponded for long periods. Wetness is the main limitation.

The limitations on these soils are many and include frost heaving, ponding, slow permeability in the subsoil, and difficulty in maintaining tilth and in harvesting late in the growing season. Undrained areas are too wet to use for cultivated crops. Winter ponding may cause damaging ice cover. The use and response of these soils depend on the effectiveness of measures for overcoming these limitations. Where needs are met, these soils are suited to corn and beans and other annual crops. Crops on these soils respond slowly to underdrainage, for which close drains are needed. Surface drainage practices are very effective. Intensive management is needed to maintain good tilth. Helpful measures are fall plowing, waiting for ideal moisture content, return of crop residues, land smoothing, and plowing not over three times between sod crops. If these soils are partly drained, permanent grass sod that tolerates ponding can be maintained. Good forage can be grown if management is good and provides annual applications of a complete fertilizer high in nitrogen content. Traffic must be restricted when these soils are wet.

Capability Unit IVw-2

Only Muck, shallow, is in this unit. It consists of level, very poorly drained, organic deposits that are 12 to 40 inches thick over mineral soil material. Muck, shallow, is ponded for long periods unless drained artificially. The underlying mineral material ranges from sandy to clayey. Permeability is rapid to a depth of 12 inches and variable below that depth. Wetness is the main limitation.

Unless drained, this mapping unit is best suited to natural permanent cover. The life span of these shallow muck areas, which are less than 3 1/2 feet thick, may be too short to warrant the investment for development. Drainage systems, water-level control, and windbreaks need to be carefully planned and coordinated. Where drained and adequately fertilized, Muck, shallow, is suited to crops. The kinds of crops grown depend on the thickness of the muck remaining after drainage. Needed practices are crop residue management and control of soil blowing, together with measures to control the water level so as to reduce subsidence and the effects of oxidation.

Capability Unit Vw-1

This unit consists of only Alluvial land. It varies in texture and drainage within each mapped area. These variable soil areas are susceptible to flooding and to damaging cutting or deposition by stream action. This land type is naturally fertile and high in organic-matter content. The variability of the soils, the small size of the areas, and susceptibility to flooding and cross channeling by streams are limitation. Wetness is the main limitation.

This land varies so much that the usefulness of each area must be considered separately. These areas are generally not suited to cultivation in their present condition, but they are suited to permanent vegetation. Where protected from flooding and drained, they normally are farmed as a part of the adjoining field. Localized treatment generally consists of adding lime and fertilizer as indicated by soil test, clearing brush, debris, and the like, and then seeding to reed canarygrass or birdsfoot trefoil and timothy. Plant growth may be only moderate where this land is used for hay and pasture. Normally, areas that cannot be mowed periodically for brush and weed control should not be seeded. Grazing should be regulated to maintain regrowth.

Capability Unit VIe-1

This unit consists of deep, strongly sloping to steep, well-drained, eroded soils. These soils are in the Arkport, Dunkirk, Hudson, and Ontario series. The texture of the surface layer varies. Permeability ranges from moderately rapid to moderately slow in the surface layer and from rapid to slow in the subsoil. The available moisture capacity is moderate to high. These soils are medium to high in lime content. Slope and the continuing hazard of erosion are severe limitations to use.

Because of severely eroded and steep slopes, these soils should be left in permanent sod. Deep-rooted legumes are well adapted. Some lime is needed for their establishment in some places, and fertilizers are needed to maintain stands and plant growth. On slopes where machinery can be safely operated, it is usually worthwhile to manage and improve these soils for growing long-lived pasture grasses and legumes. These steep soils generally can be grazed early. They are not well suited to cultivation, because of steepness, excessive erosion, and the difficulty of managing the eroded surface layer. Irrrigation is also difficult for the same reasons.

Capability Unit VIIIs-1

This unit consists of Rock land, nearly level, and Rock land, steep. These land types are shallow and occur in nearly level to steep, rocky areas that are dominated by stones and rock outcrops. A thin cover of soil material is over much of the area, but at least 25 percent of the surface consists of exposed bedrock. These land types are not suited to commercial plants. Some areas can be used for wildlife habitat.

This land is restricted to natural vegetation that is used for limited recreation, wildlife, or esthetic purposes. It is too rocky for the use of machinery. Wheel and foot traffic must be controlled if vegetation is desired. Annual application of a complete fertilizer is needed on selected areas to maintain the vigor of stabilizing cover.

Estimated Yields 5/

Tables 1, 2, and 3 gives estimated average acre yields of principal crops for those soils in the county that are suitable for cultivation. Table 1 is for field crops, table 2 for vegetable crops, and table 3 for fruit crops. The estimates in these tables are for two levels of management. In columns A are yields that can be expected if management of soils, water, and crops is average. The estimates in columns A are a little above the average yields obtained by farmers in the county in the late 1960's.

The yields shown in columns B are those that can be expected under highly skilled, or improved, management. This management consists of using suitable crop rotations; using the best fertilizer and liming practices; providing adequate drainage and irrigation, where needed; using contour farming, stripcropping, sodded waterways, or other measures needed for conserving soil and water; thoroughly controlling weeds and insects; and tilling at the right time and in the right way.

For obtaining the yields in columns B, the management needed is that recommended in the annually revised editions of "Cornell Recommends for Field Crops" and "Cornell Recommends for Vegetable Crops."

The lower yields shown in columns A can be expected under ordinary management. This management includes less than half of the recommended conservation and management practices.

The higher estimated yields shown in columns B are approximately those that have been attained by about the top 10 percent of farmers in the county using the best combinations of management practices. From year to year, a given actual yield estimate may vary about 10 percent from the estimates listed, but management that results in the crop yields shown in columns B requires that the farmer does not allow yields to be limited by any factor over which he has

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5/ ERNEST L. McPHERRON, conservation agronomist, Soil Conservation Service; and KENNETH G. WOODEN, field crops, LUCIUS A. DICKERSON, senior agent, ROBERT R. HUSTED, vegetables, and RICHARD L. PEASE, fruit, Cooperative Extension Service, assisted in the preparation of the tables in this subsection.

control. These yields may be expected to increase in future years as new varieties and improved management become available.

The yields of processed vegetables given in table 2 depend on the processor purchasing all that each grower produces. Some crops such as cucumbers are used for labor distribution, and annual acreages of individual growers are varied by contract supply and demand. Heavy textures and high-lime content of the soils reduce the yields of high-quality potatoes in the county. Under a high level of management, however, potato yields of 300 to 600 bushels per acre can be obtained on the loam and sandy soils that are acid in the surface layer.

Sugar beet yields of 22 to 24 tons per acre can be obtained on deep, neutral soils that have a good water supply. For sugar beets, stone-free, medium-textured to fine-textured soils are preferred and the best practical management is important.

TABLE 1.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED FIELD AND FORAGE CROPS UNDER TWO LEVELS OF MANAGEMENT

[Yields in columns A are those to be expected under average management; those in columns B, under improved management. Absence of yield figure indicates that crop is not suited to the soil or is not grown on it]

Soil	Corn for silage		Corn for grain		Oats		Wheat		Alfalfa		Alfalfa-trefoil-grass		Trefoil-grass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	Tons	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons	Tons	Tons	Tons	Tons	Tons
Alluvial land	--	--	--	---	--	---	--	--	---	---	---	---	---	---
Altmar loamy fine sand	8	18	40	90	30	80	25	50	1.0	5.0	1.0	3.5	1.0	3.0
Altmar gravelly fine sandy loam	8	18	40	90	40	90	30	60	2.5	5.5	1.5	4.0	1.0	3.0
Appleton gravelly loam, 0 to 3 percent slopes	15	22	60	110	35	90	30	65	---	5.5	2.0	4.0	1.0	3.5
Appleton silt loam, 0 to 3 percent slopes	15	22	60	110	35	90	30	65	---	5.5	2.0	4.0	1.0	3.5
Arkport very fine sandy loam, 0 to 6 percent slopes	15	20	60	100	45	90	25	55	3.0	4.5	1.5	3.5	1.0	2.5
Arkport very fine sandy loam, 6 to 12 percent slopes	15	20	60	100	40	80	25	50	2.5	4.5	1.5	3.5	1.0	2.5
Arkport fine sandy loam, gravelly substratum, 0 to 2 percent slopes	15	20	60	100	45	90	25	55	3.0	4.5	1.5	3.5	1.0	2.5
Arkport fine sandy loam, gravelly substratum, 2 to 6 percent slopes	15	20	60	100	45	90	25	55	3.0	4.5	1.5	3.5	1.0	2.5
Bombay fine sandy loam, 0 to 2 percent slopes	12	20	60	100	40	85	30	60	3.0	5.0	2.5	4.0	1.0	3.0
Bombay fine sandy loam, 2 to 6 percent slopes	12	20	60	100	50	85	30	60	3.0	5.0	2.5	4.0	1.0	3.0
Brockport silt loam, 0 to 4 percent slopes	7	18	35	90	30	80	25	60	---	4.5	1.0	4.0	1.0	3.5
Canandaigua silt loam	7	22	35	110	25	90	30	65	---	4.0	1.0	4.0	1.0	3.5
Canandaigua silty clay loam	6	20	30	100	25	75	15	55	---	4.0	1.0	4.0	1.0	3.5
Cayuga and Cazenovia silt loams, 0 to 2 percent slopes	12	24	70	120	45	100	30	60	3.5	7.0	2.5	4.5	2.0	3.5
Cayuga and Cazenovia silt loams, 2 to 6 percent slopes	12	24	60	120	45	100	35	65	3.5	7.0	2.5	4.5	2.0	3.5
Cayuga and Cazenovia silt loams, 6 to 12 percent slopes	12	22	60	110	40	90	35	65	3.5	6.0	2.5	4.5	2.0	3.5
Cazenovia gravelly silt loam, 0 to 3 percent slopes	16	24	80	120	55	95	35	65	2.0	6.0	1.5	3.5	1.0	3.5
Cazenovia gravelly silt loam, 3 to 8 percent slopes	16	24	80	120	60	100	35	65	2.0	6.0	1.5	3.5	1.0	3.5
Cazenovia gravelly silt loam, shale substratum, 0 to 3 percent slopes	16	24	80	120	55	95	35	65	2.0	6.0	1.5	3.5	1.0	3.5
Cazenovia gravelly silt loam, shale substratum, 3 to 8 percent slopes	16	24	80	120	60	100	35	65	2.0	6.0	1.5	3.5	1.0	3.5
Cheektowaga fine sandy loam	8	18	40	90	30	80	20	45	---	5.0	1.5	3.5	1.5	3.0
Churchville silt loam, 0 to 2 percent slopes	8	20	40	100	40	80	30	60	2.5	5.0	2.0	4.0	1.5	3.5
Churchville silt loam, 2 to 6 percent slopes	8	20	40	100	40	80	30	60	2.5	5.0	2.0	4.0	2.0	3.5
Claverack loamy fine sand, 0 to 2 percent slopes	10	18	50	90	40	85	20	50	2.0	4.0	1.5	3.5	1.0	3.0
Claverack loamy fine sand, 2 to 6 percent slopes	10	18	50	90	40	85	20	50	2.0	4.0	1.5	3.5	1.0	3.0
Collamer silt loam, 0 to 2 percent slopes	15	22	75	110	50	90	40	70	3.0	6.0	2.0	4.0	1.0	3.5
Collamer silt loam, 2 to 6 percent slopes	15	22	75	110	50	90	40	70	3.0	6.0	2.0	4.0	1.0	3.5
Colonie loamy fine sand, 0 to 6 percent slopes	6	16	30	80	20	50	20	45	2.0	4.0	1.0	2.5	---	---
Cosad fine sandy loam	7	18	35	90	30	90	20	50	---	4.0	1.0	3.5	1.5	3.0
Cut and fill land	--	--	--	---	--	---	--	--	---	---	---	---	---	---

TABLE 1.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED FIELD AND FORAGE CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Soil	Corn for silage		Corn for grain		Oats		Wheat		Alfalfa		Alfalfa–trefoil–grass		Trefoil–grass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	Tons	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons	Tons	Tons	Tons	Tons	Tons
Dunkirk silt loam, 2 to 6 percent slopes	15	24	75	120	55	100	40	70	2.0	6.0	1.5	4.0	1.0	2.5
Dunkirk silt loam, 6 to 12 percent slopes, eroded	12	22	60	110	50	90	35	65	2.0	6.0	1.5	4.0	1.0	2.5
Dunkirk and Arkport soils, 12 to 20 percent slopes, eroded	11	18	55	90	30	75	25	55	1.0	5.0	1.0	4.0	1.0	2.0
Elnora loamy fine sand, 0 to 2 percent slopes	8	18	40	90	40	80	20	50	2.0	4.0	1.0	3.5	1.0	3.0
Elnora loamy fine sand, 2 to 6 percent slopes	8	18	40	90	40	80	20	50	2.0	4.0	1.0	3.5	1.0	3.0
Farmington silt loam, 0 to 8 percent slopes	--	--	--	---	25	50	20	40	1.0	3.0	1.0	3.0	1.0	2.5
Fonda mucky silt loam	--	14	--	70	--	60	--	30	---	3.0	1.5	3.5	1.5	3.0
Fredon gravelly loam	8	20	40	100	40	80	30	60	---	4.0	2.0	4.0	2.0	4.0
Galen very fine sandy loam, 0 to 2 percent slopes	12	19	60	95	50	80	30	60	2.0	4.0	1.0	3.5	1.0	3.0
Galen very fine sandy loam, 2 to 6 percent slopes	12	19	60	95	50	80	30	60	2.0	4.0	1.0	3.5	1.0	3.0
Hamlin silt loam	12	24	60	120	50	100	30	65	3.5	6.0	3.0	5.0	3.0	4.0
Hilton gravelly loam, 0 to 3 percent slopes	12	23	60	115	50	100	35	65	3.0	6.0	2.5	4.5	1.0	3.5
Hilton gravelly loam, 3 to 8 percent slopes	12	23	60	115	50	100	35	65	3.0	6.0	2.5	4.5	1.0	3.5
Hilton silt loam, 0 to 3 percent slopes	12	24	60	120	50	100	35	65	3.0	6.0	2.5	4.5	1.0	3.5
Hilton silt loam, 3 to 8 percent slopes	12	24	60	120	50	100	35	65	3.0	6.0	2.5	4.5	1.0	3.5
Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes	12	24	60	120	50	100	35	65	3.5	6.0	3.0	5.0	3.0	4.0
Hilton and Cayuga silt loams, limestone substratum, 3 to 8 percent slopes	12	24	60	120	50	100	35	65	3.5	6.0	3.0	5.0	3.0	4.0
Howard gravelly loam, 0 to 3 percent slopes	12	20	60	100	50	100	30	60	3.0	6.0	2.5	4.5	2.5	4.0
Howard gravelly loam, 3 to 8 percent slopes	12	20	60	100	50	100	30	60	3.0	6.0	2.5	4.5	2.5	4.0
Howard gravelly loam, 8 to 15 percent slopes	12	18	60	90	45	75	30	45	3.0	5.0	2.5	4.5	2.5	4.0
Hudson silt loam, 2 to 6 percent slopes	12	22	60	110	45	100	35	65	3.0	5.5	2.5	4.5	1.0	3.0
Hudson silty clay loam, 6 to 12 percent slopes, eroded	10	18	50	90	35	80	30	55	2.5	5.5	2.5	4.5	1.0	3.0
Hudson soils, 20 to 45 percent slopes, eroded	--	--	--	---	--	---	--	--	---	---	---	---	---	---
Lairdsville silt loam, 0 to 6 percent slopes	8	24	40	120	30	100	35	65	3.0	5.5	2.0	4.5	2.0	4.0
Lakemont silty clay loam	7	18	35	90	20	60	--	50	---	4.0	---	3.0	1.0	3.0
Lamson very fine sandy loam	9	20	45	100	25	90	30	60	---	4.5	---	3.0	1.0	3.0
Lamson fine sandy loam, gravelly substratum	9	20	45	100	25	90	30	60	---	4.5	---	3.5	1.0	3.0
Lockport silt loam	8	18	40	90	30	80	25	55	---	4.0	1.0	3.5	1.0	3.0
Madalin silt loam	7	16	35	80	20	60	20	50	---	3.0	1.0	3.0	1.0	4.0
Madalin silt loam, loamy subsoil variant	7	16	35	80	20	60	20	50	---	3.0	1.0	3.0	1.0	4.0
Made land	--	--	--	---	--	---	--	--	---	---	---	---	---	---
Massena fine sandy loam	10	20	50	100	35	90	30	60	---	4.5	2.0	4.0	2.0	4.0

TABLE 1.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED FIELD AND FORAGE CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Soil	Corn for silage		Corn for grain		Oats		Wheat		Alfalfa		Alfalfa-trefoil-grass		Trefoil-grass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	Tons	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons	Tons	Tons	Tons	Tons	Tons
Minoa very fine sandy loam	10	20	50	100	50	90	30	60	---	5.0	2.0	4.0	2.0	4.0
Muck, shallow	--	--	--	---	--	---	--	--	---	---	---	---	---	---
Niagara silt loam, 0 to 2 percent slopes	10	20	50	100	35	90	30	60	---	5.0	1.5	4.5	2.0	4.0
Niagara silt loam, 2 to 6 percent slopes	10	20	50	100	35	90	30	60	---	5.0	1.5	4.5	2.0	4.0
Odessa silty clay loam, 0 to 2 percent slopes	8	18	40	90	40	80	25	50	---	4.0	1.5	4.0	2.0	4.0
Odessa silty clay loam, 2 to 6 percent slopes	8	18	40	90	40	80	30	60	2.5	4.0	2.5	4.0	2.0	4.0
Ontario loam, 2 to 8 percent slopes	12	26	60	130	55	110	35	65	3.5	6.0	2.5	4.5	2.0	3.5
Ontario loam, 8 to 15 percent slopes	12	22	60	110	50	100	30	55	3.5	5.5	2.5	4.5	2.0	3.0
Ontario loam, 8 to 15 percent slopes, eroded	12	19	60	95	40	80	25	50	2.5	5.5	2.0	4.5	1.5	2.5
Ontario loam, 15 to 30 percent slopes, eroded	--	--	--	---	--	---	--	--	1.0	3.5	1.0	2.5	1.0	2.0
Ontario loam, limestone substratum, 0 to 3 percent slopes	12	26	60	130	55	110	35	65	3.5	6.0	2.5	4.5	2.0	3.5
Ontario loam, limestone substratum, 3 to 8 percent slopes	12	24	60	120	55	100	35	65	3.5	6.0	2.5	4.5	2.0	3.5
Otisville gravelly sandy loam, 0 to 3 percent slopes	--	--	--	---	20	50	--	--	2.0	5.5	1.0	3.0	1.0	2.5
Otisville gravelly sandy loam, 3 to 8 percent slopes	--	--	--	---	20	50	--	--	2.0	4.0	1.0	3.0	1.0	2.5
Ovid silt loam, 0 to 2 percent slopes	12	18	60	90	40	80	20	60	---	5.0	2.0	4.0	2.0	3.5
Ovid silt loam, 2 to 6 percent slopes	12	18	60	90	40	80	20	60	2.0	5.0	2.0	4.0	2.0	3.5
Ovid silt loam, limestone substratum, 0 to 3 percent slopes	12	18	60	90	40	80	20	60	---	5.5	2.0	4.0	2.0	3.5
Ovid silt loam, limestone substratum, 3 to 8 percent slopes	12	18	60	90	40	80	20	60	2.0	5.5	2.0	4.0	2.0	3.5
Phelps gravelly loam, 0 to 5 percent slopes	12	24	60	120	55	100	30	65	3.0	5.0	2.0	4.0	2.0	3.5
Raynham silt loam, 0 to 2 percent slopes	12	20	60	100	35	90	30	60	---	---	1.5	4.0	2.0	4.0
Raynham silt loam, 2 to 6 percent slopes	12	20	60	100	35	90	30	60	---	---	1.5	4.0	2.0	4.0
Rhinebeck silt loam, 0 to 2 percent slopes	8	20	40	100	45	90	30	60	---	4.0	1.5	4.0	2.0	4.0
Rhinebeck silt loam, 2 to 6 percent slopes	8	20	40	100	45	90	30	60	---	4.0	1.5	4.0	2.0	4.0
Rhinebeck silty clay loam, sandy substratum, 0 to 2 percent slopes	8	20	40	100	40	85	30	60	---	4.0	1.5	4.0	2.0	4.0
Rhinebeck silty clay loam, sandy substratum, 2 to 6 percent slopes	8	20	40	100	40	85	30	60	---	4.0	1.5	4.0	2.0	4.0
Rhinebeck silt loam, thick surface variant	8	20	40	100	45	90	30	60	---	4.0	1.5	4.0	2.0	4.0
Rock land, nearly level	--	--	--	---	--	---	--	--	---	---	---	---	---	---
Rock land, steep	--	--	--	---	--	---	--	--	---	---	---	---	---	---
Schoharie silty clay loam, 2 to 6 percent slopes	10	24	50	120	45	90	35	65	3.0	5.5	1.5	4.5	2.0	4.0
Stafford loamy fine sand	8	18	40	90	20	80	20	45	---	4.5	1.0	3.5	1.0	3.0
Stafford loamy fine sand, gravelly substratum	8	18	40	90	20	80	25	50	---	4.5	1.0	3.5	1.0	3.0
Sun silt loam	5	20	25	100	20	80	20	55	---	4.0	1.0	3.0	1.0	3.0
Wayland silt loam	6	20	30	100	20	75	15	55	---	3.0	1.0	3.0	1.0	3.0

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TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED VEGETABLE CROPS UNDER TWO LEVELS OF MANAGEMENT

[Yields in columns A are those to be expected under average management; those in columns B, under improved management. Absence of yield figure indicates that crop is not suited to the soil or is not grown on it]

Soil	Cabbage		Muskmelons		Peppers		Cucumbers		Sweetcorn, fresh market		Tomatoes, market		Tomatoes, processed	
	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
Alluvial land	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Altmar loamy fine sand	10	20	--	450	200	600	--	4.5	2.0	11.0	4	12	14	23
Altmar gravelly fine sandy loam	10	20	--	450	200	600	--	4.5	2.0	11.0	4	12	14	23
Appleton gravelly loam, 0 to 3 percent slopes	12	25	--	400	150	400	--	3.5	5.0	11.0	5	8	15	23
Appleton silt loam, 0 to 3 percent slopes	10	25	--	400	150	400	--	3.5	5.0	11.0	5	8	15	23
Arkport very fine sandy loam, 0 to 6 percent slopes	8	20	100	500	200	600	2.0	4.0	4.0	9.5	5	12	15	25
Arkport very fine sandy loam, 6 to 12 percent slopes	6	18	100	400	150	400	1.5	3.0	3.0	7.0	4	10	13	22
Arkport fine sandy loam, gravelly substratum, 0 to 2 percent slopes	8	20	100	500	200	600	1.5	5.0	4.0	10.0	5	12	15	25
Arkport fine sandy loam, gravelly substratum, 2 to 6 percent slopes	8	20	100	500	200	600	1.5	4.0	4.0	10.0	5	12	15	25
Bombay fine sandy loam, 0 to 2 percent slopes	10	25	--	450	200	600	--	4.5	5.0	11.0	5	11	14	25
Bombay fine sandy loam, 2 to 6 percent slopes	10	25	100	450	200	600	--	4.0	5.0	10.0	5	11	14	25
Brockport silt loam, 0 to 4 percent slopes	8	20	--	--	--	--	--	--	3.0	7.0	--	--	--	--
Canandaigua silt loam	8	20	--	300	150	300	--	3.0	3.0	8.0	--	--	--	--
Canandaigua silty clay loam	8	20	--	--	150	300	--	2.5	3.0	8.0	--	--	--	--
Cayuga and Cazenovia silt loams, 0 to 2 percent slopes	10	20	100	450	200	550	--	--	4.0	9.5	5	10	14	25
Cayuga and Cazenovia silt loams, 2 to 6 percent slopes	10	20	100	450	200	500	1.5	4.0	4.0	9.5	5	10	13	25
Cayuga and Cazenovia silt loams, 6 to 12 percent slopes	10	20	100	350	150	350	1.0	3.0	4.0	8.0	4	9	12	20
Cazenovia gravelly silt loam, 0 to 3 percent slopes	13	30	100	450	300	650	2.0	5.0	4.0	10.0	5	12	18	28
Cazenovia gravelly silt loam, 3 to 8 percent slopes	10	25	100	450	300	600	1.5	3.5	4.0	9.0	4	11	16	26
Cazenovia gravelly silt loam, shale substratum, 0 to 3 percent slopes	13	30	100	450	300	650	2.0	5.0	4.0	10.0	5	12	18	28
Cazenovia gravelly silt loam, shale substratum, 3 to 8 percent slopes	10	25	100	400	300	600	1.5	3.5	4.0	9.0	4	11	16	26
Cheektowaga fine sandy loam	10	25	--	350	250	600	--	3.5	3.5	9.0	--	9	12	20
Churchville silt loam, 0 to 2 percent slopes	10	20	--	--	--	--	--	--	4.0	8.0	--	--	--	--
Churchville silt loam, 2 to 6 percent slopes	10	20	--	--	--	--	--	--	4.0	8.0	--	--	--	--
Claverack loamy fine sand, 0 to 2 percent slopes	10	20	100	450	250	600	2.0	5.0	5.0	10.0	5	12	15	25
Claverack loamy fine sand, 2 to 6 percent slopes	10	25	100	450	250	600	2.0	5.0	5.0	10.0	5	12	14	24
Collamer silt loam, 0 to 2 percent slopes	13	30	100	400	300	550	2.0	4.5	5.5	9.5	5	11	15	25
Collamer silt loam, 2 to 6 percent slopes	15	25	100	400	300	500	2.0	4.0	5.5	9.5	5	11	15	25

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED VEGETABLE CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Soil	Cabbage		Muskmelons		Peppers		Cucumbers		Sweetcorn, fresh market		Tomatoes, market		Tomatoes, processed	
	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
Colonie loamy fine sand, 0 to 6 percent slopes	6	25	100	500	300	600	1.5	5.0	3.0	11.0	5	12	12	20
Cosad fine sandy loam	6	20	--	350	250	500	1.5	4.0	3.0	10.0	--	9	12	20
Cut and fill land	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dunkirk silt loam, 2 to 6 percent slopes	15	30	100	400	300	500	2.0	4.5	5.0	10.0	7	10	14	24
Dunkirk silt loam, 6 to 12 percent slopes, eroded	10	25	100	350	250	500	2.0	4.0	5.0	9.0	5	10	12	20
Dunkirk and Arkport soils, 12 to 20 percent slopes, eroded	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Elnora loamy fine sand, 0 to 2 percent slopes	10	25	100	450	300	600	2.0	5.0	5.0	11.0	5	11	11	24
Elnora loamy fine sand, 2 to 6 percent slopes	10	25	100	450	300	600	1.5	4.5	5.0	11.0	5	11	11	24
Farmington silt loam, 0 to 8 percent slopes	6	15	--	--	--	--	--	--	--	--	--	--	--	--
Fonda mucky silt loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fredon gravelly loam	8	20	100	350	150	450	--	3.5	4.0	9.0	4	9	14	23
Galen very fine sandy loam, 0 to 2 percent slopes	15	25	100	450	300	600	2.0	5.0	4.0	11.0	4	11	15	25
Galen very fine sandy loam, 2 to 6 percent slopes	13	25	100	450	300	600	2.0	4.5	4.0	11.0	4	11	15	25
Hamlin silt loam	15	30	100	450	300	650	2.0	5.0	5.0	12.0	6	12	18	28
Hilton gravelly loam, 0 to 3 percent slopes	15	25	100	400	250	600	2.0	4.5	5.0	10.0	5	10	15	25
Hilton gravelly loam, 3 to 8 percent slopes	15	25	100	350	200	550	1.5	4.0	4.5	9.0	4	9	14	23
Hilton silt loam, 0 to 3 percent slopes	15	25	100	400	250	550	2.0	4.5	5.0	10.0	5	10	15	25
Hilton silt loam, 3 to 8 percent slopes	15	25	100	350	200	550	1.5	4.0	4.5	9.0	4	9	14	23
Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes	13	25	100	400	250	550	1.5	4.5	4.5	9.0	5	10	15	25
Hilton and Cayuga silt loams, limestone substratum, 3 to 8 percent slopes	10	20	100	300	200	500	1.5	4.0	4.0	8.0	4	9	14	23
Howard gravelly loam, 0 to 3 percent slopes	13	25	100	500	250	600	2.0	4.5	4.0	11.0	6	12	15	25
Howard gravelly loam, 3 to 8 percent slopes	13	25	100	450	250	600	1.5	4.0	4.0	11.0	6	11	15	25
Howard gravelly loam, 8 to 15 percent slopes	--	--	--	--	150	400	--	--	3.0	8.0	4	9	11	18
Hudson silt loam, 2 to 6 percent slopes	10	25	100	300	200	450	2.0	3.5	4.0	9.0	6	9	18	28
Hudson silty clay loam, 6 to 12 percent slopes, eroded	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hudson soils, 20 to 45 percent slopes, eroded	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lairdsville silt loam, 0 to 6 percent slopes	10	25	100	300	--	--	2.0	3.5	4.0	8.0	4	8	12	24
Lakemont silty clay loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lamson very fine sandy loam	--	20	100	350	150	500	--	4.0	2.0	9.0	4	9	9	20

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED VEGETABLE CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Soil	Cabbage		Muskmelons		Peppers		Cucumbers		Sweetcorn, fresh market		Tomatoes, market		Tomatoes, processed	
	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
Lamson fine sandy loam, gravelly substratum	--	20	100	350	150	500	--	4.0	2.0	9.0	4	9	9	20
Lockport silt loam	8	15	--	--	--	--	--	--	--	--	--	--	--	--
Madalin silt loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Madalin silt loam, loamy subsoil variant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Made land	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Massena fine sandy loam	15	25	--	350	150	500	--	4.0	5.0	11.0	5	9	15	23
Minoa very fine sandy loam	15	25	--	350	150	500	--	4.0	5.0	11.0	5	9	15	23
Muck, shallow	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Niagara silt loam, 0 to 2 percent slopes	10	25	--	300	150	400	--	3.5	4.0	9.5	5	8	13	22
Niagara silt loam, 2 to 6 percent slopes	10	25	--	300	150	400	--	3.5	4.0	9.5	5	8	13	22
Odessa silty clay loam, 0 to 2 percent slopes	10	20	--	--	--	--	--	--	--	--	--	--	12	15
Odessa silty clay loam, 2 to 6 percent slopes	10	20	--	--	--	--	--	--	--	--	--	--	12	15
Ontario loam, 2 to 8 percent slopes	15	30	100	500	250	650	2.0	5.0	5.0	12.0	7	12	18	28
Ontario loam, 8 to 15 percent slopes	15	25	--	--	200	400	1.5	3.0	5.0	10.0	6	11	15	25
Ontario loam, 8 to 15 percent slopes, eroded	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ontario loam, 15 to 30 percent slopes, eroded	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ontario loam, limestone substratum, 0 to 3 percent slopes	15	30	100	500	300	600	2.0	5.0	5.0	12.0	7	12	18	28
Ontario loam, limestone substratum, 3 to 8 percent slopes	15	25	100	450	250	550	2.0	3.5	5.0	11.0	7	11	18	28
Otisville gravelly sandy loam, 0 to 3 percent slopes	6	15	100	450	150	600	1.0	4.5	2.0	10.0	4	10	12	20
Otisville gravelly sandy loam, 3 to 8 percent slopes	6	15	--	350	150	500	1.0	3.5	2.0	10.0	3	8	11	18
Ovid silt loam, 0 to 2 percent slopes	10	20	--	350	--	400	--	3.0	2.0	8.0	--	7	11	18
Ovid silt loam, 2 to 6 percent slopes	10	20	--	350	--	350	--	3.0	2.0	8.0	--	7	11	18
Ovid silt loam, limestone substratum, 0 to 3 percent slopes	10	20	--	350	--	400	--	3.0	2.0	8.0	--	7	11	18
Ovid silt loam, limestone substratum, 3 to 8 percent slopes	10	20	--	350	--	300	--	3.0	2.0	8.0	--	7	11	18
Phelps gravelly loam, 0 to 5 percent slopes	15	25	100	350	300	600	1.5	4.5	4.5	10.0	6	12	15	25
Raynham silt loam, 0 to 2 percent slopes	10	20	--	300	150	400	--	3.5	5.0	8.0	4	7	12	20
Raynham silt loam, 2 to 6 percent slopes	10	20	--	300	150	400	--	3.5	5.0	8.0	4	7	12	20
Rhinebeck silt loam, 0 to 2 percent slopes	10	20	--	--	--	--	--	--	--	--	--	--	--	--
Rhinebeck silt loam, 2 to 6 percent slopes	10	20	--	--	--	--	--	--	--	--	--	--	--	--
Rhinebeck silty clay loam, sandy substratum, 0 to 2 percent slopes	10	20	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED VEGETABLE CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Soil	Cabbage		Muskmelons		Peppers		Cucumbers		Sweetcorn, fresh market		Tomatoes, market		Tomatoes, processed	
	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
Rhinebeck silty clay loam, sandy substratum, 2 to 6 percent slopes	10	20	--	--	--	--	--	--	--	--	--	--	--	--
Rhinebeck silt loam, thick surface variant	10	20	--	--	--	--	--	--	--	--	--	--	--	--
Rock land, nearly level	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rock land, steep	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Schoharie silty clay loam, 2 to 6 percent slopes	10	25	100	300	--	350	1.5	3.5	4.0	9.0	4	9	11	24
Stafford loamy fine sand	10	20	--	350	150	500	--	4.0	5.0	10.0	4	10	12	20
Stafford loamy fine sand, gravelly substratum	10	20	--	350	150	500	--	4.0	5.0	10.0	4	10	12	20
Sun silt loam	--	--	--	300	150	400	--	3.5	--	8.0	--	7	11	18
Wayland silt loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 3.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED FRUIT CROPS UNDER TWO LEVELS OF MANAGEMENT

[Yields in columns A are those to be expected under average management; those in columns B, under improved management. Absence of yield figure indicates that crop is not suited to the soil or is not grown on it]

Soil	Apples		Cherries (sour)		Cherries (sweet)		Grapes		Peaches		Pears		Prunes and plums	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	Bu.	Tons	Tons	Tons	Tons	Tons	Tons	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Alluvial land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Altmar loamy fine sand	250	800	2.0	6.0	---	5.5	2.5	5.5	50	225	75	250	75	250
Altmar gravelly fine sandy loam	300	850	2.0	6.0	---	5.5	3.0	6.0	50	225	100	250	100	250
Appleton gravelly loam, 0 to 3 percent slopes	200	800	---	---	---	---	2.0	5.5	---	---	75	200	75	200
Appleton silt loam, 0 to 3 percent slopes	200	800	---	---	---	---	2.0	5.5	---	---	75	200	75	200
Arkport very fine sandy loam, 0 to 6 percent slopes	350	900	3.0	7.0	3.5	6.5	3.5	7.0	100	300	175	300	170	300
Arkport very fine sandy loam, 6 to 12 percent slopes	300	800	3.0	6.5	3.0	6.5	3.0	6.0	100	300	150	300	150	300
Arkport fine sandy loam, gravelly substratum, 0 to 2 percent slopes	350	900	3.0	7.0	3.5	6.5	3.5	7.0	100	300	175	300	170	300
Arkport fine sandy loam, gravelly substratum, 2 to 6 percent slopes	350	900	3.0	7.0	3.5	6.5	3.5	7.0	100	300	175	300	170	300
Bombay fine sandy loam, 0 to 2 percent slopes	300	800	2.5	6.0	---	5.5	3.0	6.0	50	225	100	250	100	250
Bombay fine sandy loam, 2 to 6 percent slopes	300	800	2.5	6.0	3.0	5.5	3.0	6.0	50	225	100	250	100	250
Brockport silt loam, 0 to 4 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Canandaigua silt loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Canandaigua silty clay loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cayuga and Cazenovia silt loams, 0 to 2 percent slopes	250	650	2.5	5.0	2.5	5.0	2.5	5.0	50	190	125	250	125	250
Cayuga and Cazenovia silt loams, 2 to 6 percent slopes	250	650	2.5	5.0	2.5	5.0	2.5	5.0	50	190	125	250	125	250
Cayuga and Cazenovia silt loams, 6 to 12 percent slopes	200	600	2.0	4.5	2.0	4.5	2.0	4.5	40	150	100	225	100	225
Cazenovia gravelly silt loam, 0 to 3 percent slopes	300	800	2.5	5.5	2.5	5.5	3.0	6.0	50	100	125	250	125	250
Cazenovia gravelly silt loam, 3 to 8 percent slopes	300	800	2.5	5.5	2.5	5.5	3.0	6.0	50	100	125	250	125	250
Cazenovia gravelly silt loam, shale substratum, 0 to 3 percent slopes	200	500	---	---	---	---	2.0	5.0	---	---	---	---	---	---
Cazenovia gravelly silt loam, shale substratum, 3 to 8 percent slopes	200	500	---	---	---	---	2.0	5.0	---	---	---	---	---	---
Cheektowaga fine sandy loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Churchville silt loam, 0 to 2 percent slopes	200	500	---	---	---	---	2.0	5.0	---	---	50	150	50	150
Churchville silt loam, 2 to 6 percent slopes	200	500	---	---	---	---	2.0	5.0	---	---	75	150	75	150
Claverack loamy fine sand, 0 to 2 percent slopes	250	650	2.0	5.0	---	5.5	2.0	5.0	50	150	100	250	100	200
Claverack loamy fine sand, 2 to 6 percent slopes	250	650	2.0	5.0	---	5.5	2.0	5.0	50	150	125	250	125	250
Collamer silt loam, 0 to 2 percent slopes	350	900	3.0	6.5	2.5	5.5	3.5	7.0	50	150	175	300	170	300
Collamer silt loam, 2 to 6 percent slopes	350	900	3.0	6.5	2.5	5.5	3.5	7.0	50	150	175	300	170	300
Colonie loamy fine sand, 0 to 6 percent slopes	---	---	2.5	6.0	2.0	5.0	---	---	25	100	---	---	---	---

TABLE 3.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED FRUIT CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Soil	Apples		Cherries (sour)		Cherries (sweet)		Grapes		Peaches		Pears		Prunes and plums	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	Bu.	Tons	Tons	Tons	Tons	Tons	Tons	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Cosad fine sandy loam	---	---	---	---	---	---	---	---	---	---	50	150	50	150
Cut and fill land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dunkirk silt loam, 2 to 6 percent slopes	350	900	3.0	7.0	3.5	6.5	3.5	7.0	100	200	175	300	170	300
Dunkirk silt loam, 6 to 12 percent slopes, eroded	300	800	2.5	6.0	3.0	6.0	3.0	6.0	100	200	175	300	170	300
Dunkirk and Arkport soils, 12 to 20 percent slopes, eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Elnora loamy fine sand, 0 to 2 percent slopes	200	800	2.0	6.0	2.5	5.5	2.0	6.0	50	150	75	200	75	200
Elnora loamy fine sand, 2 to 6 percent slopes	200	800	2.0	6.0	2.5	5.5	2.0	6.0	50	150	75	200	75	200
Farmington silt loam, 0 to 8 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Fonda mucky silt loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Fredon gravelly loam	200	850	2.0	6.0	---	---	2.0	6.5	---	---	50	250	50	250
Galen very fine sandy loam, 0 to 2 percent slopes	250	850	2.5	6.5	2.5	6.0	2.5	6.5	50	225	125	250	125	250
Galen very fine sandy loam, 2 to 6 percent slopes	250	850	2.5	6.5	2.5	6.0	2.5	6.5	50	225	125	250	125	250
Hamlin silt loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hilton gravelly loam, 0 to 3 percent slopes	300	800	2.0	5.0	2.5	5.0	3.0	6.0	50	225	125	250	125	250
Hilton gravelly loam, 3 to 8 percent slopes	300	800	2.0	5.0	2.5	5.0	3.0	6.0	50	225	125	250	125	250
Hilton silt loam, 0 to 3 percent slopes	300	800	2.0	5.0	2.5	5.0	3.0	6.0	50	225	125	250	125	250
Hilton silt loam, 3 to 8 percent slopes	300	800	2.0	5.0	2.5	5.0	3.0	6.0	50	225	125	250	125	250
Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes	200	500	2.0	5.0	2.5	5.0	2.0	5.0	75	225	100	200	100	200
Hilton and Cayuga silt loams, limestone substratum, 3 to 8 percent slopes	200	500	2.0	5.0	2.5	5.0	2.0	5.0	75	225	100	200	100	200
Howard gravelly loam, 0 to 3 percent slopes	350	900	3.0	7.0	3.5	6.5	3.5	7.0	100	300	175	300	170	300
Howard gravelly loam, 3 to 8 percent slopes	350	900	3.0	7.0	3.5	6.5	3.5	7.0	100	300	175	300	170	300
Howard gravelly loam, 8 to 15 percent slopes	300	800	2.5	6.5	3.0	6.0	3.0	6.0	75	260	150	275	150	275
Hudson silt loam, 2 to 6 percent slopes	350	850	2.0	4.5	2.5	4.5	3.5	6.5	75	260	150	275	150	275
Hudson silty clay loam, 6 to 12 percent slopes, eroded	250	800	1.5	4.0	---	---	2.5	6.0	50	190	100	250	100	250
Hudson soils, 20 to 45 percent slopes, eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lairdsville silt loam, 0 to 6 percent slopes	200	500	---	---	---	---	2.0	4.0	---	---	75	200	75	200
Lakemont silty clay loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lamson very fine sandy loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lamson fine sandy loam, gravelly substratum	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lockport silt loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Madalin silt loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Madalin silt loam, loamy subsoil variant	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Made land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Massena fine sandy loam	200	800	---	---	---	---	2.0	6.0	---	---	75	200	75	200
Minoa very fine sandy loam	200	800	---	---	---	---	2.0	6.0	---	---	75	200	75	200
Muck, shallow	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 3.--ESTIMATED AVERAGE ACRE YIELDS OF SPECIFIED FRUIT CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Soil	Apples		Cherries (sour)		Cherries (sweet)		Grapes		Peaches		Pears		Prunes and plums	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	Bu.	Tons	Tons	Tons	Tons	Tons	Tons	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Niagara silt loam, 0 to 2 percent slopes	300	850	---	---	---	---	3.0	6.5	---	---	100	250	100	250
Niagara silt loam, 2 to 6 percent slopes	300	850	---	---	---	---	3.0	6.5	---	---	100	250	100	250
Odessa silty clay loam, 0 to 2 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Odessa silty clay loam, 2 to 6 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ontario loam, 2 to 8 percent slopes	350	900	3.0	6.5	3.5	6.5	3.5	7.0	75	260	150	275	150	275
Ontario loam, 8 to 15 percent slopes	300	800	2.5	6.0	3.0	6.0	3.0	7.0	50	225	125	250	125	250
Ontario loam, 8 to 15 percent slopes, eroded	250	800	2.0	6.0	2.5	6.0	2.5	6.0	25	225	100	250	100	250
Ontario loam, 15 to 30 percent slopes, eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ontario loam, limestone substratum, 0 to 3 percent slopes	200	500	2.5	6.5	3.0	6.0	2.5	5.0	75	260	100	250	100	250
Ontario loam, limestone substratum, 3 to 8 percent slopes	200	500	2.5	6.5	3.0	6.0	2.5	5.0	75	260	100	250	100	250
Otisville gravelly sandy loam, 0 to 3 percent slopes	300	850	3.0	7.0	3.5	6.5	3.0	6.5	75	260	100	250	100	250
Otisville gravelly sandy loam, 3 to 8 percent slopes	300	850	3.0	7.0	3.5	6.5	3.0	6.5	75	260	100	250	100	250
Ovid silt loam, 0 to 2 percent slopes	200	650	---	---	---	---	2.0	5.0	---	---	75	200	75	200
Ovid silt loam, 2 to 6 percent slopes	200	650	---	---	---	---	2.0	5.0	---	---	75	200	75	200
Ovid silt loam, limestone substratum, 0 to 3 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ovid silt loam, limestone substratum, 3 to 8 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Phelps gravelly loam, 0 to 5 percent slopes	300	800	2.0	6.0	---	6.0	3.0	7.0	---	225	100	275	100	275
Raynham silt loam, 0 to 2 percent slopes	200	800	---	---	---	---	2.0	6.0	---	---	100	200	100	200
Raynham silt loam, 2 to 6 percent slopes	200	800	---	---	---	---	3.0	6.0	---	---	100	200	100	200
Rhinebeck silt loam, 0 to 2 percent slopes	250	650	---	---	---	---	2.5	5.5	---	---	100	200	100	200
Rhinebeck silt loam, 2 to 6 percent slopes	250	650	---	---	---	---	2.5	5.5	---	---	100	200	100	200
Rhinebeck silty clay loam, sandy substratum, 0 to 2 percent slopes	---	---	---	---	---	---	---	---	---	---	100	200	100	200
Rhinebeck silty clay loam, sandy substratum, 2 to 6 percent slopes	---	---	---	---	---	---	---	---	---	---	100	200	100	200
Rhinebeck silt loam, thick surface variant	---	---	---	---	---	---	---	---	---	---	100	200	100	200
Rock land, nearly level	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rock land, steep	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Schoharie silty clay loam, 2 to 6 percent slopes	200	800	---	---	---	---	2.5	6.0	---	---	150	250	150	250
Stafford loamy fine sand	200	700	---	---	---	---	2.0	5.5	---	---	---	---	---	---
Stafford loamy fine sand, gravelly substratum	200	700	---	---	---	---	2.0	5.5	---	---	---	---	---	---
Sun silt loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Wayland silt loam	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Use of Soils as Woodland[6/]

Woodland occupies about 17 percent of the area, or 58,100 acres, in Niagara County. In the 12 towns in the county, the percentage of the woodland acreage ranges from 4 to 22 percent. About 21 percent of the Tuscarora Indian Reservation is worked (10). On this reservation the average wooded area on farms is 6 acres in size. Elsewhere in the county, woodland occurs mainly as small woodlots that average about 4 acres per farm.

Hardwoods make up the forests of the county. The hardwoods are mainly beech, white ash, oak, basswood, tulip-poplar, hickory, red maple, and elm. Elm and red maple grow on the poorly drained soils.

According to the preliminary Forest Survey Statistics (6), the acreages of commercial forest types in the county are: White pine-red pine, 1,100 acres; other softwoods, including those in plantations, 2,800 acres; oak, 2,700 acres; elm-ash-red maple, 25,200 acres; maple-beech-birch, 23,900 acres; aspen-birch, 2,300 acres.

Woodland Suitability Groups

The soils of Niagara County have been placed in 13 woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need about the same kind of management when the vegetation on them is similar, and that have about the same potential productivity.

Table 4 lists the 13 woodland groups and the map symbols for each group and rates the hazards and limitations of the soils in the groups. Miscellaneous land types that generally are not suitable as sites for commercial woodland have not been placed in woodland groups and are not in table 4. These land types are Alluvial land (Ad); Cut and fill land (Cu); Made land (Me); Muck, shallow (Ms); Rock land, nearly level (RoA); and Rock land, steep (RoF). Plantings for special use may be successful in areas of these land types if field examination reveals suitable conditions.

Each woodland group is identified by a three-part symbol, such as 2o1, 3w2, or 3s1. The first part of the symbol, always an Arabic number, indicates relative potential productivity of the soils in the group: 1 denotes very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on field determinations of average site index. Site index is the height, in feet, that the dominant trees of a given species, on a specified kind of soil, reach in a natural, unmanaged stand in a stated number of years. For the merchantable hardwoods and softwood in this county, the site index is the height reached in 50 years.

The five foregoing ratings are based on field determination of average site index of an indicator forest type or species. In Niagara County, indicator species are used, and these are given in table 4. Site indexes are grouped into site quality classes, and the classes are used to arrive at approximate expected yields per acre in cords and board feet. On the basis of research studies, site index can be converted into approximate expected growth and yield per acre in cords and board feet. The average site index is given in table 4.

The second part of the symbol indentifying a woodland group is a small letter. This letter indicates an important soil property that imposes a moderate or severe hazard or limitation in managing the soils of the group for wood crops. A letter d shows that the main limitation is the restricted rooting depth; o shows that the soils have slight or no limitations that restrict their use for trees; r shows that the main limitation is steep slopes; s shows that the soils are sandy and dry, have little or no difference in texture between the surface layer and subsoil or B horizon, have low available water capacity, and generally have a low supply of plant nutrients; and w shows that water in or on the soil, either seasonally or year round, is the chief limitation.

The last part of the symbol, another Arabic number, merely differentiates one woodland suitability group from others that have identical first and second parts in their identifying symbol.

Also given in table 4 are ratings for erosion hazard, equipment limitations, seedling mortality, plant competition, and windthrow hazard, as well as species preferred for planting and to favor in existing stands. The hazards and limitations are described in the following paragraphs.

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

The ratings for equipment limitations are based on the degree that soils and topographic features restrict or prohibit the use of equipment normally employed in tending a crop of trees or in harvesting the trees. The limitation is slight if there is little of 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. Limitations on the use of equipment are affected by the degree of slope, height of the water table, rockiness, and soil texture.

Seedling mortality refers to the expected degree of mortality of naturally occurring or planted seedlings as influenced by soil texture, depth,

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6/ By M. PETERS, woodland conservationist, Soil Conservation Service.

Woodland suitability group	Potential productivity		Erosion hazard
	Indicator species	Average site index	
Group 2o1: Deep, well drained or moderately well drained, nearly level to rolling or moderately sloping soils that are mainly medium textured but range from moderately coarse textured to moderately fine textured; developed in many kinds of material that range from sorted clay, silt, and fine sand and from gravelly outwash to glacial till; medium to high lime content: Arkport: ArB, ArC, AsA, AsB; Cayuga and Cazenovia: CcA, CcB, CcC; Cazenovia: CeA, CeB, CgA, CgB; Collamer: CnA, CnB; Dunkirk: DuB; Galen: GnA, GnB; Hilton: HgA, HgB, HlA, HlB; Hilton and Cayuga: HmA, HmB; Howard: HoA, HoB, HoC; Hudson: HsB; Ontario: OnB, OnC, OnC3, OoA, OoB; Phelps: PsA; Schoharie: ShB.	Sugar maple-------	65-70	Slight----------
Group 2o2: Deep, moderately well drained, level, medium-textured soils that developed in recent alluvial deposits; subject to occasional flooding; medium lime content: Hamlin: Ha.	Sugar maple-------	65-70	Slight---------
Group 2r1: Well drained or moderately well drained soils that are moderately sloping and medium textured to moderately fine textured; developed in water-sorted silt, very fine sand, and clay; medium to high lime content: Dunkirk: DuC3; Hudson: HtC3.	Sugar maple--------	65-70	Moderate-------
Group 2r2: Deep, well-drained, moderately steep, medium-textured soil that developed in glacial till; medium or high lime content: Ontario: OnD3.	Sugar maple--------	65-70	Moderate-------
Group 2r3: Deep, well drained or moderately well drained, eroded, moderately steep or steep and very steep soils that are moderately coarse textured to moderately fine textured; developed in water-sorted silt, fine sand, and clay; medium to high lime content: Dunkirk and Arkport: DvD3; Hudson: HuF3.	Sugar maple--------	65-70	Severe----------
Group 3o1: Deep or moderately deep, well drained or moderately well drained, level to gently sloping, moderately coarse textured to medium-textured soils that developed mainly in glacial till; medium to high lime content: Bombay: BoA, BoB; Lairdsville: LaB.	Sugar maple--------	60-65	Slight----------

AND RATINGS OF MAJOR LIMITATIONS AND HAZARDS

Equipment limitations	Seedling mortality	Plant competition		Windthrow hazard	Species suitability--	
		Hardwoods	Conifers		For planting	To favor in existing stands
Slight---------	Slight--------	Moderate---	Severe---------	Slight------	White pine, Norway spruce, white spruce, larches.	Sugar maple, white ash, basswood, white pine, hemlock, yellow birch.
Slight---------	Slight--------	Moderate---	Severe---------	Slight------	White pine, Norway spruce, black walnut, larches.	Sugar maple, white pine, white ash, basswood.
Slight---------	Slight--------	Moderate----	Severe---------	Slight------	White pine, Norway spruce, larches, black walnut.	Sugar maple, white pine, basswood, white ash.
Moderate-------	Slight--------	Moderate----	Severe---------	Slight------	Norway spruce, white spruce, white pine, larches.	Sugar maple, white pine, red oak, black cherry, white ash, basswood.
Moderate-------	Slight--------	Moderate----	Severe---------	Slight------	White pine, black walnut, yellow poplar.	Sugar maple, basswood, white ash, black walnut, red oak, black cherry.
Slight---------	Slight--------	Slight------	Moderate-------	Slight------	White pine, Norway spruce, white spruce, larches.	Sugar maple, white pine, basswood, white oak, red oak, black cherry.

TABLE 4.--WOODLAND GROUPS, THEIR POTENTIAL PRODUCTIVITY,

Woodland suitability group	Potential productivity		Erosion hazard
	Indicator species	Average site index	
Group 3s1: Deep, moderately well drained or well drained, nearly level to gently sloping, coarse-textured soils that developed in a mantle of sandy material over lacustrine clay; lime content medium to low in the sandy material and high in the underlying clay:	Sugar maple--------	60-65	Slight----------
Claverack: CmA, CmB.			
Group 3w1: Deep or moderately deep, somewhat poorly drained, level to gently sloping, medium-textured to moderately fine textured soils that developed in shaly glacial till or water-sorted clayey sediments; medium to high lime content:	Sugar maple--------	60-65	Slight----------
Brockport: BrA; Churchville: ClA, ClB; Lockport: Lo; Odessa: OdA, OdB; Rhinebeck: RbA, RbB, RhA, RhB, Rk.			
Group 3w2: Deep, somewhat poorly drained, nearly level to moderately sloping, moderately coarse textured to medium-textured soils that developed in glacial till, gravelly outwash, and lake-deposited silt and fine sand; medium to high lime content:	Sugar maple--------	60-65	Slight----------
Appleton: AnA, ApA; Fredon: Fr; Massena: Mf; Minoa: Mn; Niagara: NaA, NaB; Ovid: OvA, OvB, OwA, OwB; Raynham: RaA, RaB.			
Group 4s1: Deep, somewhat poorly drained to excessively drained, nearly level to gently sloping, coarse textured to moderately coarse textured soils that developed in water- or wind-deposited fine sand and gravelly beach deposits; medium to low lime content:	White pine---------	60-70	Slight----------
Altmar: Af, Am; Colonie: CoB; Elnora: ElA, ElB; Otisville: OsA, OsB.			
Group:4w1: Deep, somewhat poorly drained or very poorly drained, level, medium-textured to coarse-textured soils that developed in a variety of glacial deposited material; medium to high lime content:	Red maple----------	60-70	Slight----------
Canandaigua: Ca, Cb; Cosad: Cs; Lamson: Ld, Lg; Stafford: St, Su; Sun: Sw; Wayland: Wa.			
Group 5d1: Shallow, well-drained, level to gently sloping, medium-textured soils that have bedrock 10 to 20 inches below the surface; medium lime content:	White pine---------	50-60	Slight----------
Farmington: FaA.			
Group 5w1: Deep, very poorly drained and poorly drained, nearly level soils that have a moderately fine textured to moderately coarse textured surface layer and developed in lake deposits of silt, sand, and clay; medium to high lime content:	Red maple----------	50-60	Slight----------
Cheektowaga: Ch; Fonda: Fo; Lakemont: Lc; Madalin: Ma, Md.			

AND RATINGS OF MAJOR LIMITATIONS AND HAZARDS--Continued

Equipment limitations	Seedling mortality	Plant competition		Windthrow hazard	Species suitability--	
		Hardwoods	Conifers		For planting	To favor in existing stands
Slight--------	Slight-------	Slight------	Moderate------	Slight-----	White pine, Norway spruce, white spruce.	Sugar maple, white pine, red oak, black cherry.
Moderate------	Slight-------	Moderate----	Severe--------	Moderate---	White pine, white spruce, Norway spruce.	Sugar maple, white pine, red oak, white ash, basswood, hemlock.
Moderate------	Moderate-----	Moderate----	Severe--------	Moderate---	White pine, white spruce, Norway spruce, white-cedar.	Sugar maple, white pine, basswood, white-cedar.
Slight--------	Severe-------	Slight------	Moderate------	Slight-----	White pine, red pine, larches.	White pine, sugar maple, red oak, red pine.
Severe--------	Severe-------	Severe------	Severe--------	Severe-----	White pine, white spruce.	Red maple, white pine, white-cedar.
Slight--------	Severe-------	Slight------	Slight--------	Moderate---	White pine-----	White pine, red oak, hemlock.
Severe--------	Severe-------	Severe------	Severe--------	Severe-----	Generally unplantable.	Red maple, white-cedar.

drainage, flooding, height of the water table, and degree of erosion, but not by plant competition. Normal rainfall, good planting stock, and proper planting are assumed. Mortality is slight if the expected loss is less than 25 percent; moderate, if 25 to 50 percent; or severe, if 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. 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.

Windthrow hazard depends on the development of roots and the capacity of soils to hold trees firmly. The hazard is slight if trees are not expected to be blown down in commonly occurring winds. 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 a valued natural resource in Niagara County. Ring-neck pheasants and rabbits are abundant. In addition, the county has smaller numbers of white-tailed deer and gray squirrels. In the urban areas songbirds are becoming increasingly important to backyard bird watchers. Large numbers of waterfowl and shore birds can be seen in the area along the shores of Lake Ontario and the banks of the Niagara River.

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 are generally related to the kinds of soil.

The suitability of the soils in the county are rated in table 5 for eight elements of wildlife habitat and three classes of wildlife (1). These suitability ratings can be used as an aid in--

1. Planning the broad use of parks, refuges, nature-study areas, and other recreational developments for wildlife.
2. Selecting the better soils for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the relative intensity of management needed for individual habitat elements.
4. Eliminating the sites that would be difficult or not feasible to manage for specific kinds of wildlife.
5. Determining areas that are suitable for acquisition for use by wildlife.

Wildlife Habitat Elements

Table 5 lists the soils in the county and rates their suitability for eight elements of wildlife habitat and for three classes, or groups, of wildlife (1). The ratings are 1, 2, 3, and 4, each number indicating relative suitability. A rating of 1 denotes well suited; 2 denotes suited; 3, poorly suited; and 4, not suited. Soils that are well suited have few limitations, those that are suited have moderate limitations, and those that are poorly suited have severe limitations. Not considered in the rating are present land use, the location of the soil in relation to other soils, and the mobility of wildlife.

Each soil is rated in table 5 according to its suitability for various kinds of plants and other elements that make up the wildlife habitat. The elements of wildlife habitat are discussed in the following pages.

Grain and seed crops.--These crops include such seed-producing annuals 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 have a high available moisture 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 or are suited to fewer crops.

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 available moisture 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 include 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 are generally established naturally but may be planted. Among the native kinds are

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7/ By ROBERT E. MYERS, wildlife biologist, Soil Conservation Service.

TABLE 5.--SUITABILITY OF SOILS FOR WILDLIFE HABITAT ELEMENTS AND CLASSES OF WILDLIFE

[Soils rated 1 are well suited; 2, suited; 3, poorly suited; and 4 unsuited. Alluvial land (Ad), Cut and fill land (Cu), and Made land (Me) were not rated, because they are so variable]

Soil and map symbol	Wildlife habitat elements								Classes of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood plants	Coniferous plants	Wetland food and cover plants	Shallow diked impoundments	Shallow excavated impoundments	Openland	Woodland	Wetland
Altmar: Af, Am------	3	2	2	2	3	4	4	3	2	2	3
Appleton: AnA, ApA--	2	2	1	1	2	3	2	2	2	1	2
Arkport: ArB, ArC, AsA, AsB----------	2	1	1	2	2	4	4	4	1	2	4
Bombay:											
BoA----------	2	1	1	1	1	4	3	2	1	1	3
BoB----------	2	1	1	1	1	4	4	4	1	1	4
Brockport: BrA------	2	2	1	1	2	3	3	3	2	1	2
Canandaigua:											
Ca----------	4	3	3	2	2	2	2	2	3	2	2
Cb----------	4	3	3	2	2	3	4	4	3	2	4
Cayuga and Cazenovia:											
CcA----------	2	1	1	1	1	4	2	3	1	1	3
CcB, CcC--------	2	1	1	1	1	4	4	4	1	1	4
Cazenovia:											
CeA, CgA--------	2	1	1	1	3	4	3	3	1	1	3
CeB, CgB--------	2	1	1	1	3	4	4	4	1	1	4
Cheektowaga: Ch-----	4	3	3	2	2	1	3	3	3	2	3
Churchville:											
ClA----------	2	2	1	1	2	3	2	2	2	1	2
ClB----------	2	2	1	1	2	3	4	4	2	1	4
Claverack:											
CmA----------	2	1	1	2	1	4	2	3	1	1	2
CmB----------	2	1	1	2	1	4	4	4	1	1	4
Collamer:											
CnA----------	2	1	1	1	1	4	3	3	1	1	3
CnB----------	2	1	1	1	1	4	4	4	1	1	4
Colonie: CoB--------	3	3	3	3	3	4	4	4	3	3	4
Cosad: Cs----------	3	2	2	2	3	3	3	3	2	2	3
Dunkirk:											
DuB----------	2	2	1	1	1	4	4	4	1	1	4
DuC3----------	3	3	1	1	1	4	4	4	3	1	4
Dunkirk and Arkport:											
DvD3----------	4	2	1	1	1	4	4	4	2	2	4
Elnora: ElA, ElB----	3	2	2	2	3	4	4	4	2	2	4
Farmington: FaA-----	2	2	2	2	2	4	4	4	2	2	4
Fonda: Fo----------	4	3	3	2	3	1	2	1	3	3	1
Fredon: Fr----------	2	2	1	1	2	3	4	3	2	1	3
Galen:											
GnA----------	2	1	1	1	1	4	4	3	1	1	3
GnB----------	2	1	1	2	1	4	4	4	1	1	4
Hamlin: Ha----------	2	1	1	1	1	4	4	4	1	1	4
Hilton:											
HgA, HlA--------	2	1	1	1	1	4	3	3	1	1	3
HgB, HlB--------	2	1	1	1	1	4	4	4	1	1	4
Hilton and Cayuga:											
HmA----------	2	1	1	1	1	4	3	3	1	1	3
HmB----------	2	1	1	1	1	4	4	4	1	1	4
Howard:											
HoA, HoB, HoC---	2	1	1	2	2	4	2	4	1	2	4

TABLE 5.--SUITABILITY OF SOILS FOR WILDLIFE HABITAT ELEMENTS AND CLASSES OF WILDLIFE--Continued

Soil and map symbol	Wildlife habitat elements								Classes of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood plants	Coniferous plants	Wetland food and cover plants	Shallow diked impoundments	Shallow excavated impoundments	Openland	Woodland	Wetland
Hudson:											
HsB	2	1	1	1	1	4	4	4	1	1	2
HtC3	3	2	1	1	1	4	4	4	2	1	4
HuF3	4	4	1	1	1	4	4	4	4	2	4
Lairdsville: LaB	2	1	1	1	1	4	4	4	1	1	4
Lakemont: Lc	4	3	3	2	2	2	2	1	3	2	2
Lamson: Ld, Lg	4	3	3	2	2	1	4	3	3	2	3
Lockport: Lo	2	2	1	1	2	3	3	2	2	1	2
Madalin: Ma	4	3	3	2	2	2	2	1	3	2	2
Madalin, loamy subsoil variant: Md	4	3	3	2	2	2	2	1	3	2	2
Massena: Mf	2	2	1	1	2	3	2	2	2	1	2
Minoa: Mn	2	2	1	1	2	3	3	3	2	1	3
Muck: Ms	4	3	3	1	2	1	4	2	3	3	2
Niagara:											
NaA	2	2	1	1	2	3	2	2	2	1	2
NaB	2	2	1	1	2	3	4	4	2	1	4
Odessa:											
OdA	2	2	1	1	2	3	2	2	2	1	2
OdB	2	2	1	1	2	4	4	4	2	1	4
Ontario:											
OnB, OnC	2	1	1	1	1	4	4	4	1	1	4
OnC3	3	2	1	1	1	4	4	4	2	1	4
OnD3	4	3	1	1	1	4	4	4	2	2	4
OoA	2	1	1	1	1	4	4	4	1	1	4
OoB	2	1	1	1	1	4	4	4	1	1	4
Otisville:											
OsA	4	3	3	3	3	4	4	4	3	3	4
OsB	4	3	3	3	3	4	4	4	3	3	4
Ovid:											
OvA	2	2	1	1	2	3	2	2	2	1	2
OvB	2	2	1	1	2	3	4	4	2	1	4
OwA	2	2	1	1	2	3	3	3	2	1	3
OwB	2	2	1	1	2	3	4	4	2	1	4
Phelps: PsA	2	1	1	2	2	4	4	3	1	2	3
Raynham:											
RaA	2	2	1	1	2	3	2	2	2	1	2
RaB	2	2	1	1	2	4	4	4	2	2	4
Rhinebeck:											
RbA	2	2	1	1	2	3	2	2	2	1	2
RbB, RhA, RhB	2	2	1	1	2	3	4	4	2	1	4
Rk	2	2	1	1	2	3	2	2	2	1	2
Rock land: RoA, RoF	4	4	3	3	3	4	4	4	4	3	4
Schoharie: ShB	2	1	1	1	1	4	4	4	1	1	4
Stafford: St, Su	3	2	2	2	2	3	4	2	2	2	2
Sun: Sw	4	3	3	2	3	1	2	1	3	2	1
Wayland: Wa	4	3	3	2	2	2	3	1	3	2	2

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 the shrubs that can be grown on soils rated well suited are autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crab apple, multiflora rose, highbush cranberry, and silky dogwood. In addition, highbush cranberry, silky dogwood, and other shrubs that have 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 plants.--This element consists of cone-bearing, evergreen trees and shrubs that are used by wildlife primarily as cover, though some provide browse and seeds. Among these are Norway spruce, white pine, white-cedar, 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 form a dense canopy that shuts out the light.

Soils rated well suited are those on which coniferous seedlings survive well and grow at a moderate to rapid rate. These soils are well drained to somewhat poorly drained and have high available moisture capacity. Managing pure stands of conifers on these soils is somewhat difficult because the soils are also desirable for hardwoods, which readily invade the site. Planted conifers should be widely spaced to delay closure of the canopy.

Soils rated poorly suited are those on which conifers grow slowly and there is slow closure of the canopy. Establishing a stand may be difficult because of seedling mortality. These soils either have an effective rooting depth of less than 10 inches or are very poorly drained or excessively drained.

Wetland food and cover plants.--These are wild, herbaceous, annual and perennial plants that grow on moist to wet sites. They include 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.--This habitat element is rated on the basis of the soil being suitable for the construction of a low dike to impound a shallow body of water. In this habitat are marshes that receive surface runoff and flooded duck fields or diked flat areas on which domestic grains are grown and then flooded in fall with up to 18 inches of water from adjacent ponds or streams.

Soils that are rated 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 very slowly or slowly permeable and deep enough so 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 in soils that have a high water table so as to create open water areas primarily for waterfowl.

Well-suited soils are nearly level, more than 6 feet deep to bedrock, and poorly drained or very poorly drained. A seasonal high water table is within 6 inches of the surface. The subsoil must be very slowly permeable or slowly permeable and deep enough so 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.

A detailed field investigation is needed to determine the feasibility of water developments. Soil limitations for reservoir areas and embankments for ponds are given in table 8 in the subsection "Engineering Uses of the Soils." Fishponds are not included in this habitat element.

Classes of Wildlife

Each rating under "Classes of wildlife" in table 5 is based on the rating listed for selected essential habitat elements in the first part of the table in proportion to their significance for that class of wildlife. The rating for openland wildlife is based on the rating for grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood plants, and coniferous plants. The rating for woodland wildlife is based on the rating listed for all the above elements except grain and seed crops. That for wetland wildlife is based on the rating 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, herbs, and shrubs.

Woodland wildlife.--Among the birds and mammals that prefer woodland are ruffed grouse, woodcock, thrushes, vireos, scarlet tanagers, gray and red squirrels, gray foxes, white-tailed deer, and racoons.

Wetland wildlife.--Ducks, geese, rails, herons, shore birds, red-wing blackbirds, mink, muskrat, and beaver are familiar examples of birds and mammals that normally make their home around ponds, marshes, and swamps or in other wet areas.

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Engineering Uses of the Soils[8/]

During the course of a soil survey, considerable information is recorded about the properties of soils in the survey area and their relation to the landscape. When properly interpreted, much of this information is useful to agricultural and civil engineers, and to others whose work requires the use of soil mechanics and of soil engineering data. This section has been prepared for the purpose of interpreting the characteristics of the soils in the county for soil engineering uses. Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, and drainage systems. Among the properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and pH. Also important are depth to water table, depth to bedrock, and topography.

Information in this survey can be used to--

1. Make soil and land use studies that will aid in selecting and developing industrial, commercial, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground water conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations of the selected locations.
4. Locate probable sources of gravel and other construction material.
5. Correlate performance of engineering structures with soil mapping units, and thus develop information that will be useful in preliminary construction, design, and maintenance of similar structures on like soils.
6. Determine the suitability of soil mapping units for cross-country movements of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that can be used readily by others.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

This survey will not eliminate the need for onsite sampling and testing of sites for design and construction of specific engineering works and uses. Detailed site investigations are considered a necessity. Engineers and others should not apply specific values to the estimates given for bearing capacity of soils. This survey does give information from which sites most likely to be favorable for the planned structure can be selected, and from which sites having severe hazards may be eliminated from further consideration.

Much of the information in this subsection is in tables 6, 7, and 8. Table 6 lists engineering test data that were obtained when selected soils in the county were tested. Table 7 lists the soils and gives an estimate of their engineering properties. In table 8 are interpretations of the engineering properties of the soils as a source of construction material, and soil features are named that affect highway location, embankments, and structures for controlling water and erosion.

Additional information about the soils in the county can be obtained by referring to other parts of this survey, particularly the sections "Descriptions of the Soils" and "Formation, Morphology, and Classification of Soils."

Some of the terms used by soil scientists may be unfamiliar to engineers, and some common words have special meanings in soil science. Many of these terms are defined in the Glossary at the back of this publication.

Engineering Classification Systems

The soils of Niagara County have been classified in table 7 according to three systems. These systems are those of the United States Department of Agriculture (USDA), the American Association of State Highway Officials (AASHO), and the Unified Soil Classification System.

The USDA classification system is based on the texture of the mineral soil particles. For some soils the large sizes, or coarse fragments, are included, but generally the groups of particles that are less than 2 millimeters in diameter are the only ones called soil separates. The percentages used for the standard texture designations are based on the part of the soil remaining after the coarse fragments have been excluded. Where enough coarse fragments occur, the terms for them are added as adjectives to the soil class name and become a part of it.

The AASHO classification system (2) groups soils of about the same general load-carrying capacity, which is based on field performance of highways. Members of each group have similar broad common characteristics. The range in load-carrying capacity of each group, however, is wide, and there is an overlapping of load-carrying capacity in the groups. Seven groups are in this system. They range from the best soils for road subgrade, which are designated A-1, to the poorest soils for road subgrades, which are designated as A-7.

The Unified classification system (14) identifies soils according to their textural and plasticity qualities, and to their grouping with respect to

8/ By JOHN B. FLECKENSTEIN, senior agronomist, New York State Department of Transportation, Bureau of Soil Mechanics; and WALTER S. ATKINSON, State Conservation engineer, Soil Conservation Service.

their performances as engineering foundations and construction materials. The following properties are used as a basis for identification: percentage of gravel, sand, silt, and clay; grain-size distribution; and plasticity and compressibility characteristics.

In the Unified system the soils are divided into three broad groups. Coarse-grained soils are those in which more than 50 percent of the material is retained on the No. 200 sieve (0.074 millimeter). Fine-grained soils are those in which more than half of the material passes the No. 200 sieve. The third group contains the highly organic soils.

In the Unified system each of the 15 classes is designated by a pair of letters. The letter G stands for gravel, S for sand, C for clay, M for silt, and O for organic soils; W stands for well graded; P for poorly graded, L for low liquid limit, and H for high liquid limit. In this system, SM and GM are sand and gravel that include fines of silt; ML and CL are silt and clay that have a liquid limit below 50; and MH and CH are silt and clay that have a liquid limit above 50.

Further information and a more detailed description of the Unified classification are in Military Standard 619A (14) and ASTM Designations D2487, D2488, and D653.

Engineering Test Data

Samples of 11 soils in Niagara County were tested according to standard procedures to help evaluate the soils for engineering purposes. The results of these tests are shown in table 6, and these test results are representative. Nevertheless, the soils for which the samples were taken formed in highly variable glacial till or in water-deposited material, and consequently the range in texture, or grain size, of some of this material is fairly wide. The classification given in table 6 therefore does not apply in every place where the soil was mapped.

The following paragraphs discuss the columns in table 6 that may require explanation.

Moisture-density: If a soil material is compacted at increasing moisture contents, assuming that the compaction effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed "maximum dry density." Moisture-density data are important in earthwork, for, as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Lineal shrinkage: This is the decrease in one dimension of a soil mass, expressed as a percentage of that dimension when the water content is reduced from a given value to the shrinkage limit.

In-place dry density: In-place dry density is the unit dry weight of a soil in its natural or undisturbed state. Determination was made by the sand cone method according to the American Society for Testing Materials (ASTM) Designation: D1556-58T.

Mechanical analyses: These analyses were made by combined sieve and hydrometer methods. Percentages of silt and clay obtained by the hydrometer method are not used in naming textural class for soil classification in the USDA system.

Liquid limit and plastic limit: The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition. Some silty and sandy soils are nonplastic; that is, they do not become plastic at any moisture content.

Estimated Properties of the Soils

Table 7 lists the soil series and map symbols of the soils in Niagara County and shows estimated properties of the soils and the engineering and USDA classifications. Additional information about the soils is given in the section "Descriptions of the Soils."

The estimated data shown in table 7 are based on the soil test data in table 6 and on experience with test data from the same kinds of soil in other counties. Because samples were taken from only a few soils, it was necessary to estimate the AASHO and Unified classifications for the rest of the soils mapped and to estimate the permeability and available moisture capacity, as shown in table 7.

The estimates given in table 7 apply only to a depth of about 5 to 6 feet in the mapping units of the named soil series. Each soil area (mapping unit) contains inclusions of other soils that may differ considerably from the named soil. Therefore, onsite investigation is needed for specific determinations of properties.

The following paragraphs briefly describe the columns shown in table 7.

Depth to bedrock: The estimated depth to bedrock is based on observations made during the course of the survey. From place to place, however, the depth to bedrock may vary considerably.

Depth to seasonal high water table: The shallowest depth is given at which the soil is saturated with water during frost-free periods. It is either a perched or other ground water table. Soil conditions immediately after heavy precipitation are not considered.

Depth from surface: The depths given in this column for each soil correspond to significant changes in texture in the profile described as

[Tests prepared by State of New York, Department of Transportation, Bureau of Soil Mechanics, in accordance with

Soil name and location	Parent material	SCS report number	Depth	Moisture-density 1/		Percolation rate 2/	Lineal shrinkage	Reaction	Organic matter 3/	In-place dry density	In-place moisture content
				Maximum dry density	Optimum moisture						
				Lb. per cu. ft.	Pct.	Min. per in.	Pct.	pH	Pct.	Lb. per cu. ft.	Pct.
Arkport very fine sandy loam:		S65 NY32									
Town of Newfane, 400 feet west of Phillips Road and 20 feet north of Lake Road.(State Route 18). (Disturbed surface layer)	Deposit of deltaic material dominated by fine sand and containing textural lamella, or bands.	10-1,2	0-14	110	14	---	0.8	5.4	2.0	---	10
		10-3	14-25	115	11	---	0	5.3	.8	---	5
		10-4	25-32	117	12	---	1.0	5.6	.8	---	8
		10-5	32-38	123	12	---	1.0	5.7	.5	---	10
		10-6	38-60	108	17	---	.6	6.8	0	---	20
Cayuga silt loam:		S66 NY32									
Town of Niagara, 1,000 feet west of Packard and Lockport Road junction, and 100 feet north of Lockport Road. (Modal)	Multiple deposits of reddish-colored silt and clay over calcareous loam glacial till.	3-1	0-8	102	20	---	8.0	7.3	4.4	84	29
		3-2	8-25	105	19	> 80.0	10.0	7.5	1.0	96	23
		3-3	25-50	121	12	---	5.2	8.3	---	102	18
Cazenovia silt loam:		S66 NY32									
Town of Lockport, 1 mile east of Campbell Blvd. (State Route 270) and 100 feet south of Hinman Road. (Moderately well drained)	Moderately fine textured glacial till.	9-1	0-11	95	23	---	7.2	5.9	5.0	---	31
		9-2	11-13	--	--	---	---	---	---	---	--
		9-3	13-33	104	20	>120.0	9.6	6.2	.6	93	27
		9-4	33-59	112	16	---	8.6	8.5	---	97	24
		9-5	59-65	129	10	>120.0	2.2	8.2	---	---	16
Claverack loamy fine sand:		S65 NY32									
Town of Somerset, seven-tenths mile east of Johnson Creek Road and 800 feet south of Haight Road. (Modal)	Multiple lacustrine deposits of fine sand over calcareous clay and silt.	11-1	0-8	104	16	---	1.0	6.6	3.9	---	13
		11-2	8-28	104	15	---	0	6.3	1.0	---	14
		11-3	28-32	106	14	---	0	6.5	---	---	8
		11-4	32-46	97	24	---	13.0	7.0	---	---	12
		11-5	46-56	120	13	---	3.8	7.7	---	---	23
		11-6	56-65	121	12	---	1.4	7.7	---	---	13
		S66 NY32									
Town of Somerset, 200 yards northeast of Haight and Carmen Road junction, 100 feet east of Carmen Road. (Till substratum)	Multiple lacustrine deposits of fine sand over calcareous clay and silt; calcareous glacial till below depth of 43 inches.	11-1	0-10	106	15	---	.4	6.8	2.7	84	23
		11-2	10-18	107	15	2.7	0	6.2	1.4	87	27
		11-3	18-27	109	13	---	0	6.3	.5	99	23
		11-4	27-43	101	22	---	10.2	6.8	---	90	31
		11-5	43-50	120	12	>120.0	1.6	7.8	---	---	19

See footnotes at end of table.

TEST DATA

standard procedures of the American Association of State Highway Officials (AASHO) (2). The sign > means more than]

Mechanical analysis 4/											Liquid limit	Plasticity index	Classification	
Percentage passing sieve--							Percentage smaller than--						AASHO 5/	Unified 6/
3-in.	1 1/2 in.	3/4-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.				
---	---	---	100	99	94	50	38	9	2	0	--	7/ NP	A-4(3)	SM
---	---	---	100	98	92	48	36	8	2	1	--	NP	A-4(3)	SM
---	---	---	99	99	91	42	32	12	8	3	--	NP	A-4(2)	SM
---	---	100	96	93	83	33	27	12	8	4	--	NP	A-2-4(0)	SM
---	---	---	100	100	99	85	64	14	1	1	--	NP	A-4(8)	ML
100	98	98	97	96	93	85	76	53	27	17	37	10	A-6(8)	ML-CL
100	99	99	97	97	95	90	83	66	44	36	41	19	A-7-6(12)	CL
8/100	96	90	83	78	72	59	51	32	19	12	20	8	A-4(5)	CL
---	---	100	99	98	93	82	74	54	27	15	38	12	A-6(9)	ML-CL
---	---	---	---	---	--	--	--	--	--	--	--	--	----------	------
---	---	100	99	99	97	92	85	67	45	34	41	20	A-7-6(12)	CL
---	100	100	98	96	93	89	81	60	26	19	27	12	A-6(9)	CL
100	93	88	78	73	66	57	48	28	10	7	19	6	A-4(4)	ML-CL
---	---	---	100	100	98	26	20	8	2	0	--	NP	A-2-4(0)	SM
---	---	---	100	100	98	22	17	6	4	2	--	NP	A-2-4(0)	SM
---	---	---	100	100	99	31	24	6	4	3	--	NP	A-2-4(0)	SM
---	---	---	100	99	99	98	93	82	61	45	50	28	A-7-6(17)	CL
---	---	---	100	99	97	85	74	46	21	13	21	7	A-4(8)	ML-CL
---	100	99	95	91	84	67	54	24	11	7	18	2	A-4(6)	ML
---	---	100	99	98	95	27	21	8	4	2	--	NP	A-2-4(0)	SM
---	---	---	100	99	96	15	12	5	2	2	--	NP	A-2-4(0)	SM
---	---	100	99	97	93	15	12	2	2	1	--	NP	A-2-4(0)	SM
---	---	---	---	100	100	96	92	84	63	45	47	22	A-7-6(14)	ML-CL
---	---	---	100	99	92	72	61	35	9	5	--	NP	A-4(7)	ML

Soil name and location	Parent material	SCS report number	Depth	Moisture-density 1/		Percolation rate 2/	Lineal shrinkage	Reaction	Organic matter 3/	In-place dry density	In-place moisture content
				Maximum dry density	Optimum moisture						
				Lb. per cu. ft.	Pct.	Min. per in.	Pct.	pH	Pct.	Lb. per cu. ft.	Pct.
		S66 NY32									
Collamer silt loam:											
Town of Royalton, 400 feet north of Slayton Settlement Road, and 500 yards northwest of Hartland Road junction (Moderately well drained)	Lacustrine deposit of silt and clay; calcareous glacial till below depth of 58 inches.	2-1	0-8	108	16	---	4.6	5.4	2.3	92	24
		2-2	8-15	110	16	---	5.6	5.4	.6	98	20
		2-3	15-29	111	16	>120.0	7.6	5.4	.4	98	23
		2-4	29-58	114	14	---	6.0	6.1	---	100	19
		2-5	58-63	120	12	>120.0	.4	8.5	---	---	16
		S66 NY32									
Hilton silt loam:											
Town of Royalton, 100 feet south of Johnson Road on the east side of Griswold Road. (More silty than modal)	Calcareous, medium-textured glacial till deposit.	17-1	0-8	103	17	---	4.6	6.3	5.0	---	30
		17-2	8-18	115	14	---	4.8	6.8	.5	89	26
		17-3	18-25	118	13	>120.0	6.0	8.3	.6	106	18
		17-4	25-57	125	11	---	5.0	8.3	---	120	14
		S66 NY32									
Howard gravelly loam:											
Town of Newfane, one-half mile south of Lake Road (State Route 18) and 100 feet east of Phillips Road. (Silty substratum)	Moderately coarse textured sand and gravel deposit containing a small amount of clay and silt; silt and clay below depth of 43 inches.	8-1	0-10	116	12	---	4.4	5.9	2.0	---	20
		8-2	10-22	124	11	21.0	2.8	6.6	.8	102	16
		8-3	22-36	120	12	---	6.2	6.9	.9	106	17
		8-4	36-43	119	13	---	10.0	7.1	.6	---	18
		8-5	43-50	103	20	>120.0	10.2	7.3	---	---	27
		S65 NY32									
Odessa silty clay loam:											
Town of Cambria, 800 feet east of Thrall and Upper Mountain Road junction and 1,300 feet south of Upper Mountain Road. (Modal)	Reddish-colored lacustrine deposit that is dominated by clay and silt.	3-1	0-8	100	20	---	7.6	6.8	4.1	---	16
		3-2	8-16	103	21	---	9.6	6.6	1.1	---	14
		3-3	16-19	101	22	---	12.4	7.7	.7	---	19
		3-4	19-33	103	21	---	12.4	7.8	---	---	20
		3-5	33-56	107	18	---	9.2	7.9	---	---	21
		S66 NY32									
Otisville gravelly sandy loam:											
Town of Newfane, one-half mile east of Ridgewood and 30 feet south of Ridge Road (State Route 104). (Modal)	Coarse-textured sand and gravel deposit; former Lake Iroquois beach ridge.	1-1	0-9	117	12	---	2.2	6.4	2.9	---	16
		1-2	9-16	125	11	---	1.4	6.3	.5	99	13
		1-3	16-28	120	12	1.1	.4	6.6	.2	97	12
		1-4	28-50	121	12	.5	.4	6.9	---	99	10

See footnotes at end of table.

TEST DATA--Continued

Mechanical analysis 4/											Liquid limit	Plasticity index	Classification	
Percentage passing sieve--							Percentage smaller than--						AASHO 5/	Unified 6/
3-in.	1 1/2 in.	3/4-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.				
---	---	---	100	99	97	90	77	47	21	15	26	8	A-4(8)	CL
---	---	---	---	100	99	94	79	43	24	18	25	10	A-4(8)	CL
---	---	---	100	100	98	92	78	41	22	19	26	11	A-6(9)	CL
---	---	---	100	100	98	91	76	40	21	18	25	8	A-4(8)	CL
---	100	99	97	92	82	63	49	18	7	4	--	NP	A-4(6)	ML
100	99	95	90	87	82	70	60	36	18	8	36	10	A-4(7)	ML-CL
---	98	95	84	79	72	57	49	28	12	8	23	7	A-4(4)	ML-CL
---	99	97	92	89	82	63	53	31	18	16	22	8	A-4(6)	CL
8/100	94	90	84	81	76	64	56	35	17	12	21	9	A-4(6)	CL
---	---	99	80	72	60	44	37	20	8	5	29	7	A-4(2)	SM-SC
---	100	97	80	71	60	43	36	20	10	7	19	3	A-4(2)	SM
---	100	94	70	60	36	24	21	12	8	6	24	9	A-2-4(0)	SC
---	100	83	49	39	24	18	15	12	9	8	38	15	A-2-6(0)	GM-GC
---	---	100	100	100	99	94	88	70	43	34	38	13	A-6(9)	ML-CL
---	---	---	100	99	98	92	83	58	26	16	38	13	A-6(9)	ML-CL
---	---	---	100	98	96	90	82	60	37	27	42	22	A-7-6(13)	CL
---	---	---	---	100	100	97	90	73	55	45	51	29	A-7-6(18)	CH
---	---	---	---	100	100	99	94	82	70	54	50	28	A-7-6(17)	CL
---	---	---	100	99	98	95	88	68	50	37	34	18	A-6(11)	CL
---	99	94	84	77	52	28	23	12	6	4	23	2	A-2-4(0)	SM
---	100	97	87	72	30	16	12	5	3	2	--	NP	A-1-b(0)	SM
---	99	94	83	65	28	11	9	3	2	1	--	NP	A-1-b(0)	SW-SM
---	100	96	79	60	16	6	4	2	1	1	--	NP	A-1-b(0)	SW-SM

Soil name and location	Parent material	SCS report number	Depth	Moisture-density 1/		Percolation rate 2/	Lineal shrinkage	Reaction	Organic matter 3/	In-place dry density	In-place moisture content
				Maximum dry density	Optimum moisture						
				Lb. per cu. ft.	Pct.	Min. per in.	Pct.	pH	Pct.	Lb. per cu. ft.	Pct.
		S66 NY32									
Rhinebeck silt loam:											
Town of Porter, 1 mile west of Ransomville Road and 800 yards south of Lake Road.(State Route 18). (Modal)	Brownish-colored lacustrine deposit that is dominated by clay and silt.	15-1	0-8	104	17	---	4.4	7.2	4.0	---	28
		15-2	8-10	---	--	---	---	---	---	---	--
		15-3	10-23	106	18	---	9.8	7.6	1.0	101	22
		15-4	23-60	109	17	---	8.6	8.6	---	106	20
Town of Porter, 1 mile north of Braley Road and 100 feet east of Ransomville Road. (Finer textured than modal)	Brownish-colored lacustrine deposit that is dominated by clay and silt.	4-1	0-8	107	16	---	6.6	7.4	3.8	---	24
		4-2	8-11	104	19	---	8.6	6.6	1.1	---	22
		4-3	11-21	103	20	>120.0	10.2	7.0	.7	99	23
		4-4	21-57	110	18	---	8.0	8.4	---	107	21
		S65 NY32									
Town of Porter, three-tenths mile north of Braley Road and 600 feet west of Ransomville Road. (Till substratum)	Brownish-colored lacustrine deposit that is dominated by clay and silt; calcareous glacial till below a depth of 58 inches.	5-1	0-8	105	19	---	8.0	7.5	2.8	---	15
		5-2	8-14	103	21	---	8.0	7.4	1.9	---	16
		5-3	14-22	101	21	---	10.0	7.3	.9	---	16
		5-4	22-36	102	20	---	10.0	7.5	---	---	15
		5-5	36-58	105	19	---	10.0	7.7	---	---	17
		5-6	58-65	127	10	---	1.0	7.9	---	---	10

See footnotes at end of table.

TEST DATA--Continued

Mechanical analysis 4/											Liquid limit	Plasticity index	Classification	
Percentage passing sieve--							Percentage smaller than--						AASHO 5/	Unified 6/
3-in.	1 1/2 in.	3/4-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.				
---	---	100	99	99	97	86	76	48	25	14	30	9	A-4(8)	ML-CL
---	---	---	---	--	--	--	--	--	--	--	--	--	----------	---------
---	---	---	100	99	96	89	82	62	41	32	35	15	A-6(10)	CL
---	---	---	100	100	100	99	90	69	44	30	34	13	A-6(9)	CL
100	95	93	89	85	80	71	64	46	24	15	35	11	A-6(7)	ML-CL
---	---	---	100	99	95	88	82	66	43	28	35	17	A-6(11)	CL
---	100	100	99	98	96	92	85	69	46	36	43	22	A-7-6(13)	CL
96	96	96	96	95	93	90	84	76	51	35	36	17	A-6(11)	CL
---	100	99	97	95	91	80	72	50	29	19	33	14	A-6(10)	CL
---	100	100	99	98	95	88	80	62	42	30	41	21	A-7-6(13)	CL
---	99	99	99	99	99	95	90	76	55	39	46	24	A-7-6(15)	CL
---	---	---	100	99	98	95	95	81	56	44	41	21	A-7-6(13)	CL
---	---	---	100	99	98	95	91	75	55	39	34	16	A-6(10)	CL
100	97	96	91	89	82	62	50	23	13	9	16	5	A-4(5)	ML-CL

Soil name and location	Parent material	SCS report number	Depth	Moisture-density 1/		Percolation rate 2/	Lineal shrinkage	Reaction	Organic matter 3/	In-place dry density	In-place moisture content
				Maximum dry density	Optimum moisture						
				Lb. per cu. ft.	Pct.	Min. per in.	Pct.	pH	Pct.	Lb. per cu. ft.	Pct.
		S66 NY32									
Rhinebeck silty clay loam: Town of Royalton, three-tenths mile southwest of Akron Road (State Route 93) and 100 feet north of Ertman Road. (Sandy substratum)	Brownish-colored lacustrine deposit that is dominated by clay and silt, but has sand layers below a depth of 40 inches; postglacial Lake Tonawanda sediments.	18-1	0-9	89	27	---	6.6	5.8	6.3	---	36
		18-2	9-11	97	24	---	7.0	5.6	1.5	---	--
		18-3	11-24	105	19	>120.0	8.0	7.2	.7	98	24
		18-4	24-48	105	19	---	6.0	5.2	---	104	22
		18-5	48-55	106	14	---	0	8.5	---	---	26

1/ Based on the Moisture-Density Relations of Soils Using 5.5-Pound Rammer and 12-inch Drop: AASHO Designation T 99-57, Method C (2).

2/ Based on "Standard Percolation Test," N.Y. State Dept. of Health, Bul. No. 1.

3/ Wet combustion method. Based on 1942 Cornell University Agronomy test procedure modified by Bureau of Soil Mechanics.

4/ Mechanical analyses according to the AASHO Designation T 88(2). Results by this procedure frequently may differ somewhat from results that would have been 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

TEST DATA--Continued

Mechanical analysis 4/											Liquid limit	Plasticity index	Classification	
Percentage passing sieve--							Percentage smaller than--						AASHO 5/	Unified 6/
3-in.	1 1/2 in.	3/4-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.				
---	---	---	100	100	100	98	92	76	39	19	45	15	A-7-5(11)	ML and OL
---	---	---	---	---	100	99	97	93	59	38	37	14	A-6(10)	ML-CL
---	---	---	100	100	99	91	86	74	49	32	36	15	A-6(10)	CL
---	99	99	98	97	96	94	89	74	32	18	28	9	A-4(8)	CL
---	---	---	---	100	100	13	9	1	0	0	--	NP	A-2-4(0)	SM

2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

5/ Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49.

6/ Based on the Unified Soil Classification System for Roads, Airfields, Embankments, and Foundations (14). The SCS and Bureau of Public Roads (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. An example of a borderline classification obtained by this use is ML-CL.

7/ NP=Nonplastic.

8/ An estimated 1 percent larger than 3 inches was discarded.

representative. Other than these depths, however, the estimated data cover the range of characteristics of the soil as it occurs in the county.

Dominant USDA textures: The textures indicated correspond to the textures given in the technical description of the profile representative for the series.

Unified and AASHO classifications: The estimated classifications are based on actual test data from this county and other survey areas. The subsection "Engineering Classification Systems" explains the headings.

Percentage passing sieve: These columns show estimated particle-size distribution according to standard size sieves.

Permeability: Permeability values are estimates of the range in rates that water moves in the major soil horizons. These estimates are based on soil texture, soil structure, porosity, permeability and infiltration tests, and drainage observations of the hydraulic conductivity of the soils.

Available moisture capacity: This is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. In table 7 it is expressed as inches of water per inch of soil depth.

Reaction: The pH ranges given in this column represent a summary of the many field determinations of pH taken during the survey on each of the soils in the county. Reaction is defined in the Glossary.

Engineering Interpretations of the Soils

Table 8 gives suitability ratings for soils as a source of topsoil, granular material, and fill material and lists the characteristics of soils that affect stated engineering practices.

The engineering interpretations in table 8 are provided as a set of guides and indicators of potential hazards of characteristics that require unusual or special precautions in planning, designing, or constructing engineering structures. The interpretations given in the table apply only to a depth of about 5 to 6 feet of the named soil of soils. Each soil area (mapping unit) contains mapping inclusions of other soils that may differ considerably from the named soil. Therefore, onsite investigation is needed for a specific use.

Explanations of the column headings in table 8 follow:

Suitability as source of topsoil: The thickness, texture, and natural fertility of the surface layer of a soil determines its suitability for use as a topdressing for roadbanks, embankments, and other areas for the growth of vegetation. Only the surface layer of the soil is considered in this rating, except as noted otherwise.

Granular material: This column gives information about the soils as a possible source of sand and gravel for construction purposes. It should not be assumed that, for a soil rated good, all areas of the soil can be used for commercial development of sand or gravel. A soil rated good has better possibilities as a source of clean sand or gravel than soils rated poor or fair.

Fill material: This is material used to build embankments. Considered in estimating the ratings were the condition of the borrow area; ease of excavation, hauling, and compaction characteristics; and performance of the material when placed.

Highway locations: Soil features that affect highway location include shallowness to rock, a high water table, steep slopes, and the hazards of mass sliding and flooding.

Embankment foundations: Soil features that affect embankment foundations are compressibility, shrink-swell potential, shear strength, and slope.

Foundations for low buildings: These are affected chiefly by features of the undisturbed soil that influence its capacity to support low buildings having normal foundation loads. Specific values of bearing strength are not assigned.

Ponds: Under the "Reservoir area" subheading, consideration is given primarily to the soil properties of undisturbed soils that affect the seepage rate. In addition, shallowness to bedrock and the susceptibility to overflow onto the flood plains are noted. Under the "Embankment" subheading, the soils are rated according to the stability and permeability of the materials if used in construction of the pond embankment. The permeability noted in this column is for the soil material when compacted at optimum moisture. The information given is also pertinent to dikes and levees.

Drainage: The soil features are described relative to their natural drainage, their in-place permeability, and the presence of a seasonal high water table or seepage.

Irrigation: Noted in this column are the relative ease with which water normally infiltrates into, percolates through, and drains from the soil and the available moisture capacity of the soil.

Terraces and diversions: The slope of the land and the relative erodibility of the soil materials are the main considerations. Other soil features considered are depth to rock and the presence of a seasonal high water table. Nearly level soils need no terracing; steep soils are not well adapted to terracing. Highly erodible soils require special care in the construction of terraces and diversions.

Waterways: Slope of the soil and erodibility of the soil materials are the main considerations. Depth to rock, seepage, and prolonged flow are noted where applicable.

Engineering Properties of Geologic Deposits and Bedrock

Recognition of the characteristics of the parent geologic materials, bedrock, and ground water is essential to adequate soil interpretations for engineering uses in the glaciated land of Niagara

County. The sections, "Descriptions of the Soils" and "Formation, Morphology, and Classification of Soils," in this soil survey give the geologic origin of the soils in the county. The following geologic deposits occur: glacial till, glacial outwash, lacustrine sediments, alluvium, and muck and peat.

Each geologic unit has engineering significance that differs from that of other geologic units. The broad engineering significance of each geologic unit is discussed in the following paragraphs.

Deep Glacial Till

Deep glacial till occurs in the uplands, mostly where the topography is sloping or hilly. Ordinarily, the deposits are 3 1/2 feet thick or more over bedrock. Compactness of the material in place varies and depends on whether the material was overridden by the ice or left in place when the ice melted. Glacial till is generally unstratified, but in some places local sorting has formed pockets of sand, gravel, silt, or clay within the soil mass.

Soils formed dominantly in deep glacial till are in the Appleton, Bombay, Cayuga, Cazenovia, Hilton, Massena, Ontario, Ovid, and Sun series. Some phases of the Cayuga, Hilton, Ontario, and Ovid series are underlain by limestone bedrock at a depth of 3 1/2 to 6 feet. A phase of the Cazenovia series is underlain by shale at these same depths.

Generally, these soils provide stable subgrades, good foundations for embankments consisting of 10 feet or more of fill material, and, with proper treatment, stable highway slopes. These soils also furnish good foundation support for buildings. Where properly compacted, materials excavated from the deposits can be used to form stable fills and embankments.

Soils of the Cayuga and Churchville series and the Madalin series, loamy subsoil variant, have a 20- to 40-inch layer of lacustrine clay or silt over till. The material below a depth of 20 to 40 inches has the same characteristics as that formed in deep glacial till. Unless the clayey cap is removed, these soils are generally suitable only for moderately high embankments of 5 to 10 feet.

Thin Glacial Till

This material is similar to deep glacial till, except that the depth to bedrock is generally less than 3 1/2 feet. Even in light grading operations, bedrock generally is exposed in cuts. The content of channery and flaggy fragments in soils formed in thin glacial till is generally higher than in soils formed in deeper material. Farmington soils formed in thin till over limestone bedrock.

The Brockport, Lairdsville, and Lockport soils formed in thin till, lacustrine silt or clay, or both, over soft shale bedrock. The soft shale under these soils disintegrates and becomes unstable where it is exposed to the effect of frost and alternate wetting and drying. Where Queenston shale occurs north of Ridge Road, there are hard layers in the formation that are difficult to excavate in some places.

Glacial Outwash

These deposits include outwash terraces, eskers, valley trains, kames, and lake beaches and bars. The material consists of sorted sand and gravel deposited by the melt water from a glacier. Many deposits include localized silt and clay strata that impede drainage. The Altmar, Fredon, Howard, Otisville, and Phelps soils formed in deposits of glacial outwash.

Sand and gravel from outwash are suitable for many uses. Depending on gradation, soundness, and plasticity, outwash can be used for such purposes as (1) fill material for underwater placement; (2) ordinary fill; (3) material to strengthen an unstable subgrade; (4) subbase for pavements; (5) wearing surfaces for driveways, parking lots, and some low-class roads; (6) material for highway shoulders; (7) free-draining, granular backfill for structures and pipes; (8) outside shells of impounding dams; and (9) abrasives for ice control on highways.

In some places these granular materials are too permeable for the construction of a homogeneous embankment intended to hold water. Cut slopes in the more sandy material are subject to severe erosion and sloughing. In some places soils formed in glacial outwash are underlain by layers of wet, compressible soil materials and suitable only for moderately high embankments of 5 to 10 feet.

Lacustrine Sediments

These deposits consist of coarse-textured to fine-textured materials that washed into glacial lakes and eventually settled to the bottom. In some places they are stratified fine sand and silt, and in other places are varved silt and clay. A few sand and silt lenses occur interbedded with the varved materials, and because lake elevations fluctuated, silt and clay lacustrine sediments underlie outwash deposits in many areas.

Many areas of these lacustrine sediments have a high water table, and loose, wet silt and clay underlie the surface materials. Lacustrine sediments normally are increasingly wet as depth increases. Infiltration is restricted, and where the relief is nearly level, runoff is slow.

The landform of these deposits is a plain, a dissected terrace, or a delta that has an unstable front. Where the soils are steep on terrace fronts, erosion is serious and landslides are numerous.

The kinds of lacustrine deposits and kinds of soil that formed in these deposits are as follows:

Deep, sandy deposits-----Arkport, Colonie, Elnora, Galen, Lamson, Minoa, and Stafford soils.

TABLE 7.--ESTIMATED ENGINEERING

[Alluvial land (Ad), Cut and fill land (Cu), Made land (Me), Muck shallow (Ma) Rock land, nearly level (RoA), estimate was not made. The sign > means more than; the sign < means less than. An asterisk in the first soils in such mapping units may have different properties and limitations, and for this reason it is necessary table]

Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface (typical profile)	Classification	
				Dominant USDA textures	Unified
	Feet	Feet	Inches		
Altmar: Af, Am----------	6+	1½-2	0-10	Loamy fine sand and gravelly fine sandy loam.	SM
			10-16	Loamy fine sand----------	SM
			16-50	Stratified loamy fine sand, sand, and gravel.	GM or SM
Appleton: AnA, ApA----------	3½+	½-1	0-8	Gravelly loam and silt loam---	SM or SC, ML or CL
			8-20	Loam----------	ML or CL
			20-50	Loam till----------	SM or SC, ML or CL
Arkport: ArB, ArC, AsA, AsB--Properties are for ArB and ArC. Mapping units AsA and AsB have the same properties as ArB and ArC, except they are underlain by gravelly layers below a depth of 40 inches. Estimates are variable for these layers.	6+	2½-3	0-8	Very fine sandy loam or fine sandy loam.	ML or SM
			8-48	Loamy very fine sand and loamy fine sand with bands of very fine sandy loam.	ML or SM
			48-60	Fine sand----------	SM or ML
Bombay: BoA, BoB----------	5+	1½-2	0-15	Fine sandy loam and very fine sandy loam.	SM or ML
			15-21	Loamy fine sand to very fine sandy loam.	SM or ML
			21-29	Fine sandy loam to silt loam; gravelly or nongravelly.	ML or SM
			29-60	Loam or gravelly loam till----	SM or ML
Brockport: BrA----------	2-3½	½-1	0-10	Silt loam----------	ML or CL
			10-28	Silty clay----------	CL
			28-50	Soft shale bedrock.	
Canandaigua: Ca, Cb----------	6+	0-½	0-35	Silty clay loam and silt loam.	ML or CL
			35-50	Stratified loamy fine sand, silt, and clay.	(1/)

See footnotes at end of table.

and Rock land, steep (RoF) are so variable that their properties were not estimated. Absence of data indicates column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The to follow carefully the instructions for referring to other series that appear in the first column of this

Classification--Con. AASHO	Coarse fraction greater than 3 inches	Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction
	Percent					Inches per hour	Inches per inch of depth	pH
A-2-4 or A-4	<5	70-95	60-90	40-75	15-50	>6.3	0.05-0.13	5.5-7.0
A-2-4	<5	70-95	60-90	40-70	15-30	>6.3	0.02-0.07	5.5-7.0
A-1-6 or A-2	<5	60-90	50-85	30-70	0-30	>6.3	---	7.0-7.6+
A-2 or A-4	<5	70-90	65-90	45-90	25-80	0.63-2.0	0.09-0.18	6.0-7.0
A-4	<5	80-90	75-90	65-90	50-80	0.63-2.0	0.13-0.18	6.0-7.0
A-2 or A-4	<5	85-90	80-90	55-85	30-70	<0.63	---	7.6+
A-2 or A-4	----	95-100	95-100	70-95	25-60	2.0-6.3	0.07-0.15	5.0-6.5
A-2 or A-4	----	95-100	95-100	65-95	20-60	2.0-6.3	0.07-0.15	5.6-7.3
A-2 or A-4	----	95-100	95-100	60-100	20-85	2.0-6.3	---	6.6-7.6+
A-4	<5	90-100	85-100	55-95	35-75	2.0-6.3+	0.09-0.20	5.6-7.3
A-2 or A-4	<5	75-100	70-100	50-95	20-65	2.0-6.3+	0.03-0.15	5.6-7.3
A-2, A-4, or A-6	<5	75-100	70-100	50-95	20-80	0.20-0.63	0.05-0.20	6.1-7.3
A-2, A-4	<5	70-90	65-90	45-85	25-65	<0.63	---	7.6+
A-4 or A-6	<5	80-100	75-100	65-100	50-95	6.3-2.0	0.13-0.20	6.0-7.0
A-7 or A-6	<5	90-100	85-100	80-100	70-95	<0.20	0.12-0.17	6.5-7.5
A-4 or A-6	<5	95-100	90-100	80-100	65-95	0.63-2.0	0.15-0.20	6.6-7.6+
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface (typical profile)	Classification	
				Dominant USDA textures	Unified
	Feet	Feet	Inches		
*Cayuga: CcA, CcB, CcC-------- For the Cazenovia part of these mapping units, see the Cazenovia series.	3½-6+	1½-2	0-8	Silt loam----------	ML or CL
			8-25	Silty clay loam to silty clay.	CL
			25-50	Gravelly loam till----------	SM, ML or CL
Cazenovia: CeA, CeB, CgA, CgB. Mapping units CgA and CgB have the same properties as the other units, except they are underlain by shale bedrock at a depth of 3½ to 6 feet.	3½-6+	1½-2	0-11	Gravelly silt loam, silt loam--	ML or CL
			11-28	Silty clay loam, clay loam; gravelly or nongravelly.	CL
			28-65	Silt loam till; gravelly or nongravelly.	ML or CL
Cheektowaga: Ch----------	6+	0-½	0-9	Fine sandy loam----------	SM, ML, or OL
			9-22	Loamy fine sand----------	SM
			22-50	Silty clay----------	CL
Churchville: ClA, ClB-------	4+	½-1	0-9	Silt loam----------	ML or CL
			9-31	Silty clay loam to silty clay--	CL
			31-50	Loam till----------	SM, SC, ML or CL
Claverack: CmA, CmB---------	6+	1½-2	0-32	Loamy fine sand----------	SM
			32-50	Silty clay----------	CL
Collamer: CnA, CnB----------	6+	1½-2	0-58	Silt loam----------	ML or CL
Colonie: CoB----------	6+	3+	0-55	Loamy fine sand and fine sand--	SM
Cosad: Cs----------	6+	½-1½	0-9	Fine sandy loam----------	SM-ML
			9-26	Loamy fine sand----------	SM
			26-50	Silty clay----------	ML or CL
*Dunkirk: DuB, DuC3, DvD3---- For the Arkport part of mapping unit DvD3, see the Arkport series.	6+	3+	0-70	Silt loam to very fine sandy loam.	ML or CL
Elnora: ElA, ElB----------	6+	1½-2	0-50	Loamy fine sand or fine sand---	SM
Farmington: FaA----------	1½	1½+	0-18	Silt loam to loam----------	ML or CL
			18	Limestone bedrock.	

See footnotes at end of table.

PROPERTIES OF SOILS--Continued

Classification--Con. AASHO	Coarse fraction greater than 3 inches	Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction
	Percent					Inches per hour	Inches per inch of depth	pH
A-4 or A-6	<5	95-100	90-100	75-100	55-95	0.63-2.0	0.15-0.20	5.6-7.3
A-6 or A-7	<5	95-100	90-100	80-100	80-100	0.20	0.13-0.17	6.1-7.6+
A-4	<10	70-90	65-90	55-85	40-70	<0.63	---	7.6+
A-4 or A-6	0-10	75-100	70-100	50-100	50-90	0.63-2.0	0.10-0.20	5.6-7.3
A-6 or A-7	0-10	80-100	70-100	70-100	65-95	<0.63	0.11-0.17	6.1-7.3
A-4 or A-6	0-10	75-90	70-90	70-90	50-80	<0.20	---	7.6+
A-4	-----	95-100	90-100	70-95	40-65	> 2.0	0.08-0.15	6.1-7.3
A-2-4	-----	95-100	90-100	50-80	15-35	> 2.0	0.04-0.08	6.1-7.3
A-6 or A-7	-----	100	100	95-100	90-100	< 0.20	---	6.6-7.6+
A-4	< 5	95-100	90-100	80-100	65-95	0.63-2.0	0.15-0.20	5.6-7.3
A-7 or A-6	< 5	95-100	90-100	80-100	75-100	< 0.20	0.13-0.17	6.1-7.6
A-4	< 10	75-90	70-90	60-90	40-80	< 0.63	---	7.6+
A-2-4	-----	95-100	90-100	45-80	15-35	2.0-6.3+	0.04-0.08	5.6-7.3
A-6 or A-7	-----	95-100	95-100	95-100	85-100	< 0.20	---	6.6-7.6+
A-4	-----	95-100	90-100	80-100	65-95	0.20-2.0	0.18-0.20	5.6-7.6
A-2	-----	95-100	90-100	45-80	10-35	>6.3	0.04-0.08	5.1-7.3
A-2 or A-4	-----	95-100	90-100	65-85	20-55	2.0-6.3+	0.07-0.15	5.6-7.3
A-2	-----	95-100	90-100	45-80	15-35	2.0-6.3+	0.04-0.08	5.6-7.3
A-6 or A-7	-----	100	100	95-100	85-100	<0.20	---	6.6-7.6+
A-4 or A-6	-----	95-100	90-100	80-100	65-95	0.20-2.0	0.18-0.20	5.1-7.6+
A-2	-----	95-100	90-100	45-80	15-35	>6.3	0.04-0.08	5.1-6.5
A-4	0-10	80-100	75-100	50-100	45-90	0.63-6.3	0.11-0.20	5.6-7.3

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Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface (typical profile)	Classification	
				Dominant USDA textures	Unified
	Feet	Feet	Inches		
Fonda: Fo	6+	0-½	0-7	Mucky silt loam	ML or OL
			7-50	Silty clay to silty clay loam.	CL or CH
Fredon: Fr	6+	½-1½	0-12	Gravelly loam	SM, SC or ML
			12-22	Gravelly loam	ML or SM
			22-50	Stratified sand and gravel	(1/)
Galen: GnA, GnB	6+	1½-2	0-27	Very fine sandy loam	SM or ML
			27-50	Loamy fine sand to loamy very fine sand with very fine sandy loam and silt lenses.	SM or ML
Hamlin: 2/ Ha	3½+	1½-2½	0-40	Silt loam	ML or CL
			40-50	Variable texture	(1/)
*Hilton: HgA, HgB, HlA, HlB, HmA, HmB. For Cayuga part of HmA and HmB, refer to the Cayuga series in this table. Mapping units HmA and HmB have the same properties as the other units, except they are underlain by limestone bedrock at a depth of 3½ to 6 feet.	6+	1½-2	0-9	Gravelly loam and silt loam	SM or SC ML or CL
			9-30	Loam, silt loam; gravelly or nongravelly.	ML, CL or SM
			30-60	Gravelly loam or fine sandy loam till.	SM or SC ML or CL
Howard: HoA, HoB, HoC	6+	3+	0-29	Gravelly loam	ML, SM or SC
			29-44	Very gravelly loam	GM or GC
			44-57	Stratified sand and gravel	(1/)
Hudson: HsB, HtC3, HuF3	6+	1½-2	0-12	Silt loam and silty clay loam.	ML or CL
			12-30	Silty clay loam and silty clay.	CL
			30-50	Silt loam to silty clay on varved silt and clay.	ML or CL
Lairdsville: LaB	1½-3½	1½-2	0-8	Silt loam	ML or CL
			8-32	Silty clay loam to clay	CL
			32-48	Soft shale bedrock slightly weathered in upper part.	(1/)

See footnotes at end of table.

PROPERTIES OF SOILS--Continued

Classification--Con. AASHO	Coarse fraction greater than 3 inches	Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction
	Percent					Inches per hour	Inches per inch of depth	pH
A-4 or A-6	------	95-100	95-100	90-100	70-100	0.63-2.0	0.17-0.20	6.1-7.3
A-6 or A-7	------	95-100	95-100	95-100	85-100	<0.20	0.14-0.17	6.1-7.6+
A-2 or A-4	0-5	45-85	40-85	30-85	15-75	0.63-6.3	0.06-0.17	5.6-7.3
A-2 or A-4	0-5	45-85	40-85	35-85	25-85	2.0-6.3+	0.07-0.17	5.6-7.3
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
A-2 or A-4	------	95-100	90-100	55-95	20-65	0.63-6.3	0.07-0.15	5.6-7.3
A-2 or A-4	------	95-100	90-100	55-95	20-65	0.63-6.3+	0.07-0.15	6.1-7.6+
A-4 or A-6	------	95-100	90-100	80-100	65-95	0.63-2.0	0.18-0.20	6.1-7.3
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
A-2 or A-4	0-10	75-95	70-90	50-90	30-80	0.20-6.3	0.10-0.18	5.6-7.3
A-4	0-10	80-90	75-90	65-90	45-80	0.20-2.0	0.13-0.18	5.6-7.6+
A-2 or A-4	0-10	65-85	60-85	40-80	25-65	< 0.63	---------	7.6+
A-2 or A-4	0-5	65-85	60-85	40-85	25-75	2.0-6.3	0.09-0.17	5.6-7.3
A-1 or A-2	0-5	40-70	35-70	25-65	15-35	>6.3	0.05-0.13	6.6-7.6+
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
A-4 or A-6	0-5	95-100	90-100	80-100	75-95	0.20-2.0	0.15-0.20	5.6-7.3
A-7 or A-6	------	95-100	95-100	95-100	85-100	<0.63	0.14-0.17	6.1-7.3
A-4 or A-6	------	100	100	95-100	70-100	<0.63	0.14-0.20	7.6+
A-6 or A-4	0-5	75-100	70-100	60-100	50-95	0.20-2.0	0.12-0.20	5.6-7.3
A-7 or A-6	------	95-100	90-100	80-100	65-95	<0.20	0.12-0.17	5.6-7.6+
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface (typical profile)	Classification	
				Dominant USDA textures	Unified
	Feet	Feet	Inches		
Lakemont: Lc	6+	0-½	0-8	Silty clay loam	OL, ML or CL
			8-26	Silty clay loam to clay	CL or CH
			26-50	Silty clay loam, silty clay to varved silt and clay.	CL or CH
Lamson: Ld, Lg. Mapping unit Lg has the same properties as for Ld, except it is underlain by gravelly layers at a depth of 3 to 6 feet. Estimates are variable for these layers.	6+	0-½	0-8	Very fine sandy loam, fine sandy loam.	SM, ML, or OL
			8-30	Fine sandy loam, very fine sandy loam, loamy very fine sand.	SM or ML
			30-50	Fine sand, very fine sand, and silt.	(1/)
Lockport: Lo	1½-3½	0-1½	0-8	Silt loam	ML or CL
			8-23	Silty clay loam and silty clay.	CL
			23-36	Partially weathered shale.	
			36	Shale bedrock.	
Madalin: Ma	6+	0-½	0-6	Silt loam	ML, CL, or OL
			6-50	Silty clay loam and clay	CL
Madalin, loamy subsoil variand: Md.	6+	0-½	0-8	Silt loam	ML, CL, or OL
			8-26	Silty clay	CL
			26-50	Silt loam and fine sandy loam; gravelly or non-gravelly.	ML or CL
Massena: Mf	6+	½-1½	0-8	Fine sandy loam	SM or ML
			8-17	Loamy fine sand to silt loam.	SM or ML
			17-23	Gravelly fine sandy loam to silt loam.	SM, SC or ML
			23-29	Silt loam to fine sandy loam; gravelly or nongravelly.	ML or CL
			29-50	Very fine sandy loam to silt loam glacial till; gravelly or nongravelly.	SM or ML

See footnotes at end of table.

Classification--Con. AASHO	Coarse fraction greater than 3 inches	Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction
	Percent					Inches per hour	Inches per inch of depth	pH
A-4 or A-6	-----	100	95-100	90-100	70-95	0.20-0.63	0.14-0.20	6.1-7.3
A-6 or A-7	-----	100	100	95-100	85-100	<0.20	0.14-0.17	6.1-7.6
A-6 or A-7	-----	100	100	90-100	70-100	<0.20	---------	7.6+
A-2 or A-4	-----	95-100	90-100	60-95	20-85	>2.0	0.07-0.20	5.6-7.3
A-4	-----	95-100	90-100	65-95	35-65	>2.0	0.13-0.15	6.1-7.6+
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
A-4 or A-6	0-5	90-100	85-100	70-100	50-95	0.20-2.0	0.14-0.20	5.6-7.3
A-7 or A-6	-----	95-100	90-100	80-100	65-95	<0.20	0.12-0.17	5.6-7.3
A-4 or A-6	-----	95-100	90-100	80-100	65-95	0.63-2.0	0.15-0.20	5.6-7.3
A-6 or A-7	-----	95-100	90-100	80-100	75-100	<0.20	0.13-0.17	6.1-7.6+
A-4 or A-6	< 5	95-100	90-100	80-100	65-95	0.63-2.0	0.15-0.20	6.0-7.3
A-6 or A-7	< 5	95-100	90-100	80-100	65-100	<0.20	0.13-0.17	6.0-7.3
A-4 or A-6	< 5	90-100	85-100	60-100	35-90	<0.20	---------	7.6+
A-2 or A-4	0-10	65-100	60-100	40-95	25-75	2.0-6.3	0.09-0.17	6.1-7.3
A-2 or A-4	0-10	75-100	70-100	45-95	15-75	>2.0	0.05-0.17	6.1-7.3
A-2 or A-4	0-5	75-100	70-100	50-100	30-90	0.63-6.3	0.10-0.20	6.1-7.3
A-4	0-5	75-100	70-100	55-100	50-90	0.20-0.63	0.10-0.20	6.1-7.3
A-2 or A-4	0-5	75-100	70-100	50-100	30-90	<0.20	---------	7.6+

Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface (typical profile)	Classification	
				Dominant USDA textures	Unified
	Feet	Feet	Inches		
Minoa: Mn	6+	½-1	0-20	Very fine sandy loam, loamy fine sand.	SM or ML
			20-30	Loamy very fine sand with lenses of loam.	SM or ML
			30-50	Stratified very fine sand and silt.	(1/)
Niagara: NaA, NaB	6+	½-1	0-13	Silt loam and very fine sandy loam.	ML or CL
			13-50	Silt loam with thin lenses of clay.	CL
Odessa: OdA, OdB	6+	½-1	0-8	Silty clay loam	ML or OL, CL
			8-56	Silty clay to clay	CL or CH
Ontario: OnB, OnC, OnC3, OnD3, OoA, OoB. Mapping units OoA and OoB have the same properties as the other units, except they are underlain by limestone bedrock at a depth of 3½ to 6 feet.	6+	3+	0-14	Loam	SM or ML
			14-54	Gravelly loam to fine sandy loam.	SM, SC, ML, or CL
Otisville: OsA, OsB	6+	3+	0-9	Gravelly sandy loam	SM
			9-28	Gravelly loamy sand	SW or SM
			28-50	Stratified sand and gravel	SW-SM or SM
Ovid: OvA, OvB, OwA, OwB. Mapping units OwA and OwB have the same properties as the other units, except they are underlain by limestone bedrock at a depth of 3½ to 6 feet.	6+	½-1	0-11	Silt loam	ML-SC or CL
			11-24	Silty clay loam to clay loam.	CL
			24-50	Loam till	ML-SC or CL
Phelps: PsA	6+	1½-2	0-30	Gravelly loam to gravelly fine sandy loam.	ML, CL, SM or SC
			30-50	Stratified fine sand and gravel.	(1/)
Raynham silt loam: RaA, RaB	6+	½-1½	0-25	Silt loam	ML or CL
			25-50	Very fine sandy loam to loamy very fine sand with layers of silt and fine sand.	ML or SM

See footnotes at end of table.

PROPERTIES OF SOILS--Continued

Classification--Con. AASHO	Coarse fraction greater than 3 inches	Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction
	Percent					Inches per hour	Inches per inch of depth	pH
A-2 or A-4	-----	80-100	75-100	45-100	15-90	0.63-6.3	0.06-0.20	5.6-7.3
A-2 or A-4	-----	80-100	75-100	45-100	15-90	0.63-6.3	0.06-0.20	5.6-7.3
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	--------
A-4	----	90-100	85-100	60-100	35-90	0.63-2.0	0.12-0.20	6.1-7.3
A-4 or A-6	----	95-100	90-100	80-100	65-95	<0.63	---------	6.6-7.6+
A-4 or A-6	----	95-100	90-100	80-100	65-95	0.20-2.0	0.15-0.20	6.1-7.3
A-6 or A-7	----	95-100	90-100	85-100	75-100	<0.20	0.13-0.17	6.1-7.6+
A-2 or A-4	0-10	75-90	70-90	50-90	30-80	0.63-2.0	0.10-0.20	5.6-7.3
A-2 or A-4	5-10	55-90	55-90	35-85	20-70	<0.63	0.10-0.20	5.6-7.6+
A-1-b or A-2 or A-4	----	65-85	60-85	40-70	10-45	>6.3	0.05-0.12	5.1-7.3
A-2 or A-1-b	----	65-90	60-85	25-65	10-30	>6.3	0.02-0.06	5.6-7.3
A-1-b	----	60-80	55-80	10-65	0-25	>6.3	---------	6.1-7.6+
A-4	0-5	95-100	90-100	75-95	45-90	0.63-2.0	0.14-0.20	5.6-7.3
A-4 or A-6	0-5	80-90	75-90	70-90	60-80	<0.63	0.13-0.16	6.1-7.6+
A-4	0-5	75-85	65-85	55-80	40-65	<0.20	---------	7.6+
A-2 or A-4	0-5	65-85	60-85	40-85	25-75	0.63-6.3	0.09-0.14	5.6-7.3
(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
A-4	----	100	100	85-100	50-95	0.63-2.0	0.15-0.20	5.6-7.3
A-4	----	100	100	85-95	45-85	0.63-6.3	0.11-0.16	6.1-7.6+

Soil series and map symbols	Depth to bedrock	Depth to seasonal high water table	Depth from surface (typical profile)	Classification	
				Dominant USDA textures	Unified
	Feet	Feet	Inches		
Rhinebeck:					
RbA, RbB----------	6+	½-1	0-10	Silt loam----------	ML or CL
			10-60	Silty clay loam to clay-------	CL
RhA, RhB----------	6+	½-1	0-9	Silty clay loam----------	CL, ML, or OL
			9-24	Silty clay loam to clay-------	CL
			24-48	Silt loam----------	ML or CL
			48-55	Fine sand----------	SM
Rhinebeck, thick surface variant: Rk.	6+	½-1½	0-17	Silt loam----------	ML or CL
			17-24	Very fine sandy loam to silt loam.	ML
			24-50	Silty clay----------	CL
Schoharie: ShB----------	6+	1½-2	0-12	Silty loam to silty clay loam-	ML or CL
			12-30	Silty clay to clay----------	CL
			30-50	Varved silt and clay----------	ML or CL
Stafford: St, Su---------- Mapping unit Su has the same properties as St, except it is underlain by gravel layers at a depth of 3½ to 6 feet. Estimates are variable for these layers.	6+	½-1½	0-30	Loamy fine sand----------	SM
			30-50	Fine and medium sand----------	SM
Sun: Sw----------	4	0-½	0-8	Silt loam----------	SM, SC, ML or OL
			8-22	Fine sandy loam to silt loam--	ML, CL, SM or SC
			22-50	Gravelly loam till----------	SM, SC, ML or CL
Wayland: [2/] Wa----------	3½+	0-1	0-8	Silt loam----------	ML or OL
			8-30	Silt loam----------	ML or CL
			30-50	Silty clay loam to silt loam--	ML or CL

[1/] Variable.

[2/] Subject to flooding.

PROPERTIES OF SOILS--Continued

Classification--Con. AASHO	Coarse fraction greater than 3 inches	Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction
	Percent					Inches per hour	Inches per inch of depth	pH
A-4 or A-6	0-5	85-100	85-100	80-100	70-95	0.63-2.0	0.17-0.20	6.1-7.3
A-7 or A-6	0-5	90-100	90-100	85-100	75-100	<0.63	0.13-0.17	6.1-7.6+
A-4 or A-7	----	100	100	90-100	70-100	0.63-2.0	0.17-0.20	5.6-7.3
A-6	----	100	100	95-100	85-100	<0.63	0.14-0.17	6.1-7.6+
A-4	----	95-100	95-100	90-100	70-100	<0.63	---	7.6+
A-2 or A-4	----	95-100	95-100	65-100	10-50	>6.3	---	6.1-7.3
A-4	----	100	100	90-100	70-100	0.63-2.0	0.15-0.20	5.6-7.3
A-4	----	100	100	85-100	50-100	0.63-6.3	0.11-0.20	6.1-7.6+
A-6	----	100	100	95-100	85-100	<0.20	---	7.6+
A-4 or A-6	----	95-100	95-100	90-100	85-95	0.63-2.0	0.15-0.20	6.1-7.3
A-6 or A-7	----	100	100	100	95-100	<0.63	0.13-0.17	6.1-7.3
A-6 or A-4	----	95-100	95-100	90-100	80-100	<0.20	---	7.6+
A-4 or A-2	----	95-100	95-100	65-85	25-40	>6.3	0.07-0.10	5.6-7.3
A-2	----	95-100	95-100	50-80	10-30	>6.3	---	5.6-7.6+
A-4	0-5	85-100	80-100	60-100	35-85	0.63-2.0	0.10-0.20	5.6-7.3
A-2 or A-4	0-5	70-95	65-95	50-90	25-80	0.20-2.0	0.10-0.20	5.6-7.3
A-2 or A-4	0-5	60-90	55-90	35-85	20-65	<0.63	---	7.6+
A-4 or A-6	----	95-100	95-100	90-100	70-95	0.63-2.0	0.18-0.20	6.1-7.3
A-4 or A-7	----	95-100	95-100	90-100	75-95	0.63-2.0	0.18-0.20	6.1-7.3
A-4 or A-6	----	95-100	95-100	90-100	80-95	<0.20	---	6.5-7.6+

TABLE 8.--INTERPRETATION OF

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Alluvial land: Ad----	Variable: excellent in places; may be wet in natural state.	Generally unsuitable.	Extremely variable--	Subject to flooding; high water table.	Variable soil material and soil strength; underlain in places by wet, compressible soils.
Altmar: Af----------	Poor: sandy; low fertility; unstable on steep slopes.	Generally good in substratum below depth of 20 to 40 inches; wet in places.	Fair to good: highly erodible where sandy.	Seasonal high water table; cut slopes and subgrade unstable below water table; subject to differential frost heave.	Generally adequate strength for moderately high fills.
Am----------	Unsuitable: too gravelly.	Good: cemented in places; wet in places.	Good to excellent---	Seasonal high water table; cut slopes subject to seepage; subject to differential frost heave.	Generally adequate strength for moderately high fills.
Appleton: AnA----------	Poor to unsuitable; gravelly.	Unsuitable----	Good: seasonally wet.	Seasonal high water table; cut slopes subject to seepage and sloughing.	Adequate strength for high embankments.
ApA----------	Fair to good: gravelly in places.	Unsuitable----	Good: seasonally wet.	Seasonal high water table; cut slopes subject to seepage and sloughing.	Generally adequate strength for high embankments.

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Generally not applicable; subject to flooding; variable compressibility and shear strength.	Subject to frequent flooding; permeable in places; bedrock at a depth of 4 feet in places.	Variable materials.	Cut slopes unstable; natural outlets inadequate.	Variable material; subject to flooding.	Nearly level relief.	Variable material.
Seasonal high water table; variable bearing capacity; compressible under vibrating loads.	Rapid permeability; seasonal high water table at a depth of 1½ to 2 feet.	Upper 20 to 40 inches sandy; subject to piping; highly erodible; rapid permeability; underlying material contains gravel and sand and may be suitable for outside shell.	Seasonal high water table at a depth of 1½ to 2 feet; rapid permeability; cut slopes unstable; subject to seepage.	Low available moisture capacity; seasonal high water table at a depth of 1½ to 2 feet; rapid water-intake rate; subject to soil blowing.	Nearly level; rapid permeability.	Stratified sand and gravel below a depth of about 16 inches.
Seasonal high water table; variable bearing capacity; compressible under vibrating loads.	Rapid permeability; seasonal high water table at a depth of 1½ to 2 feet.	Fair stability and shear strength for outside shell; rapid permeability.	Seasonal high water table at a depth of 1½ to 2 feet; rapid permeability; cut slopes unstable; subject to seepage.	Low available moisture capacity; seasonal high water table at a depth of 1½ to 2 feet; rapid water-intake rate.	Nearly level relief; rapid permeability.	Stratified sand and gravel below a depth of about 16 inches.
Seasonal high water table; generally moderately high to high bearing capacity; generally low compressibility.	Seasonal high water table; moderately slow or slow permeability below a depth of 20 inches.	Generally no adverse features.	Seasonal high water table at a depth of ½ to 1 foot; cut slopes subject to seepage; moderately slow or slow permeability below depth of 20 inches.	Moderate water-intake rate; moderate available moisture capacity.	Nearly level relief.	Subject to prolonged flow.
Seasonal high water table; generally moderately high to high bearing capacity; generally low compressibility.	Seasonal high water table; moderately slow or slow permeability below a depth of 20 inches.	Generally no adverse features.	Seasonal high water table at a depth of ½ to 1 foot; cut slopes subject to seepage; moderately slow or slow permeability below a depth of 20 inches.	Moderate water-intake rate; moderately available moisture capacity.	Nearly level relief.	Subject to prolonged flow.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Arkport: ArB, ArC	Fair to good: erodible on steep slopes; sandy.	Unsuitable	Fair: highly erodible by wind and water.	Subgrade subject to differential frost heave; cut slopes highly erodible and unstable.	Generally adequate strength for moderately high embankments; underlain in places by wet, compressible soil material.
AsA, AsB	Fair: gravelly surface layer in places; sandy.	Poor: granular material may be between depths of 40 and 50 inches but is variable.	Variable: highly erodible by wind and water.	Subgrade subject to differential frost heave; cut slopes highly erodible and unstable.	Generally adequate strength for moderately high embankments; underlain in places by wet, compressible soil material.
Bombay: BoA, BoB	Poor to fair: may contain gravel; sandy.	Unsuitable	Fair in sandy cap: underlying till good.	Seasonal high water at a depth of 1½ to 2 feet; cut slopes subject to seepage and sloughing; variable textures above till subject to differential frost heave.	Generally adequate strength for high embankments.
Brockport: BrA	Fair to good: may contain too much clay in spots.	Unsuitable	Poor: clayey; low soil yield.	Shale bedrock at a depth of 1½ to 3½ feet; seasonal high water table at a depth of ½ to 1 foot; possibility of rock swell on pressure release; seepage on cut slopes.	Generally adequate strength for high embankments.
Canandaigua: Ca	Good: seasonally wet.	Unsuitable	Generally poor: surface layer high in organic matter; wet in natural state.	Prolonged high water table; cut slopes subject to seepage and sloughing; cut subgrade subject to differential frost heave.	Variable strength and generally compressible; may be adequate for light fills.

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Variable bearing capacity and compressibility; large settlements possible under vibrating loads.	Variable permeability; sand lenses subject to excess seepage.	Poor stability; poorly graded fine sand; subject to piping; highly erodible; variable permeability.	Well drained; drainage not needed.	High water-intake rate; moderate to high available moisture capacity; highly erodible.	Variable permeability; highly erodible.	Highly erodible.
Variable bearing capacity and compressibility; large settlements possible under vibrating loads.	Variable permeability; sand lenses subject to excess seepage.	Poor stability; poorly graded fine sand; subject to piping; highly erodible; variable permeability.	Well drained; drainage not needed.	High water-intake rate; moderate to high available moisture capacity; highly erodible.	Variable permeability; highly erodible.	Highly erodible.
Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; high bearing capacity; low compressibility.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; moderately slow or slow permeability below a depth of about 20 inches but may have sand lenses subject to seepage.	Good stability and shear strength; permeability of subsoil and substratum material good where compacted.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; cut slopes subject to seepage and sloughing; moderately slow or slow permeability below a depth of about 20 inches.	High water-intake rate; moderate to low available moisture capacity; seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet.	Undulating topography; variable texture to a depth of 20 inches.	Undulating topography; variable texture to a depth of 20 inches.
Shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet; seasonal high water table $\frac{1}{2}$ to 1 foot below surface.	Shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet.	Low shear strength; poor workability where wet; low soil yield per acre.	Seasonal high water table at a depth of $\frac{1}{2}$ to 1 foot; slow permeability below surface; shale bedrock at a depth of $1\frac{1}{2}$ to 3 feet.	Low water-intake rate; available moisture capacity is moderate; seasonal high water table at a depth of $\frac{1}{2}$ to 1 foot.	Nearly level relief.	Dense clayey subsoil; shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet.
Variable bearing capacity and compressibility; prolonged high water table.	Prolonged high water table; sand lenses subject to seepage in absence of water table.	Fair to good stability; slow permeability for inside core; surface soil high in organic matter.	Prolonged high water table; cut slopes unstable; sands subject to piping; natural outlets inadequate.	Prolonged high water table; generally not irrigated.	Nearly level relief.	Prolonged high water table; highly erodible.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Canandaigua: (Con.) Cb----------	Fair: clay content is high; seasonally wet.	Unsuitable----	Generally poor: surface layer high in organic matter; wet in natural state.	Prolonged high water table; cut slopes subject to seepage and sloughing; cut subgrade subject to differential frost heave.	Variable strength and generally compressible; may be adequate for light fills.
Cayuga and Cazenovia: CcA, CcB, CcC---------	Fair to good: may have high clay content.	Unsuitable----	Cayuga: poor in clay cap, generally good in till below. Cazenovia: generally good.	Seasonal high water table at a depth of 1½ to 2 feet; cut slopes subject to seepage and subject to sloughing in places.	Generally adequate strength for moderately high embankments.
Cazenovia: CeA, CeB----------	Poor to unsuitable: gravelly.	Unsuitable----	Generally good: seasonally wet.	Seasonal high water table at a depth of 1½ to 2 feet; cut slopes subject to seepage and subject to sloughing in places.	Generally adequate strength for moderately high embankments.
CgA, CgB----------	Poor to unsuitable: gravelly.	Unsuitable----	Good, but low soil yield: shale bedrock at a depth of 3½ to 6 feet.	Seasonal high water table at a depth of 1½ to 2 feet; cut slopes subject to seepage and subject to sloughing in places; shale bedrock at a depth of 3½ to 6 feet; rock swell on pressure release in places.	Generally adequate strength for high embankments.
Cheektowaga: Ch---------	Fair: sandy but high organic-matter content; may be wet.	Unsuitable----	Poor: sand underlain by wet clay at shallow depths.	Prolonged high water table; wet and clayey subgrade.	Generally adequate strength for low embankments.

PROPERTIES OF SOILS--Continued

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Variable bearing capacity and compressibility; prolonged high water table.	Prolonged high water table; sand lenses subject to seepage in absence of water table.	Fair to poor stability; slow permeability for inside core; surface soil high in organic matter.	Prolonged high water table; cut slopes unstable; sands subject to piping; natural outlets inadequate.	Prolonged high water table; generally not irrigated.	Nearly level relief.	Prolonged high water table; highly erodible.
Seasonal high water table; generally low compressibility and moderately high bearing capacity.	Seasonal high water table; moderately slow and slow permeability; CcC is moderately sloping.	Good stability; slow permeability for inside core; clayey material, especially Cayuga cap, may be difficult to work.	Seasonal high water table at a depth of 1½ to 2 feet; moderately slow or slow permeability; cut slopes subject to seepage.	Moderate water-intake rate; available moisture capacity is high.	Generally no adverse features.	Subject to prolonged flow and seepage.
Seasonal high water table; generally adequate strength and low compressibility.	Seasonal high water table; moderately slow and slow permeability.	Good stability; slow permeability for inside core; seasonally wet.	Seasonal high water table at a depth of 1½ to 2 feet; moderately slow or slow permeability; cut slopes subject to seepage.	Moderate water-intake rate; available moisture capacity is high.	Generally no adverse features.	Subject to prolonged flow and seepage.
Seasonal high water table; generally adequate strength and low compressibility; shale bedrock at a depth of 3½ to 6 feet; rock swell on pressure release in places.	Seasonal high water table; moderately slow and slow permeability; shale bedrock at a depth of 3½ to 6 feet.	Stability good; slow permeability for inside core; seasonally wet; low soil yield in places; shale bedrock at a depth of 3½ to 6 feet.	Seasonal high water table at a depth of 1½ to 2 feet; moderately slow or slow permeability; cut slopes subject to seepage.	Moderate water-intake rate; high available moisture capacity.	Generally no adverse features.	Subject to prolonged flow and seepage; deep cuts expose bedrock in places.
Prolonged high water table; generally low bearing capacity; compressible clayey substratum.	Prolonged high water table; rapidly permeable sand 20 to 40 inches thick over slowly permeable clay.	Poor: wet sand over clay.	Prolonged high water table; permeability rapid in sandy cap and slow in underlying clay; unstable ditchbanks.	Must be drained; rapid water-intake rate; low available moisture capacity in root zone.	Nearly level relief.	Prolonged flow; ponding; ditchbanks unstable in sandy cap.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Churchville: ClA, ClB.	Fair to good: may be too clayey in places.	Unsuitable---	Surface and subsoil poor: high clay content; till below a depth of 20 to 40 inches generally fair: may be wet.	Seasonal high water table; nonuniform soils over till; cut slopes subject to seepage and sloughing.	Generally adequate strength for moderate to high embankments.
Claverack: CmA, CmB----	Generally poor: sandy; low available moisture capacity.	Unsuitable---	Poor: shallow sand cap; wet clay and silt underlying materials.	Seasonal high water table; cut slopes subject to seepage and sloughing; clayey material hinders hauling where wet; subgrade in sand cap subject to differential frost heave.	Generally adequate strength for low embankments.
Collamer: CnA, CnB-----	Good----------	Unsuitable---	Poor to fair: highly erodible; may be wet.	Seasonal high water table; subject to seepage and slope stability problems; subgrade subject to differential frost heave.	Generally adequate strength for low embankments; variable strength; underlain by wet compressible material in some places.
Colonie: CoB----------	Generally poor: sandy; low available moisture capacity.	Generally unsuitable: fine sands.	Good: highly erodible by soil blowing and water; noncohesive dune sand in some areas.	Fine sand hinders hauling operations; highly erodible; cut slopes unstable; subject to differential frost heave.	Generally adequate strength for moderately high embankments; underlain by wet compressible soil material in places.
Cosad: Cs----------	Generally fair: sandy; low available moisture capacity.	Unsuitable----	Poor: clay substratum at a depth of 20 to 40 inches; wet in places.	Seasonal high water table; flat topography; slopes and subgrade unstable; subject to seepage and differential frost heave; clayey material in substratum hinders hauling operations where wet.	Generally adequate strength for low embankments; underlain by soft wet material in places.

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Seasonal high water table; generally moderately high to high bearing capacity.	Seasonal high water table; permeability slow to moderately slow.	Stability good; slow permeability; clayey cap is difficult to work where wet.	Seasonal high water table at a depth of ½ to 1 foot; permeability slow or moderately slow below surface; cut slopes subject to seepage.	Moderate water-intake rate; moderate available moisture capacity in root zone.	Generally no adverse features.	Subject to prolonged flow.
Seasonal high water table; generally low bearing capacity; compressible clayey substratum.	Seasonal high water table; rapidly permeable sand 20 to 40 inches thick over slowly permeable clay.	Stability fair to poor; sandy material permeable and highly erodible; clayey substratum difficult to compact.	Seasonal high water table at a depth of 1½ to 2 feet; material very unstable wet; fine sand subject to piping; cut slopes subject to seepage.	Rapid water-intake rate; low available moisture capacity.	Sandy surface layer; subject to water erosion and soil blowing.	Highly erodible.
Seasonal high water table; low bearing capacity; variable compressibility.	Permeability variable; contains sand layers; subject to excess seepage in places; seasonal high water table.	Stability fair: permeability variable; highly erodible; poor workability where wet.	Seasonal high water table at a depth of 1½ to 2 feet; cut slopes subject to seepage and sloughing.	Moderate water-intake rate; high available moisture capacity.	Subsoil difficult to work where wet.	Highly erodible.
Moderately high bearing capacity; settlement possible under vibratory loads; underlain by wet bottom sediments in places.	Rapidly permeable sands.	Stability fair: fine sand subject to piping; permeability rapid; highly erodible; fine sand hinders hauling operations.	Well drained to excessively drained; drainage not needed.	High water-intake rate; low to moderate available moisture capacity; droughty; subject to soil blowing.	Subject to soil blowing and plugging of channel.	Highly erodible fine sand.
Low bearing capacity; variable compressibility; seasonal high water table.	Seasonal high water table at a depth of ½ to 1½ feet; rapidly permeable sandy surface 20 to 40 inches thick over slowly permeable clay.	Fair stability; sandy surface material permeable and erodible; clayey material below a depth of 20 to 40 inches difficult to work where wet.	Seasonal high water table at a depth of ½ to 1½ feet; sandy material flows where wet; ditchbanks unstable; fine sand subject to piping; slowly permeable clayey substratum.	High water-intake rate; low available moisture capacity.	Subject to soil blowing and plugging of channels.	Highly erodible fine sand over clay at a depth of 20 to 40 inches.

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TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Cut and fill land: Cu. Because of variability of material no interpretations have been made.					
Dunkirk: DuB, DuC3----	Good for DuB; fair to poor for DuC3: low in organic matter.	Unsuitable---	Poor to fair: highly erodible; underlying material may be too wet for proper compaction in places.	Cut slopes subject to seepage and sloughing; unstable subgrade; silty material with high clay content hinders hauling operations where wet.	Generally adequate strength for low embankments; underlain by wet compressible material in places.
Dunkirk and Arkport: DvD3.	Variable: too sandy or too clayey in places; low in organic matter.	Unsuitable---	Poor to fair: highly erodible; underlying material may be too wet for proper compaction in places.	Cut slopes subject to seepage and sloughing; subject to differential frost heave; silty or sandy materials hinder hauling operations in places; moderately steep slopes.	Generally adequate strength for low embankments; moderately steep slopes; underlain by soft wet material in places.
Elnora: ElA, ElB-----	Poor: sandy; low available moisture capacity.	Unsuitable---	Good in sandy material: highly erodible by soil blowing and water; underlying material variable in texture and wet in places.	Seasonal high water table; cut slopes and subgrade unstable; fine sands hinder hauling operations; subject to severe differential frost heave.	Generally adequate strength for low embankments; underlain by soft, wet, compressible soil material in many places; large settlement possible under heavy fills.
Farmington: FaA-----	Poor: contains some gravel.	Unsuitable: possible source of dolomite for crushing.	Poor: stony; low soil yield.	Hard bedrock at a depth of 1 to 1½ feet; some seepage at rock contact.	Adequate strength for very high embankments.
Fonda: Fo----------	Fair to good: wet; high clay content in places.	Unsuitable---	Poor: highly organic surface layer; clayey subsoil and substratum.	Prolonged high water table; ponding; cut slopes unstable; wet subgrade in cuts.	Generally adequate strength for low embankments; variable compressibility.

PROPERTIES OF SOILS--Continued

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Generally low to moderate bearing capacity; variable compressibility.	Permeability variable; sandy layer subject to excess seepage.	Moderate to low shear strength and stability; permeability slow where compacted for inside core; erodible.	Unstable cut slopes; sandy layers subject to piping.	Moderate water-intake rate; high available moisture capacity; DuC3 is severely eroded.	Irregular topography generally.	Highly erodible.
Generally low to moderate bearing capacity; variable compressibility; moderately steep slopes.	Variable permeability; sandy layers subject to excess seepage; moderately steep slopes.	Variable textured material ranging from fine sand to silty clay loam; erodible.	Moderately steep slopes; well drained; drainage not needed.	Moderately steep slopes; severely eroded; moderate to rapid water-intake rate; moderate to high available moisture capacity.	Irregular topography; highly erodible; variable permeability.	Highly erodible.
Seasonal high water table variable compressibility; large settlement possible under heavy or vibratory loads.	Rapid permeability.	Stability fair; fine sand subject to piping; rapid permeability; highly erodible.	Seasonal high water table at a depth of 1½ to 2 feet; ditchbanks very unstable; fine sand subject to piping.	High water intake rate; low available moisture capacity; seasonal high water table at a depth of 1½ to 2 feet.	Highly susceptible to soil blowing during dry periods; difficult to establish vegetation.	Highly susceptible to soil blowing and water erosion; difficult to establish vegetation.
High bearing capacity; hard bedrock at a depth of 1 to 1½ feet.	Hard bedrock at a depth of 1 to 1½ feet.	Hard bedrock at a depth of 1 to 1½ feet; low soil yield; contains stones.	Hard bedrock at a depth of 1 to 1½ feet.	Moderate water-intake rate; low available moisture capacity; hard bedrock at a depth of 1 to 1½ feet.	Hard bedrock at a depth of 1 to 1½ feet.	Hard bedrock at a depth of 1 to 1½ feet.
Prolonged high water table; generally low bearing capacity; variable compressibility.	Prolonged high water table; slow permeability.	Poor stability; surface layer high in organic matter; poor workability.	Prolonged high water table; slow permeability; unstable cut slopes; natural outlets generally inadequate.	Prolonged high water table; generally not irrigated.	Depressional relief.	Depressional relief.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Fredon: Fr----------	Poor: gravelly--	Generally good: cemented in some areas; in places too thin for commercial exploitation.	Good: cemented in places; some areas underlain by wet silt and clay, which are poor.	Seasonal high water table; flat relief; subject to differential frost heave; some areas underlain by wet silt and clay.	Generally adequate strength for low embankments.
Galen: GnA, GnB-----	Good to fair: low available moisture capacity in places; sandy.	Unsuitable---	Fair: fine and very fine sand that is highly erodible by soil blowing and water; underlying material clayey or silty in places and may be poor.	Seasonal high water table; cut slopes subject to seepage and sloughing; sandy material hinders hauling operations; subject to differential frost heaving.	Generally adequate strength for low embankments; sandy surface layer generally underlain by a soft, wet subsoil.
Hamlin: Ha----------	Good in surface layer; fair to good in subsoil; may be wet.	Unsuitable---	Generally unsuitable: generally wet in natural state; silty.	Subject to flooding; seasonal high water table at a depth of $\frac{1}{2}$ to $2\frac{1}{2}$ feet.	Variable but generally low soil strength; generally adequate strength for low embankments.
Hilton: HgA, HgB----------	Poor: gravelly--	Unsuitable---	Good----------	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; cut slopes subject to seepage and some sloughing; subgrade in cuts generally good.	Generally adequate strength for high embankments.
HlA, HlB----------	Fair: contains some gravel.	Unsuitable---	Good----------	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; cut slopes subject to seepage and some sloughing; subgrade in cuts generally good.	Generally adequate strength for high embankments.

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Seasonal high water table; generally moderate bearing capacity; generally low compressibility except under vibratory loads.	Seasonal high water table; moderately rapid to rapid permeability.	Good stability and shear strength for outside shell; rapid permeability; some areas underlain by wet silt and clay.	Seasonal high water table at a depth of $\frac{1}{2}$ to $1\frac{1}{2}$ feet; moderately rapid to rapid permeability; flat relief.	Moderate to high water-intake rate; moderate available moisture capacity; must be drained.	Flat relief--	Flat relief.
Seasonal high water table; variable compressibility; large settlements possible under heavy or vibratory loads.	Seasonal high water table; variable permeability; sandy layers subject to excess seepage.	Stability poor; fine and very fine sands subject to piping; moderately rapid to rapid permeability; highly erodible.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; ditchbanks unstable; fine sand subject to piping.	High water-intake rate; moderate available moisture capacity.	Subject to soil blowing and plugging of channel.	Highly erodible; difficult to establish vegetation.
Subject to flooding; seasonal high water table at a depth of $\frac{1}{2}$ to $2\frac{1}{2}$ feet; variable strength and compressibility.	Subject to annual flooding; subject to excess seepage during dry periods; bedrock at a depth of $3\frac{1}{2}$ feet in places.	Stability fair to poor; fine sand and silt subject to piping, highly erodible; wet in natural state in places.	Subject to flooding; seasonal high water table at a depth of $1\frac{1}{2}$ to $2\frac{1}{2}$ feet; natural outlets generally inadequate; ditchbanks unstable.	Moderate water-intake rate; high available moisture capacity; seasonal high water table at a depth of $1\frac{1}{2}$ to $2\frac{1}{2}$ feet; subject to flooding.	Flat relief; subject to flooding.	Highly erodible; subject to flooding.
Generally moderately high or high bearing capacity; generally low compressibility; seasonal high water table.	Seasonal high water table; moderately slow or slow permeability.	Good stability and shear strength; permeability slow where compacted.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; subject to seepage.	Moderate water-intake rate; high available moisture capacity; seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet.	Generally no adverse features.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet.
Generally moderately high or high bearing capacity; generally low compressibility; seasonal high water table.	Seasonal high water table; moderately slow or slow permeability.	Good stability and shear strength; permeability slow where compacted.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; subject to seepage.	Moderate-water-intake rate; high available moisture capacity; seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet.	Generally no adverse features.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Hilton and Cayuga: HmA, HmB	Fair to poor: some gravel or too clayey in places.	Unsuitable	Hilton: good. Cayuga: surface layer and subsoil poor, clayey; underlying till good; bedrock at a depth of 3½ to 6 feet.	Seasonal high water table at a depth of 1½ to 2 feet; non-uniform soil material in Cayuga, also wet subgrade in places; bedrock generally encountered in most cuts; rock swell on pressure release in places.	Adequate strength for high embankment.
Howard: HoA, HoB, HoC.	Poor: gravelly	Generally good: not very deep and cemented in places.	Generally good: underlain by till or bottom sediments in places.	Water table and till or bottom sediments in deep cuts in places; where cuts are dominantly sandy, subject to severe erosion; subject to differential frost heave.	Generally adequate for moderately high embankments; in places underlain by lacustrine bottom sediments.
Hudson: HsB	Good to fair: too clayey in places.	Unsuitable	Poor to fair where dry; very poor where wet: clayey; moderate shrink-swell potential.	Seasonal high water table; cut slopes and subgrade unstable; clayey soil hinders hauling operations where wet.	Generally adequate strength for low embankments; soils compressible.
HtC3	Poor: clayey and thin.	Unsuitable	Poor to fair where dry; very poor where wet: clayey, moderate shrink-swell potential.	Seasonal high water table; cut slopes and subgrade unstable; clayey soil hinders hauling operations where wet.	Generally adequate strength for low embankments; soils compressible.
HuF3	Generally unsuitable: too clayey.	Unsuitable	Poor to fair where dry; very poor where wet: clayey; moderate shrink-swell potential.	Seasonal high water table; cut slopes and subgrade unstable; clayey soil hinders hauling operations where wet; steep slopes.	Steep slopes

PROPERTIES OF SOILS--Continued

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diverions	Waterways
	Reservoir	Embankment				
Generally adequate strength for most buildings; most excavations expose bedrock generally; bedrock swells on pressure release in places; seasonal high water table.	Seasonal high water table; moderately slow or slow permeability; bedrock at a depth of 3½ to 6 feet.	Good stability and shear strength; permeability slow where compacted.	Seasonal high water table at a depth of 1½ to 2 feet; subject to seepage; bedrock at a depth of 3½ to 6 feet.	Moderate water-intake rate; high available moisture capacity; seasonal high water table at a depth of 1½ to 2 feet.	Generally no adverse features.	Seasonal high water table at a depth of 1½ to 2 feet.
Generally adequate strength; water table in places, HoC is moderately sloping; compressible under vibratory loads.	Moderately rapid to rapid permeability; HoC is moderately sloping.	Good stability and shear strength for outside shell; rapid permeability.	Well to somewhat excessively drained; drainage not needed.	High water-intake rate; low to moderate available moisture capacity; HoC is moderately sloping.	Moderately rapid to rapid permeability.	Moderately rapid to rapid permeability.
Seasonal high water table; moderately high to high compressibility; generally low to moderately low bearing capacity.	Seasonal high water table; moderately slow or slow permeability.	Poor stability and shear strength; slow permeability for inside core; poor workability where wet.	Seasonal high water table at a depth of 1½ to 2 feet; cut slopes unstable; slow internal drainage.	Moderate water-intake rate; high to moderate available moisture capacity; seasonal high water table at a depth of 1½ to 2 feet.	Irregular topography generally.	Highly erodible.
Seasonal high water table; moderately high to high compressibility; generally low to moderately low bearing capacity; moderate slopes.	Seasonal high water table; moderately slow or slow permeability; moderate slopes.	Poor stability and shear strength; slow permeability for inside core; poor workability where wet.	Seasonal high water table at a depth of 1½ to 2 feet; cut slopes unstable; slow internal drainage; moderate slopes.	Moderate water-intake rate; high to moderate available moisture capacity; seasonal high water table at a depth of 1½ to 2 feet; moderate slopes.	Irregular topography generally.	Highly erodible.
Steep slopes; subject to mass slippage.	Steep slopes------	Poor stability and shear strength; slow permeability for inside core; poor workability where wet.	Steep slopes; drainage not needed.	Steep slopes; generally not irrigated.	Steep slopes.	Steep slopes.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Lairdsville: LaB-------	Poor to fair: clayey in places; some stones in places.	Unsuitable----	Poor: clayey; shallow to shale bedrock; low soil yield.	Shale bedrock at a depth of 1½ to 3½ feet; seasonal high water table at a depth of 1½ to 2 feet; seepage above rock; rock swells on pressure release in places.	Generally adequate strength for high embankments.
Lakemont: Lc----------	Fair to poor: clayey.	Unsuitable----	Poor: clayey; generally wet in natural state; moderate shrink swell potential.	Prolonged high water table; unstable cut slopes and subgrade; level or depressional relief; clayey material hinders hauling operations where wet.	Generally adequate strength for low embankments; moderately high to high compressibility.
Lamson: Ld----------	Good: seasonally wet.	Unsuitable----	Fair to poor: highly erodible by soil blowing and water; underlain by soft, wet, silty and clayey bottom sediment or till in places.	Prolonged high water table; level or depressional relief; natural outlets inadequate; cut slopes and subgrade unstable; subject to differential frost heave.	Generally adequate strength for low embankments; moderately high compressibility.
Lg----------	Fair: seasonally wet; sandy.	Unsuitable in topmost 40 inches; suitable in places below.	Poor in topmost 40 inches; underlying gravel good.	Prolonged high water table; level or depressional relief; natural outlets inadequate; cut slopes and subgrade unstable; subject to differential frost heave.	Generally adequate strength for low embankments; moderately high compressibility.
Lockport: Lo----------	Poor to fair: too clayey or stony in places.	Unsuitable----	Poor: clayey; 20 to 40 inches to shale; low soil yield.	Seasonal high water table; seepage and sloughing at rock contact; shale bedrock at a depth of 20 to 40 inches; rock may swell on pressure release.	Generally adequate strength for high embankments.

PROPERTIES OF SOILS--Continued

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Seasonal high water table; shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet; bedrock swells on pressure release in places.	Shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet.	Shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet; poor stability and shear strength; slow permeability for inside core; poor workability where wet.	Seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet; cut slopes unstable; slow permeability; shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet.	Moderate to slow water-intake rate; moderate to high available moisture capacity; seasonal high water table at a depth of $1\frac{1}{2}$ to 2 feet.	Shale bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet; dense clayey subsoil; construction difficult.	Shale to bedrock at a depth of $1\frac{1}{2}$ to $3\frac{1}{2}$ feet.
Prolonged high water table; low bearing capacity; moderately high to high compressibility.	Prolonged high water table; slow permeability.	Poor stability; moderate shrink-swell potential; poor workability where wet.	Cut slopes unstable; prolonged high water table table; slow permeability; natural outlets inadequate.	Prolonged high water table; generally not irrigated.	Depressional relief.	Subject to prolonged flow.
Prolonged high water table; generally low strength and moderately high compressibility.	Prolonged high water table; moderately rapid to rapid permeability.	Fair to poor stability; fine sand subject to piping; highly erodible; variable permeability where compacted.	Prolonged high water table; cut slopes very unstable; fine sand subject to piping; natural outlets inadequate.	Prolonged high water table; generally not irrigated.	Depressional relief.	Depressional relief; prolonged high water table; cut slopes very unstable; subject to piping.
Prolonged high water table; generally low strength and moderately high compressibility.	Prolonged high water table; moderately rapid to rapid permeability.	Fair to poor stability; fine sand subject to piping, highly erodible; gravelly material below a depth of 40 inches suitable for outside shell; rapid permeability.	Prolonged high water table; cut slopes very unstable; fine sand subject to piping; natural outlets inadequate.	Prolonged high water table; generally not irrigated.	Depressional relief.	Depressional relief; prolonged high water table; cut slopes unstable; subject to piping.
Seasonal high water table; shale bedrock at a depth of 20 to 40 inches; rock swells on pressure release in places.	Shale bedrock at a depth of 20 to 40 inches.	Shale bedrock at a depth of 20 to 40 inches; poor stability and shear strength; slow permeability for inside core; poor workability where wet.	Seasonal high water table; slow permeability; shale bedrock at a depth of 20 to 40 inches.	Low water-intake rate; seasonal high water table; moderate available moisture capacity.	Nearly level relief.	Nearly level relief; clayey subsoil; subject to seepage.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Madalin: Ma	Fair: clayey and wet in natural state in places.	Unsuitable---	Poor: clayey and wet in places; moderate shrink-swell potential.	Prolonged high water table; level or depressional relief; cut slopes and subgrade unstable; subject to seepage.	Generally adequate for low embankments; moderately high to high compressibility.
Md	Fair: clayey and wet in natural state in places.	Unsuitable---	Poor in clayey layers; underlying till fair: wet in places.	Prolonged high water table; level or depressional relief; cut slopes and subgrade unstable; subject to seepage; nonuniform subgrades.	Generally adequate strength for moderately high embankments.
Made land: Me. No interpretations made because of variability of material.					
Massena: Mf	Fair: sandy or contain stones; seasonally wet.	Unsuitable---	Sandy cap fair, till substratum good: sands subject to erosion by soil blowing and water; wet in places.	Seasonal high water table; nonuniform soil material in shallow cuts; subject to seepage and sloughing; subgrade subject to differential frost heave.	Generally adequate strength for high embankments; sand compressible under vibratory loads.
Minoa: Mn	Good to fair: sandy and seasonally wet in places.	Unsuitable---	Poor to fair: very fine sand, fine sand, and silt; erodible by soil blowing and water; wet in places.	Seasonal high water table; large areas of level relief; cut slopes unstable and highly erodible; subgrades wet; trafficability difficult in places; subject to differential frost heave.	Generally adequate strength for low embankments; underlain by soft, wet, compressible silt and clay in places.

PROPERTIES OF SOILS--Continued

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankments				
Prolonged high water table; generally low strength and moderately high to high compressibility.	Prolonged high water table; slow permeability.	Poor stability; poor workability where wet; subject to shrink swell.	Cut slopes unstable; slow permeability; inadequate natural outlets in places.	Prolonged high water table; generally not irrigated.	Depressional relief.	Depressional relief; clayey subsoil; subject to seepage.
Prolonged high water table; variable strength and compressibility.	Prolonged high water table; slow permeability.	Layers of clayey material have poor stability where wet; subject to shrink swell; underlying till has good stability and shear strength; slow permeability where compacted; wet in places.	Cut slopes unstable; slow permeability; inadequate natural outlets in places.	Prolonged high water table; generally not irrigated.	Depressional relief.	Depressional relief; clayey subsoil; subject to seepage.
Seasonal high water table; generally high bearing capacity and low compressibility.	Seasonal high water table; contains sand layers subject to excess seepage.	Sandy cap fair; subject to soil blowing and erosion by water; good stability and good shear strength in till substratum; slow permeability where compacted.	Seasonal high water table at a depth of ½ to 1½ feet; ditchbanks unstable; seepage problems.	Moderate to high water-intake rate; low available moisture capacity in the root zone; seasonal high water table at a depth of ½ to 1½ feet.	Level relief.	Ditchbanks unstable; seepage problems; prolonged flow.
Seasonal high water table; variable compressibility.	Prolonged high water table; sandy layers subject to excess seepage.	Stability fair: fine sand subject to piping; highly erodible; sandy material hinders hauling operations.	Seasonal high water table at a depth of ½ to 1 foot; ditchbanks unstable; fine sand subject to piping.	High water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of ½ to 1 foot.	Level relief.	Ditchbanks unstable; highly erodible.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Muck, shallow: Ms------	Unsuitable: can be used as an amendment to mineral soils.	Unsuitable----	Unsuitable----------	Prolonged high water table and ponding; organic soil; cuts not practical.	Organic soil unstable for embankment foundations; underlain by wet compressible sediment generally.
Niagara: NaA, NaB------	Good: wet in places.	Unsuitable----	Poor: highly erodible silt and very fine sand; subsurface layer may be too wet for proper compaction.	Seasonal high water table; unstable subgrade and cut slopes; seepage in cuts.	Generally adequate strength for low embankments; underlain by wet compressible soil generally.
Odessa: OdA, OdB-------	Poor to fair: too clayey generally.	Unsuitable----	Poor: clayey and wet for long periods; moderate shrink-swell potential.	Seasonal high water table; cut slopes and subgrades unstable; clayey soils hinder hauling operations where wet.	Generally adequate strength for low to moderately high embankments; moderate to high compressibility; subject to shrink swell.
Ontario: OnB, OnC, OnC3, OnD3--	OnB, OnC fair to good: gravelly in places; OnC3, OnD3 poor: low in organic matter and gravelly in places.	Unsuitable----	Generally good: contains a few large boulders.	Generally no adverse features: OnD3 has moderately steep slopes; some seepage on cut slopes in places; rock in some cuts.	Generally adequate strength for high embankments; OnD3 has moderately steep slopes.
OoA, OoB----------	Fair to good: gravelly in places.	Unsuitable: possible source of dolomite limestone for crushing at a depth below $3\frac{1}{2}$ to 6 feet.	Generally good: contains a few large angular stones; limited soil yield over the bedrock.	Hard bedrock at a depth of $3\frac{1}{2}$ to 6 feet; seepage over the rock in cuts; rock swells on pressure release in places.	Generally adequate strength for high embankments.

Soil features affecting--Continued						
Foundation for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankments				
Prolonged high water table; organic soils over variable materials.	Prolonged high water table; rapid permeability; organic soils over variable materials.	Organic soil unsuitable; underlying materials are variable.	Very high shrinkage where first drained; underlying mineral material at a depth of 12 to 40 inches; sand, silt, or clay in places.	High water-intake rate; variable available moisture capacity.	Level or depressional relief.	Subject to prolonged flow; unstable organic soil material.
Seasonal high water table; low bearing capacity; variable compressibility.	Seasonal high water table; sandy layers subject to excess seepage.	Fair to poor stability; highly erodible; very fine sands subject to piping.	Seasonal high water table at a depth of ½ to 1 foot; cut slopes unstable; very fine sand subject to piping.	Moderate water-intake rate; moderate to high available moisture capacity; seasonal high water table at a depth of ½ to 1 foot.	Very fine sands; siltation problems; subject to piping.	Ditchbanks unstable; highly erodible.
Seasonal high water table; low to moderately low bearing capacity; moderate to high compressibility.	Seasonal high water table; slow permeability.	Low shear strength strength; subject to shrink swell; poor workability.	Seasonal high water table at a depth of ½ to 1 foot; cut slopes unstable; slow permeability.	Low water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of ½ to 1 foot.	OdA has level relief; clayey subsoil that is difficult to work.	Highly erodible.
High bearing capacity; low compressibility; OnC, OnC3 have moderate slopes; OnD3 has moderately steep slopes.	Moderately slow or slow permeability at a depth of below about 14 inches; OnD3 has moderately steep slopes.	Good stability and shear strength; slow permeability where compacted; contains a few large boulders.	Drainage generally not needed except for small wet inclusions.	Moderate water-intake rate; high available moisture capacity; OnC, OnC3, and OnD3 have moderate or moderately steep slopes.	Generally no adverse features but OnD3 has moderately steep slopes.	Erodible on moderate to moderately steep slopes of OnC, OnC3, and OnD3.
High bearing capacity; negligible compressibility; hard bedrock at a depth of 3½ to 6 feet.	Moderately slow to slow permeability at a depth below about 14 inches; hard bedrock at a depth below 3½ to 6 feet.	Good stability and shear strength; slow permeability where compacted; contains a few large boulders; limited yield over the bedrock.	Drainage not generally needed except in areas of small wet inclusions.	Moderate water-intake rate; high available moisture capacity.	Bedrock along grade line in places.	Bedrock along grade line in places.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Otisville: OsA, OsB---	Unsuitable to poor: low available moisture capacity and low organic-matter content; generally too gravelly.	Good: cemented in places.	Good: underlain by sand or lake-laid silt and clay or till in places.	Subgrade in cuts subject to differential frost heave; silt, clay, or till in deep cuts in places, which may be wet or cause seepage.	Generally adequate strength for moderately high embankments; in places underlain by wet silt and clay.
Ovid: OvA, OvB----------	Good to fair: clayey and some gravel in places.	Unsuitable---	Fair: seasonally wet; moderate shrink-swell potential.	Seasonal high water table; subgrade subject to differential frost heave; cut slopes unstable; clayey material hinders hauling operations where wet.	Generally adequate strength for high embankments.
OwA, OwB----------	Good to fair: clayey and some gravel in places.	Unsuitable: possible source of dolomite limestone for crushing at a depth below 3 1/2 to 6 feet.	Fair: seasonally wet; moderate shrink-swell potential; limited soil yields over bedrock.	Seasonal high water table; subgrade subject to differential frost heave; cut slopes unstable; clayey material hinders hauling operations where wet; some cuts partly in rock and partly in soil; seepage at rock surface on rock subgrade; rock swell on pressure release in places.	Generally adequate strength for high embankments.
Phelps: PsA----------	Poor: gravelly--	Generally good: in places shallow over lacustrine or till deposits; cemented in places.	Good: gravelly and sandy deposits; highly erodible where dominantly sandy; underlying deposits variable.	Seasonal high water table; cut slopes and subgrade below water table; subject to differential frost heave; may encounter soft, wet, weak silt and clay in deep cuts in places.	Generally adequate strength for moderately high embankments; variable compressibility of underlying material.

PROPERTIES OF SOILS--Continued

Soil features affecting--Continued						
Foundations for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Generally moderate bearing strength; compressible under vibratory loads; some areas underlain by till or weak, soft, bottom sediments of variable compressibility.	Rapid permeability.	Good stability and shear strength for outside shells; rapid permeability.	Excessively drained; drainage not needed.	High water-intake rate; low available moisture capacity.	Gravelly and sandy material; rapid permeability.	Gravelly and sandy material; rapid permeability; excessively drained.
Seasonal high water table; moderately high bearing capacity; moderate shrink-swell potential in places; compressibility variable.	Seasonal high water table; moderately slow to slow permeability.	Good stability; slow permeability; clayey material hinders hauling operations where wet.	Seasonal high water table at a depth of 1/2 to 1 foot; moderately slow or slow permeability at a depth below about 11 inches; cut slopes unstable.	Moderate water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of 1/2 to 1 foot.	Slow permeability at a depth below about 24 inches.	Subject to prolonged flow.
Seasonal high water table; moderately high bearing capacity; moderate shrink-swell potential in places; variable compressibility; hard bedrock at a depth of 3 1/2 to 6 feet; rock swell on pressure release in places.	Seasonal high water table; moderately slow and slow permeability; limestone bedrock at a depth of 3 1/2 to 6 feet.	Good stability; slow permeability; clayey material hinders hauling operations where wet; limited soil yield over the bedrock.	Seasonal high water table at a depth of 1/2 to 1 foot; moderately slow to slow permeability below a depth of about 11 inches; cut slopes unstable; limestone bedrock to a depth of 6 feet.	Moderate water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of 1/2 to 1 foot.	Slow permeability at a depth below about 24 inches; limestone bedrock at a depth below 3 1/2 to 6 feet; shallow in places.	Subject to prolonged flow; limestone bedrock along grade line in places.
Generally moderately high bearing capacity; settlement under vibratory loads in places; underlain by weak silt and clay in places; seasonal high water table.	Seasonal high water table; rapid permeability.	Good stability and shear strength for outside shell; rapid permeability.	Drainage not generally needed except in small wet areas; seasonal high water table at a depth of 1 1/2 to 2 feet.	Moderate to high water-intake rate; moderate available moisture capacity.	Gravelly and sandy subsoil and substratum; rapid permeability.	Seasonal high water table at a depth of 1 1/2 to 2 feet; sand and gravel at a depth of about 30 inches.

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Raynham: RaA, RaB----	Good----------	Unsuitable---	Fair to poor: silt and very fine sand; highly erodible; generally wet with depth.	Seasonal high water table; cut slopes and subgrade unstable; subject to differential frost heave; silty and sandy material hinders hauling operations where wet.	Generally adequate strength for low embankments; compressible soil.
Rhinebeck: RbA, RbB----------	Fair to good: clayey in places.	Unsuitable---	Generally poor: material generally plastic and too wet; moderate shrink-swell potential.	Seasonal high water table; cut slopes and subgrade unstable; seepage and sloughing are problems; clayey soils hinder hauling operations when wet.	Generally adequate strength for low embankments; generally underlain by soft compressible materials.
RhA, RhB----------	Poor to fair: clayey.	Unsuitable---	Generally poor: uppermost 3 1/2 to 6 feet same as RbA and RbB; fine sand below is poorly graded, generally wet, and highly erodible.	Seasonal high water table; cut slopes and subgrade unstable; seepage and sloughing; clayey soils hinder hauling operations where wet.	Generally adequate strength for low embankments; generally underlain by soft compressible materials.

Soil features affecting--Continued						
Foundations for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Seasonal high water table; compressible soils.	Seasonal high water table; variable permeability.	Fair to poor stability; silt and very fine sand subject to piping; highly erodible.	Seasonal high water table at a depth of 1/2 to 1 1/2 feet; cut slopes very unstable; permeability variable.	Moderate water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of 1/2 to 1 1/2 feet; drainage generally needed.	Siltation problems; poor stability; RaA has level relief.	Prolonged flow; cut slopes highly erodible.
Seasonal high water table; generally low bearing capacity; moderately high compressibility.	Seasonal high water table; moderately slow to slow permeability below a depth of about 10 inches.	Poor stability and shear strength; slow permeability for inside core; poor workability where wet.	Seasonal high water table at a depth of 1/2 to 1 foot; cut slopes unstable; permeability moderately slow or slow below about 10 inches.	Moderate to low water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of 1/2 to 1 foot.	Clayey subsoil; difficult to work; erodible; RbA has level relief.	Prolonged flow; erodible.
Seasonal high water table; generally low bearing capacity; moderately high compressibility.	Seasonal high water table; contains sandy layers subject to excess seepage.	Poor stability and shear strength to a depth of 3 1/2 to 6 feet; fine sands below are poorly graded and wet; subject to piping.	Seasonal high water table at a depth of 1/2 to 1 foot; cut slopes unstable; permeability moderately slow to slow at a depth below about 10 inches.	Moderate to low water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of 1/2 to 1 foot.	Clayey subsoil difficult to work; may cut sand layers along grade line; RhA has level relief.	Prolonged flow; erodible; cut sand layers along grade line in places.

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Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Rhinebeck: (Con.) Rk----------	Good----------	Unsuitable---	Generally poor: silt and very fine sand to a depth of 2 feet is generally poorly graded and highly erodible; underlying clayey material is generally wet and plastic; moderate shrink-swell potential.	Seasonal high water table; cut slopes and subgrade unstable; seepage and sloughing; clayey soil hinders hauling operations where wet.	Generally adequate strength for low embankments; generally underlain by soft compressible materials.
Rock land: RoA, RoF--	Unsuitable-----	Unsuitable: possible source of dolomite for crushing.	Unsuitable: blasted rock excellent for some uses.	Bedrock exposed over most of areas; RoF is steep.	Adequate strength for high embankments; RoF is steep.
Schoharie: ShB-------	Poor to fair: too clayey in places.	Unsuitable---	Generally poor: poor workability where wet; moderate shrink-swell potential.	Seasonal high water table; cut slopes and subgrade unstable; clayey soil hinders hauling operations where wet.	Generally adequate strength for low fills; variable compressibility; subject to shrink swell.
Stafford: St----------	Poor: sandy; low available moisture capacity.	Generally unsuitable.	Fair: highly erodible by water and by soil blowing; seasonally wet.	Seasonal high water table; cut slopes subject to seepage and sloughing and are very erodible; subgrades generally wet and unstable; subject to differential frost heave.	Generally adequate strength for low embankments; variable compressibility.
Su----------	Poor: sandy; low available moisture capacity.	Fair: gravelly materials at a depth below 3 1/2 feet; generally under water; supply limited in places.	Gravelly substratum good, but short supply in places; sandy surface layer fair: highly erodible.	Seasonal high water table; cut slopes subject to seepage and sloughing and are highly erodible; subgrades generally wet and unstable; subject to differential frost heave.	Generally adequate strength for low embankments; variable compressibility.

PROPERTIES OF SOILS--Continued

Soil features affecting--Continued						
Foundations for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Seasonal high water table; generally low bearing capacity; moderately high compressibility.	Seasonal high water table; moderately slow to slow permeability at a depth below about 17 to 24 inches.	Silt and very fine sand to a depth of 2 feet; subject to piping; clayey material below is same as RbA and RbB.	Seasonal high water table at a depth of 1/2 to 1 foot; cut slopes unstable; moderately slow to slow permeability at a depth below about 10 inches.	Moderate to low water-intake rate; moderate available moisture capacity; seasonal high water table at a depth of 1/2 to 1 foot.	Level relief.	Prolonged flow; highly erodible; level relief.
Bedrock exposed over most of areas; RoF is steep.	Bedrock exposed over most of areas; RoF is steep.	Bedrock exposed over most of areas.	Bedrock exposed over most of areas; RoF is steep.	Bedrock exposed over most of areas; Rof is steep.	Bedrock exposed over most of areas; RoF is steep.	Bedrock exposed over most of areas; RoF is steep.
Seasonal high water table; generally low to moderately low bearing capacity; soils generally compressible.	Seasonal high water table; moderately slow to slow permeability at a depth below about 12 inches.	Poor stability and shear strength; slow permeability for inside core; poor workability where wet; moderate shrink-swell potential.	Seasonal high water table at a depth of 1 1/2 to 2 feet; cut slopes unstable; moderately slow or slow permeability at a depth below about 12 inches.	Slow to moderate water-intake rate; high available moisture capacity; seasonal high water table at a depth of 1 1/2 to 2 feet.	Clayey subsoil; poor workability where wet.	Clayey subsoil; erodible; cuts unstable.
Seasonal high water table; compressible under heavy and vibratory loads; in places underlain by weak, wet bottom sediments.	Seasonal high water table; rapid permeability.	Stability fair to poor; fine sand subject to piping; highly erodible.	Seasonal high water table at a depth of 1/2 to 1 1/2 feet; cut slopes unstable; rapid permeability; natural outlets inadequate in places.	Good water-intake rate; low available moisture capacity; needs drainage generally.	Level relief.	Cuts unstable; sandy materials; rapid permeability; seasonal high water table at a depth of 1/2 to 1 1/2 feet.
Seasonal high water table; compressible under heavy and vibratory loads; in places underlain by weak, soft, wet bottom sediments.	Seasonal high water table; rapid permeability.	Stability fair to good in sandy surface layer; gravelly substratum suitable for outside shell; rapid permeability.	Seasonal high water table at a depth of 1/2 to 1 1/2 feet; cut slopes unstable; rapid permeability; natural outlets may be inadequate.	Good water-intake rate; low available moisture capacity; needs drainage generally.	Level relief.	Cuts unstable; sandy materials; rapid permeability; seasonal high water table at a depth of 1/2 to 1 1/2 feet.

TABLE 8.--INTERPRETATION OF ENGINEERING

Soil series and map symbols	Suitability as source of--			Soil features affecting--	
	Topsoil	Granular material	Fill material	Highway location	Embankment foundations
Sun: Sw----------	Good to fair: wet for long periods.	Unsuitable---	Fair: wet for long periods.	Prolonged high water table; cut slopes subject to seepage and sloughing; drainage outlets generally unavailable.	Generally adequate strength for moderately high embankments; in places surface layer unstable.
Wayland: Wa----------	Good, but wet in places.	Unsuitable---	Unsuitable: generally wet.	Subject to flooding; prolonged high water table.	Variable bearing power and compressibility; generally adequate strength for low embankments.

Soil features affecting--Continued						
Foundations for low buildings	Ponds		Drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Generally not recommended for this use; prolonged high water table; moderately high-bearing capacity and low compressibility; in places surface layer is mucky.	Prolonged high water table; variable permeability.	High content of organic matter in surface layer; stability of material below generally good; permeable in places.	Prolonged high water table; cut slopes unstable; permeability variable above depth of about 2 feet; moderately slow or slow below this depth; natural outlets may be inadequate.	Prolonged high water table; generally not irrigated.	Level or depressional relief.	Level or depressional relief; cut slopes unstable; prolonged high water table.
Prolonged high water table; subject to flooding; variable bearing capacity and compressibility.	Prolonged high water table; subject to flooding.	High content of organic matter in surface layer; silty material; poor stability; highly erodible; generally wet.	Prolonged high water table; cut slopes unstable; subject to flooding; outlets generally inadequate.	Prolonged high water table; generally not irrigated.	Level relief.	Level relief; subject to flooding and prolonged flow.

Sand 20 to 40 inches thick over clay.	Claverack, Cosad, and Cheektowaga soils.
Sand 3 to 6 feet thick over gravel.	Gravelly substratum phases of Lamson and Stafford soils.
Deep, silty deposits	Dunkirk, Collamer, Niagara, Canandaigua, and Raynham soils.
Deep, clayey deposits	Hudson, Madalin, Odessa, Rhinebeck, Schoharie and Lakemont soils and Rhinebeck soils, thick surface variant.
Clay deposits 40 inches or more thick over sandy material.	Rhinebeck soils, sandy substratum.

Except for muck and peat, soils formed in lacustrine sediments present more engineering problems than any other soils in the county because of their topographic location and their low strength and stability. Some of the silty and clayey deposits are difficult to drain. They are highly susceptible to frost heave. Also, they lose strength seasonally when thawing increases the moisture content. Silty and clayey deposits are generally suitable only for low embankments 5 feet high or less. Settlement under heavy fills and structures is considerable in places. Cut slopes are generally very unstable and piping is a concern in the silty and sandy or gravelly deposits.

Alluvial Deposits

These stratified material are sediments dropped from the present streams, and they form the flood plain adjacent to the streams. The textures in each deposit vary from place to place. Alluvium is subject to periodic flooding. Surface drainage varies. A shallow water table is characteristic of alluvial deposits in many areas.

Alluvial land and soils of the Hamlin and Wayland series formed in alluvial sediments. In some areas of the Hamlin and Wayland soils, limestone or shale bedrock is within 1 1/2 to 3 1/2 feet of the surface.

The support for foundations is normally poor on alluvial sediments. Soils formed in recent alluvium should be avoided as building sites. Sewage effluent disposal is troublesome because of flooding or the seasonal or permanent high water table.

Muck and Peat

Accumulations of plant and animal remains in very poorly drained areas are mostly organic matter, but they contain varying amounts of inorganic material in places. They are in swamps and at the surface of other very poorly drained, depressed areas.

Muck, shallow, is the only mapping unit of organic soils in the county. In areas of this shallow muck, there is sandy, loamy, or clayey material within 1 to 3 1/2 feet of the surface.

Organic soils ordinarily are entirely unsuitable for highway and embankment sites and for other engineering structures because they are highly compressible and unstable. Generally, these materials are underlain by soft wet alluvium, marl, or lacustrine sediments.

Bedrock

The subsection "Geology" in this soil survey describes the extent and geographical occurrence of the different kinds of bedrock underlying the soils of Niagara County. In addition to some exposed rock, there are many areas where it is at shallow depths. This is true for cuts in thin glacial till and in some deeper cuts in thick glacial till.

Hard bedrock normally provides good foundations for highways. Bedrock in dam foundations generally requires sealing to prevent excess seepage. Some kinds of shale swell and flake readily if exposed in cuts, whereas others quickly revert to their original clay content. Knowledge of rock durability and other characteristics is required when considering the suitability of bedrock for construction uses.

Nonfarm Uses of the Soils

This subsection gives ratings for the limitations of soils that are used for homesites, disposal of septic tank effluent, picnic and extensive play areas, camping sites, and other community development and recreational uses. Table 9 lists the soils in the county and shows the soil features that are most limiting and the estimated degree to which these features affect use for the various purposes.

The major properties that affect use of soils for community development are slope; drainage or depth to a seasonal high water table; soil permeability or the rate at which water moves through the soil; stoniness, or the content of stones 10 inches or more across; texture of the surface layer or particle-size (sand, silt, clay, gravel, and cobblestones) distribution; hard bedrock that generally requires blasting before it can be removed; soft bedrock that generally can be removed with power tools; and the flooding and ponding hazards.

In table 9, the limitations of the soils in the county are rated slight, moderate or severe. If the limitations are rated moderate or severe, the chief limitation or limitations for the use specified are listed. A rating of slight indicates that the soil has few or no limitations and is considered desirable for the use named. A rating of moderate shows that a moderate problem is recognized but can be overcome or corrected. A rating of severe indicates that the use of the soil is seriously limited by hazards or restrictions that are difficult to overcome. A rating of severe does not imply that a soil so rated cannot be put to that use. Also, it should be recognized that large scale cuts or fills in an area may alter the natural soil so much that ratings given in the table no longer apply.

Any single soil property does not restrict all types of community use equally. For example, a seasonal high water table that is a moderate limitation for many uses can severely limit the use of the soil for the disposal of septic tank effluent.

The interpretations given in table 9 apply only to a soil depth of about 5 to 6 feet. Each soil area (mapping unit) contains inclusions of other soils that may differ considerably from the named soil. Therefore, onsite investigation is needed for a specific use.

Following are explanations of the uses rated in table 9.

Homesites.--The soils are rated as sites for homes or other buildings of three stories or less that have a basement. Considered in rating are depth to a seasonal or prolonged high water table, slope, depth to bedrock, stoniness, and hazard of flooding. For buildings without a basement, depth to rock and the water table are less restrictive. Also, slope is considered primarily for subdivision development. It is less restricting for isolated buildings.

Problems of sewage disposal, water supply, stabilizing or maintaining vegetative cover, or access roads are not considered in the ratings. Other engineering properties of soils that are pertinent, such as compressibility and bearing capacity, are referred to in the engineering section of this soil survey.

Specific location of buildings normally requires onsite investigation.

Septic tank effluent disposal.--It is assumed that the soils are to be used as drainage fields for disposal of effluent from adequately designed and installed septic tank systems. The source of water supply, whether from individual or community systems, is not a consideration in the ratings. Specific location of drainage fields for disposal of effluent requires onsite investigation.

Among the major soil properties influencing the use are permeability, depth to seasonal or prolonged high water table, depth to bedrock, slope, stoniness, and hazard of flooding or ponding.

Streets and parking lots.--Soil requirements for streets and parking lots are similar to those for highways. In rating the soils, the main features considered are depth to seasonal or prolonged high water table, slope, depth to bedrock, stoniness, and hazard of flooding.

Tables 7 and 8 and the text of the subsection "Engineering Uses of the Soils" provide other pertinent information, such as stability of cut slopes, subgrade conditions, and source of fill material. Specific layout requires onsite investigation.

Underground utilities.--The choice of a soil suitable for the installation of underground service facilities, such as storm drains, sewers, water or gas mains, or underground electric or telephone cables, is determined mainly by the depth to bedrock. Locally, Queenston shale is rippable but Medina sandstone and Lockport limestone require blasting. Other soil features that are important are slope, texture, content of large stones and boulders, and depth to a prolonged high water table. Flood hazard and depth to water table provide severe seasonal limitations. The corrosion potential has not been considered as part of these rating.

Camp sites.--The soils are rated for use as tent or trailer camp sites for large numbers of people. Frequent use during the camping season involving heavy foot and vehicular traffic is assumed. Problems of sewage disposal, water supplu, and access roads are not considered in the ratings. The major soil properties considered are depth to a seasonal high water table, permeability, slope, stoniness, texture of the surface layer, and hazard of flooding or ponding during periods of heavy use.

Hiking and riding trails.--Soils used for hiking or riding trails are left essentially in their natural state. The main features that influence the use of soils for these uses are depth to a seasonal or prolonged high water table, slope, texture of the surface layer, stoniness or rockiness, and hazard of flooding or ponding.

Picnic and extensive play areas.--Soils are rated for play areas to be used mainly by children and for picnic areas that provide tables and fireplaces for large numbers of people. These areas are left essentially in their natural state. Problems of water supply and sewage disposal are not considered in the rating. The main soil features considered in the rating are depth to seasonal high water table, slope, depth to bedrock, surface stoniness, texture of the surface layer, and the hazard of flooding during periods of heavy use.

Athletic fields and intensive play areas.--The soils are rated for developing areas for intensive use for baseball, football, tennis, and similar sports. Areas selected for these uses must be nearly level, have good drainage, and have favorable textures of the surface layer. Importation of fill material or topsoil is not considered in the ratings.

Lawns and fairways.--Among the soil properties that determine the suitability of soils for lawns and golf fairways are depth to a seasonal or prolonged high water table, slope, depth to bedrock, texture of the surface layer, stoniness, and hazard of flooding. No importation of fill or topsoil is considered in the ratings, and traps or roughs are not considered as part of the fairway. Deep, well drained or moderately well drained soils that have a medium-textured or moderately coarse textured surface layer and are no more than moderately sloping are well suited for these uses.

TABLE 9.--ESTIMATED DEGREE AND KIND OF LIMITATIONS

[Cut and fill land (Cu) and Made land (Me) are

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Alluvial land: Ad--------	Severe: subject to flooding; seasonal high water table.	Severe: subject to flooding; seasonal high water table.	Severe: subject to flooding; seasonal high water table.	Severe: subject to flooding; seasonal high water table.
Altmar:				
Af----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; severe pollution hazard.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; subject to sloughing.
Am----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; severe pollution hazard.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; subject to sloughing.
Appleton: AnA----------	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow or slow permeability below 12 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Arkport:				
AsA----------	Slight----------	Moderate: variable permeability in subsoil; severe pollution hazard.	Slight----------	Moderate: loose sands subject to sloughing.
AsB----------	Slight----------	Moderate: variable permeability in subsoil; severe pollution hazard.	Slight----------	Moderate: loose sands subject to sloughing.
Bombay:				
BoA----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: seasonal high water table at a depth of 1½ to 2 feet; moderately slow or slow permeability below 21 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight----------
BoB----------	Moderate: seasonal high water table at a depth of ½ to 2 feet.	Severe: seasonal high water table at a depth of 1½ to 2 feet; moderately slow or slow permeability below 21 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Slight----------

FOR SELECTED NONFARM USES OF THE SOILS

so variable that they were not rated]

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Severe: subject to frequent flooding; seasonal high water table.	Severe: subject to frequent flooding; seasonal high water table.	Severe: subject to frequent flooding; seasonal high water table.	Severe: subject to frequent flooding; seasonal high water table.	Severe: subject to frequent flooding; seasonal high water table.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer.	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer.	Moderate: sandy surface layer.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer.	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer; slope.	Moderate: gravelly surface layer.
Severe: seasonal high water table at a depth of ½ to 1 foot; gravelly surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow or slow permeability below 12 inches; gravelly surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot; gravelly surface layer.
Slight----------	Slight----------	Slight----------	Slight----------	Slight.
Slight----------	Slight----------	Slight----------	Moderate: slope------	Slight.
Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Slight.

TABLE 9.--ESTIMATED DEGREE AND KIND OF LIMITATIONS

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Brockport: BrA	Severe: seasonal high water table at a depth of ½ to 1 foot; shale rock at a depth of 1½ to 3½ feet.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability; soft shale bedrock at a depth of 1½ to 3 feet.	Severe: seasonal high water table at depth of ½ to 1 foot.	Moderate: soft shale rock at a depth of 1½ to 3½ feet; seasonal high water table at depth of ½ to 1 foot.
Canandaigua:				
Ca	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to sloughing.
Cb	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to sloughing.
Cayuga and Cazenovia:				
CcA	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: slow to moderately slow permeability below 8 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.
CcB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: slow to moderately slow permeability below 8 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.
CcC	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Severe: slow to moderately slow permeability below 8 inches; slope.	Severe: slope	Moderate: seasonal high water table at a depth of 1½ to 2 feet.
Cazenovia:				
CeA	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: slow to moderately slow permeability below 11 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.
CeB	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Severe: slow to moderately slow permeability below 11 inches; slope.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.

FOR SELECTED NONFARM USES OF THE SOILS--Continued

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability.	Moderate: seasonal high water table at a depth of ½ to 1 foot; slow permeability.
Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.
Severe: prolonged high water table; subject to ponding; silty clay loam surface layer.	Severe: prolonged high water table; subject to ponding; silty clay loam surface layer.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding; silty clay loam surface layer.	Severe: prolonged high water table; ponding; silty clay loam surface layer.
Severe to moderate: slow to moderately slow permeability below 8 inches.	Slight----------	Slight----------	Severe: slow to moderately slow permeability below 8 inches.	Slight.
Severe to moderate: slow to moderately slow permeability below 8 inches.	Slight----------	Slight----------	Severe: slow to moderately slow permeability below 8 inches; slope.	Slight.
Severe to moderate: slow to moderately slow permeability below 8 inches.	Slight----------	Slight----------	Severe: slow to moderately slow permeability below 8 inches; slope.	Slight.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow and slow permeability; gravelly surface layer.	Slight----------	Slight----------	Severe: gravelly surface layer; moderately slow and slow permeability below 11 inches.	Moderate: gravelly surface layer.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow and slow permeability; gravelly surface layer.	Slight----------	Slight----------	Severe: gravelly surface layer; moderately slow and slow permeability below 11 inches; slope.	Moderate: gravelly surface layer.

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Cazenovia (cont.) CgA	Moderate: seasonal high water table at a depth of 1½ to 2 feet; shale rock at a depth of 3½ to 6 feet.	Severe: slow to moderately slow permeability below 11 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; shale rock at a depth of 3½ to 6 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; shale substratum at a depth of 3½ to 6 feet.
CgB	Moderate: seasonal high water table at a depth of 1½ to 2 feet; shale rock at a depth of 3½ to 6 feet.	Severe: slow to moderately slow permeability below 11 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; shale rock at a depth of 3½ to 6 feet; slope.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; shale substratum at a depth of 3½ to 6 feet.
Cheektowaga: Ch	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.
Churchville: ClA	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 9 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
ClB	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 9 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Claverack: CmA	Moderate: slow permeability; seasonal high water table at a depth of 1½ to 2 feet.	Severe: slow permeability below 32 inches; seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; subject to sloughing.
CmB	Moderate: slow permeability; seasonal high water table at a depth of 1½ to 2 feet.	Severe: slow permeability below 32 inches; seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; subject to sloughing.

FOR SELECTED NONFARM USES OF THE SOILS--Continued

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow and slow permeability; gravelly surface layer.	Slight----------	Slight----------	Severe: gravelly surface layer; moderately slow and slow permeability below 11 inches.	Moderate: gravelly surface layer.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow and slow permeability; gravelly surface layer; slope.	Slight----------	Slight----------	Severe: gravelly surface layer; moderately slow and slow permeability below 11 inches; slope.	Moderate: gravelly surface layer.
Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.
Severe: seasonal high water table at a depth of ½ to 1 foot; permeability.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability.	Moderate: seasonal high water table at a depth of ½ to 1 foot; slow permeability.
Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability; slope.	Moderate: seasonal high water table at a depth of ½ to 1 foot; slow permeability.
Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight----------	Moderate: sandy surface layer.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer.	Moderate: sandy surface layer.
Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight----------	Moderate: sandy surface layer.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer; slope.	Moderate: sandy surface layer.

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Collamer:				
CnA	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: moderately slow permeability below 15 inches; seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; subject to sloughing.
CnB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: moderately slow permeability below 15 inches; seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; subject to sloughing.
Colonie: CoB	Slight	Slight: severe pollution hazard.	Slight	Moderate: sands subject to sloughing.
Cosad: Cs	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 26 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot; subject to sloughing.
Dunkirk:				
DuB	Slight	Severe: moderately slow permeability below 14 inches.	Slight	Moderate: silt and very fine sand; subject to sloughing.
DuC3	Moderate: slope	Severe: moderately slow permeability below 14 inches.	Moderate: slope	Moderate: silt and very fine sand; subject to sloughing.
DvD3	Severe: slope	Severe: moderately slow permeability below 14 inches; slope.	Severe: slope	Moderate: silt and very fine sand; subject to sloughing.
Elnora: ElA, ElB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; severe pollution hazard.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sand subject to sloughing.
Farmington: FaA	Severe: hard bedrock at a depth of 1 to 1½ feet.	Severe: hard bedrock at a depth of 1 to 1½ feet.	Severe: hard bedrock at a depth of 1 to 1½ feet.	Severe: hard bedrock at a depth of 1 to 1½ feet.

FOR SELECTED NONFARM USES OF THE SOILS--Continued

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight.
Moderate: seasonal high water table at a depth of 1½ to 2 depth.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Slight.
Moderate: sandy surface layer.	Slight----------	Moderate: sandy surface layer.	Moderate: sandy surface layer.	Moderate: sandy surface layer.
Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 26 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of 1 foot; slow permeability below 26 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 26 inches.
Slight----------	Slight----------	Slight----------	Moderate: slope; moderately slow permeability below 14 inches.	Slight.
Moderate: slope-------	Slight----------	Moderate: slope------	Severe: slope--------	Moderate: slope.
Severe: slope---------	Moderate: slope------	Severe: slope--------	Severe: slope--------	Severe: slope.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer.	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sandy surface layer.	Moderate: sandy surface layer.
Moderate: hard bedrock at a depth of 1 to 1½ feet; stones and occasional rock outcrops.	Slight----------	Moderate: occasional rock outcrops and stones.	Severe: hard bedrock at a depth of 1 to 1½ feet; slopes; stones or occasional rock outcrops.	Severe: hard bedrock at a depth of 1 to 1½ feet; stones and occasional rock outcrops.

TABLE 9.--ESTIMATED DEGREE AND KIND OF LIMITATIONS

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Fonda: Fo	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.
Fredon: Fr	Severe: seasonal high water table at a depth of ½ to 1 foot; persists for long periods in places.	Severe: seasonal high water table at a depth of ½ to 1 foot; severe hazard of pollution.	Severe: seasonal high water table at a depth of ½ to 1 foot; persists for long periods in places.	Severe: seasonal high water table at a depth of ½ to 1 foot; subject to sloughing.
Galen: GnA, GnB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; variable permeability; severe pollution hazard.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; sand subject to sloughing.
Hamlin: Ha	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding and sloughing.
Hilton:				
HgA	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: moderately slow or slow permeability below 15 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight
HgB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: moderately slow or slow permeability below 15 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Slight
HlA	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: moderately slow or slow permeability below 15 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight
HlB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: moderately slow or slow permeability below 15 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.
Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot; gravelly surface layer.
Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Slight.
Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer.	Moderate: gravelly surface layer.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer; slope.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer; slope.	Moderate: gravelly surface layer.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of ½ to 2 feet.	Slight.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer; slope.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of ½ to 2 feet; slope.	Slight.

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TABLE 9.--ESTIMATED DEGREE AND KIND OF LIMITATIONS

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Hilton and Cayuga:				
HmA	Moderate: seasonal high water table at a depth of 1½ to 2 feet; hard bedrock at a depth of 3½ to 6 feet.	Severe: moderately slow or slow permeability below 8 to 15 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: hard bedrock at a depth of 3½ to 6 feet.
HmB	Moderate: seasonal high water table at a depth of 1½ to 2 feet; hard bedrock at a depth of 3½ to 6 feet.	Severe: moderately slow or slow permeability below 8 to 15 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Moderate: hard bedrock at a depth of 3½ to 6 feet.
Howard:				
HoA	Slight	Slight: severe pollution hazard.	Slight	Moderate: loose sand and gravel at a depth of 44 inches; subject to sloughing.
HoB	Slight	Slight: severe pollution hazard.	Slight	Moderate: loose sand and gravel at a depth of 44 inches; subject to sloughing.
HoC	Moderate: slope	Moderate: slope; severe pollution hazard.	Moderate: slope	Moderate: slope; loose sand and gravel at a depth of 44 inches; subject to sloughing.
Hudson:				
HsB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: slow permeability below 12 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; silt and clay subject to sloughing.
HtC3	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Severe: slow permeability below 12 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; slope.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; silt and clay subject to sloughing.
HuF3	Severe: slope	Severe: slope; slow permeability.	Severe: slope	Severe: slope

FOR SELECTED NONFARM USES OF THE SOILS--Continued

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow to slow permeability below 15 inches.	Slight	Slight	Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow to slow permeability below 8 to 10 inches.	Slight.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow to slow permeability below 15 inches; slope.	Slight	Slight	Moderate: seasonal high water table at a depth of 1½ to 2 feet; moderately slow to slow permeability below 8 to 10 inches; slope.	Slight.
Moderate: gravelly surface layer.	Slight	Slight	Moderate: gravelly surface layer.	Moderate: gravelly surface layer.
Moderate: slope; gravelly surface layer.	Slight	Slight	Moderate: slope; gravelly surface layer.	Moderate: gravelly surface layer.
Moderate: slope; gravelly surface layer.	Slight	Moderate: slope	Severe: slope	Moderate: slope; gravelly surface layer.
Severe: slow permeability below 12 inches.	Slight	Slight	Severe: slow permeability below 12 inches.	Slight.
Severe: slow permeability below 12 inches.	Moderate: silty clay loam surface layer.	Moderate: slope; silty clay loam surface layer.	Severe: slope; silty clay loam surface layer; slow permeability below 12 inches.	Moderate: slope; silty clay loam surface layer.
Severe: slope; slow permeability.	Severe: slope	Severe: slope	Severe: slope; slow permeability.	Severe: slope.

TABLE 9.--ESTIMATED DEGREE AND KIND OF LIMITATIONS

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Lairdsville: LaB--------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; red shale bedrock at a depth of 1½ to 3½ feet.	Severe: slow permeability below 8 inches; shale bedrock at a depth of 1½ to 3½ feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; red shale at a depth of 1½ to 3 feet.	Moderate: red shale bedrock at a depth of 1½ to 3½ feet.
Lakemont: Lc----------	Severe: seasonal high water table at a depth of 0 to ½ foot; ponding.	Severe: seasonal high water table at a depth of 0 to ½ foot; ponding; slow permeability.	Severe: seasonal high water table at a depth of 0 to ½ foot; ponding.	Severe: seasonal high water table; ponding; silt and clay subject to sloughing.
Lamson: Ld, Lg----------	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table at a depth of 0 to ½ foot; ponding.	Severe: prolonged high water table; ponding; sand subject to sloughing.
Lockport: Lo----------	Severe: seasonal high water table at a depth of ½ to 1½ feet; red shale bedrock at a depth of 1½ to 3½ feet.	Severe: slow permeability below 8 inches; seasonal high water table at a depth of ½ to 1½ feet; red shale bedbedrock at a depth of 1½ to 3½ feet.	Severe: seasonal high water table at a depth of ½ to 1½ feet; red shale bedrock at a depth of 1½ to 3½ feet.	Moderate: seasonal high water table at a depth of ½ to 1½ feet; red shale bedrock at a depth of 1½ to 3½ feet.
Madalin:				
Ma----------	Severe: prolonged high water table; ponding; silt and clay subject to sloughing.	Severe: prolonged high water table; ponding; silt and clay subject to sloughing.	Severe: prolonged high water table; ponding; silt and clay subject to sloughing.	Severe: prolonged high water table; ponding; silt and clay subject to sloughing.
Md----------	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.	Severe: prolonged high water table; ponding.
Massena: Mf----------	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; possible pollution hazard.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Minoa: Mn----------	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; possible pollution hazard.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot; sand subject to sloughing.
Muck: Ms----------	Severe: prolonged high water table; frequent ponding.	Severe: prolonged high water table; frequent ponding.	Severe: prolonged high water table; frequent ponding.	Severe: prolonged high water table; frequent ponding.

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Severe: slow permeability below 8 inches.	Slight----------	Slight----------	Severe: slow permeability at a depth below 8 inches.	Moderate: red shale bedrock at a depth of 1½ to 3½ feet.
Severe: seasonal high water table at a depth of 0 to ½ foot; subject to ponding; slow permeability.	Severe: seasonal high water table at a depth of 0 to ½ foot; subject to ponding.	Severe: seasonal high water table at a depth of 0 to ½ foot; subject to ponding.	Severe: seasonal high water table at a depth of 0 to ½ foot; subject to ponding; slow permeability.	Severe: seasonal high water table at a depth of 0 to ½ foot; subject to ponding.
Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.
Severe: seasonal high water table at a depth of ½ to 1½ feet; some ponding; slow permeability.	Moderate: seasonal high water table at a depth of ½ to 1½ feet; some ponding.	Moderate: seasonal high water table at a depth of ½ to 1½ feet.	Severe: seasonal high water table at a depth of ½ to 1½ feet; some ponding; slow permeability.	Moderate: seasonal high water table at a depth of ½ to 1½ feet; some ponding; slow permeability below 8 inches.
Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.
Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.	Severe: prolonged high water table; ponding; slow permeability.
Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Severe: prolonged high water table; frequent ponding.	Severe: prolonged high water table; frequent ponding.	Severe: prolonged high water table; frequent ponding.	Severe: prolonged high water table; frequent ponding.	Severe: prolonged high water table; frequent ponding.

TABLE 9.--ESTIMATED DEGREE AND KIND OF LIMITATIONS

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Ovid:				
OvA, OvB	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow to slow permeability below 11 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
OwA, OwB	Severe: seasonal high water table at a depth of ½ to 1 foot; hard bedrock at a depth of 3½ to 6 feet below the surface.	Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow to slow permeability below 11 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot; hard bedrock at a depth of 3½ to 6 feet.	Moderate: seasonal high water table at a depth of ½ to 1 foot; hard bedrock at a depth of 3½ to 6 feet.
Phelps: PsA	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; severe pollution hazard.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; subject to sloughing.
Raynham: RaA, RaB	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot; subject to severe sloughing.
Rhinebeck:				
RbA, RbB	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 10 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
RhA, RhB	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 10 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot; severe sloughing of the sandy substratum.
Rk	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 24 inches.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot; some sloughing.

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow to slow permeability below 11 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow to slow permeability below 11 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow to slow permeability below 11 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow to slow permeability below 11 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer.	Slight----------	Slight----------	Moderate: seasonal high water table at a depth of 1½ to 2 feet; gravelly surface layer.	Moderate: gravelly surface layer.
Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 10 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 10 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 10 inches; silty clay loam surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 10 inches; silty clay loam surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.
Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 24 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability below 24 inches.	Moderate: seasonal high water table at a depth of ½ to 1 foot.

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Niagara: NaA, NaB-------	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; moderately slow permeability.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water at a depth of ½ to 1 foot; subject to sloughing.
Odessa: OdA, OdB--------	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot; slow permeability.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Ontario:				
OnB----------	Slight----------	Severe: moderately slow permeability below 14 inches.	Moderate: slope-----	Slight----------
OnC----------	Moderate: slope------	Severe: moderately slow permeability below 14 inches.	Severe: slope-------	Slight----------
OnC3----------	Moderate: slope------	Severe: moderately slow permeability below 14 inches.	Severe: slope-------	Slight----------
OnD3----------	Severe: slope--------	Severe: moderately slow permeability below 14 inches; slope.	Severe: slope-------	Moderate: slope-------
OoA----------	Moderate: hard bedrock at a depth of 3½ to 6 feet.	Severe: moderately slow permeability below 14 inches.	Slight----------	Moderate: hard bedrock at a depth of 3½ to 6 feet.
OoB----------	Moderate: hard bedrock at a depth of 3½ to 6 feet.	Severe: moderately slow permeability below 14 inches.	Moderate: slope-----	Moderate: hard bedrock at a depth of 3½ to 6 feet.
Otisville:				
OsA----------	Slight----------	Slight: severe pollution hazard.	Slight----------	Slight----------
OsB----------	Slight----------	Slight: severe pollution hazard.	Moderate: slope-----	Slight----------

FOR SELECTED NONFARM USES OF THE SOILS--Continued

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot.
Severe: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.	Severe: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.	Moderate: seasonal high water table at a depth of ½ to 1 foot; silty clay loam surface layer.
Moderate: moderately slow permeability below 14 inches.	Slight----------	Slight----------	Moderate: slope; moderately slow permeability below 14 inches.	Slight.
Moderate: slope-------	Slight----------	Moderate: slope------	Severe: slope; moderately slow permeability below 14 inches.	Moderate: slope.
Moderate: slope-------	Slight----------	Moderate: slope------	Severe: slope; moderately slow permeability below 14 inches.	Severe: eroded; slope.
Severe: slope----------	Moderate: slope------	Severe: slope--------	Severe: slope; moderately slow permeability below 14 inches.	Severe: eroded; slope.
Moderate: moderately slow permeability below 14 inches.	Slight----------	Slight----------	Moderate: moderately slow permeability below 14 inches.	Slight.
Moderate: moderately slow permeability below 14 inches; slope.	Slight----------	Slight----------	Moderate: moderately slow permeability below 14 inches.	Slight.
Moderate: gravelly surface layer.	Slight----------	Slight----------	Moderate: gravelly surface layer.	Moderate: gravelly surface layer.
Moderate: gravelly surface layer.	Slight----------	Slight----------	Moderate: slope; gravelly surface layer.	Moderate: gravelly surface layer.

TABLE 9.--ESTIMATED DEGREE AND KIND OF LIMITATIONS

Soil and map symbols	Community developments			
	Homesites	Septic tank effluent disposal	Streets and parking lots	Underground utilities
Rock land:				
RoA	Severe: bedrock at or near the surface; stones.	Severe: bedrock at or near the surface; stones.	Severe: bedrock at or near the surface; stones.	Severe: bedrock at or near the surface; stones.
RoF	Severe: bedrock at or near the surface; stones; slope.	Severe: bedrock at or near the surface; stones; slope.	Severe: bedrock at or near the surface; stones; slope.	Severe: bedrock at or near the surface; stones; slope.
Schoharie: ShB	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Severe: slow permeability below 12 inches.	Moderate: seasonal high water table at a depth of 1½ to 2 feet.	Moderate: seasonal high water table at a depth of 1½ to 2 feet; silty clay loam surface layer.
Stafford: St, Su	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Severe: seasonal high water table at a depth of ½ to 1 foot.	Moderate: seasonal high water table at a depth of ½ to 1 foot; subject to sloughing.
Sun: Sw	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.
Wayland: Wa	Severe: prolonged high water table; subject to flooding.	Severe: prolonged high water table; subject to flooding.	Severe: prolonged high water table; subject to flooding.	Severe: prolonged high water table; subject to flooding.

FOR SELECTED NONFARM USES OF THE SOILS--Continued

Recreation use				
Campsites	Hiking and riding trails	Picnic and extensive play areas	Athletic fields and intensive play areas	Lawns and fairways
Severe: bedrock at or near the surface; stones.	Severe: bedrock at or near the surface; stones.	Severe: bedrock at or near the surface; stones.	Severe: bedrock at or near the surface; stones.	Severe: bedrock at or near the surface; stones.
Severe: bedrock at or near the surface; stones; slope.	Severe: bedrock at or near the surface; stones; slope.	Severe: bedrock at or near the surface; stones; slope.	Severe: bedrock at or near the surface; stones; slope.	Severe: bedrock at or near the surface; s stones; slope.
Severe: slow permeability at a depth below 12 inches.	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Severe: slow permeability below 12 inches.	Moderate: silty clay loam surface layer.
Severe: seasonal high water table at a depth of $\frac{1}{2}$ to 1 foot.	Moderate: seasonal high water table at a depth of $\frac{1}{2}$ to 1 foot; sandy surface layer.	Moderate: seasonal high water table at a depth of $\frac{1}{2}$ to 1 foot; sandy surface layer.	Severe: seasonal high water table at a depth of $\frac{1}{2}$ to 1 foot.	Moderate: seasonal high water table at a depth of $\frac{1}{2}$ to 1 foot; sandy surface layer.
Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.	Severe: prolonged high water table; subject to ponding.
Severe: prolonged high water table; subject to flooding and ponding.	Severe: prolonged high water table; subject to flooding and ponding.	Severe: prolonged high water table; subject to flooding and ponding.	Severe: prolonged high water table; subject to flooding and ponding.	Severe: prolonged high water table; subject to flooding and ponding.

DESCRIPTIONS OF THE SOILS

This section describes the soil series and mapping units of Niagara County. The approximate acreage and proportionate extent of each mapping unit are given in table 10.

In the pages that follow, a general description of each soil series is given. Each series contains a short description of a profile that is representative of the series; a more detailed description of the same profile that soil scientists, engineers, and others can use to make highly technical interpretations; and one or more paragraphs giving the range in characteristics of the soils in the series, as mapped in this county. Unless otherwise specified the colors given are for moist soil. Following the series description, each mapping unit in the series is described individually. For full information on any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit. Miscellaneous land types, such as Alluvial land, are described in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At the end of the description of each mapping unit are listed the capability unit and the woodland group in which the mapping unit has been placed. The page where each of these groups is described can be found readily by referring to the Guide to Mapping Units.

For more general information about the soils, the reader can refer to the section "General Soil Map," in which broad patterns of soils are described. Many of the terms used in the soil descriptions and other parts of the survey are defined in the Glossary.

TABLE 10.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Alluvial land	363	0.1	Cazenovia gravelly silt loam, shale substratum, 0 to 3 percent slopes	696	0.2
Altmar loamy fine sand	866	.2	Cazenovia gravelly silt loam, shale substratum, 3 to 8 percent slopes	326	.1
Altmar gravelly fine sandy loam	1,327	.4	Cheektowaga fine sandy loam	616	.2
Appleton gravelly loam, 0 to 3 percent slopes	14,463	4.2	Churchville silt loam, 0 to 2 percent slopes	8,003	2.4
Appleton silt loam, 0 to 3 percent slopes	15,387	4.5	Churchville silt loam, 2 to 6 percent slopes	382	.1
Arkport very fine sandy loam, 0 to 6 percent slopes	865	.2	Claverack loamy fine sand, 0 to 2 percent slopes	3,051	.9
Arkport very fine sandy loam, 6 to 12 percent slopes	414	.1	Claverack loamy fine sand, 2 to 6 percent slopes	2,828	.8
Arkport fine sandy loam, gravelly substratum, 0 to 2 percent slopes	703	.2	Collamer silt loam, 0 to 2 percent slopes	3,938	1.2
Arkport fine sandy loam, gravelly substratum, 2 to 6 percent slopes	480	.1	Collamer silt loam, 2 to 6 percent slopes	6,130	1.8
Bombay fine sandy loam, 0 to 2 percent slopes	820	.2	Colonie loamy fine sand, 0 to 6 percent slopes	752	.2
Bombay fine sandy loam, 2 to 6 percent slopes	448	.1	Cosad fine sandy loam	4,525	1.3
Brockport silt loam, 0 to 4 percent slopes	531	.2	Cut and fill land	2,473	.7
Canandaigua silt loam	10,132	3.0	Dunkirk silt loam, 2 to 6 percent slopes	883	.3
Canandaigua silty clay loam	3,931	1.2	Dunkirk silt loam, 6 to 12 percent slopes, eroded	724	.2
Cayuga and Cazenovia silt loams, 0 to 2 percent slopes	618	.2	Dunkirk and Arkport soils, 12 to 20 percent slopes, eroded	427	.1
Cayuga and Cazenovia silt loams, 2 to 6 percent slopes	3,415	1.0	Elnora loamy fine sand, 0 to 2 percent slopes	2,793	.8
Cayuga and Cazenovia silt loams, 6 to 12 percent slopes	436	.1	Elnora loamy fine sand, 2 to 6 percent slopes	1,533	.4
Cazenovia gravelly silt loam, 0 to 3 percent slopes	187	.1	Farmington silt loam, 0 to 8 percent slopes	777	.2
Cazenovia gravelly silt loam, 3 to 8 percent slopes	313	.1			

TABLE 10.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Fonda mucky silt loam	2,830	0.8	Ontario loam, 8 to 15 percent slopes	461	0.1
Fredon gravelly loam	3,019	.9	Ontario loam, 8 to 15 percent slopes, eroded	251	.1
Galen very fine sandy loam, 0 to 2 percent slopes	2,354	.7	Ontario loam, 15 to 30 percent slopes, eroded	294	.1
Galen very fine sandy loam, 2 to 6 percent slopes	1,681	.5	Ontario loam, limestone substratum, 0 to 3 percent slopes	748	.2
Hamlin silt loam	3,336	1.0	Ontario loam, limestone substratum, 3 to 8 percent slopes	758	.2
Hilton gravelly loam, 0 to 3 percent slopes	7,503	2.2	Otisville gravelly sandy loam, 0 to 3 percent slopes	768	.2
Hilton gravelly loam, 3 to 8 percent slopes	2,754	.8	Otisville gravelly sandy loam, 3 to 8 percent slopes	1,414	.4
Hilton silt loam, 0 to 3 percent slopes	8,362	2.4	Ovid silt loam, 0 to 2 percent slopes	20,180	5.9
Hilton silt loam, 3 to 8 percent slopes	6,499	1.9	Ovid silt loam, 2 to 6 percent slopes	3,874	1.1
Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes	2,586	.8	Ovid silt loam, limestone substratum, 0 to 3 percent slopes	883	.3
Hilton and Cayuga silt loams, limestone substratum, 3 to 8 percent slopes	846	.2	Ovid silt loam, limestone substratum, 3 to 8 percent slopes	236	.1
Howard gravelly loam, 0 to 3 percent slopes	1,633	.5	Phelps gravelly loam, 0 to 5 percent slopes	4,158	1.2
Howard gravelly loam, 3 to 8 percent slopes	1,986	.6	Raynham silt loam, 0 to 2 percent slopes	8,343	2.4
Howard gravelly loam, 8 to 15 percent slopes	147	(1/)	Raynham silt loam, 2 to 6 percent slopes	666	.2
Hudson silt loam, 2 to 6 percent slopes	3,024	.9	Rhinebeck silt loam, 0 to 2 percent slopes	21,246	6.2
Hudson silty clay loam, 6 to 12 percent slopes, eroded	299	.1	Rhinebeck silt loam, 2 to 6 percent slopes	1,750	.5
Hudson soils, 20 to 45 percent slopes, eroded	195	.1	Rhinebeck silty clay loam, sandy substratum, 0 to 2 percent slopes	5,125	1.5
Lairdsville silt loam, 0 to 6 percent slopes	525	.2	Rhinebeck silty clay loam, sandy substratum, 2 to 6 percent slopes	245	.1
Lakemont silty clay loam	12,870	3.8	Rhinebeck silt loam, thick surface variant	1,082	.3
Lamson very fine sandy loam	1,554	.5	Rock land, nearly level	517	.2
Lamson fine sandy loam, gravelly substratum	961	.3	Rock land, steep	1,002	.3
Lockport silt loam	7,292	2.1	Schoharie silty clay loam, 2 to 6 percent slopes	856	.2
Madalin silt loam	9,750	2.9	Stafford loamy fine sand	602	.2
Madalin silt loam, loamy subsoil variant	3,424	1.0	Stafford loamy fine sand, gravelly substratum	1,577	.5
Made land	2,019	.6	Sun silt loam	7,669	2.2
Massena fine sandy loam	2,293	.7	Wayland silt loam	2,776	.8
Minoa very fine sandy loam	5,965	1.8	Urban (not mapped)	9,218	2.7
Muck, shallow	1,121	.3	Pits and quarries	805	.2
Niagara silt loam, 0 to 2 percent slopes	10,050	3.0	Indian Reservation	6,335	1.9
Niagara silt loam, 2 to 6 percent slopes	268	.1	New York State Power Authority Reservoir	1,910	.6
Odessa silty clay loam, 0 to 2 percent slopes	23,852	7.0	Water areas less than 40 acres	2,905	.8
Odessa silty clay loam, 2 to 6 percent slopes	1,574	.5	Total	341,120	100.0
Ontario loam, 2 to 8 percent slopes	3,338	1.0			

1/ Less than 0.05 percent.

Alluvial Land

Alluvial land (Ad) consists of alluvial soils that generally are stratified and vary widely in texture and drainage within short distances. Soil materials of this mapping unit have been recently deposited by streams during periods of flooding. Changes are frequent in the make up of materials and in surface topography because of changes in the stream flow and in the flooding cycle. The soil patterns are so variable that mapping separate soil series is not practical. Profile development is little or none. Most of this land has been mapped adjacent to the smaller streams in the county that flood several times a year.

Some areas are wooded. Cleared areas are mainly in pasture or are idle and reverting to brush and weeds. (Capability unit Vw-1; not assigned to a woodland suitability group)

Altmar Series

The Altmar series consists of deep, moderately well drained to somewhat poorly drained, coarse textured to moderately coarse textured soils that formed in beach sands and in associated deposits of sand and gravel. These soils are located north of the Ridge Road (U.S. Highway 104) in Niagara County The two major areas are near the southern part of the town of Wilson (Daniels Road) and the southeastern part of the town of Newfane (Hess Road). These soils are level or nearly level and occupy areas that are intermediate between the Otisville soils at the higher elevations and the Fredon soils at the lower elevations. Slope is less than 4 percent.

A representative profile of an Altmar soil has a surface layer of dark grayish-brown gravelly fine sandy loam 10 inches thick. The subsoil, about 6 inches thick, is yellowish-brown loamy fine sand that is distinctly mottled and is neutral in reaction. A loose, brown to grayish-brown substratum occurs at a depth of 16 inches. It consists of alternating layers of sand and gravel. It is neutral in the upper part and is mildly alkaline at a depth of 40 inches.

In Altmar soils the seasonal high water table is within 18 inches of the surface early in spring and during other excessively wet periods. Permeability is moderately rapid to rapid throughout. Depth of rooting is restricted by the water table, and most roots are in the upper 20 to 24 inches of the profile. As the growing season progresses and the water table is lowered, roots can extend to a depth of about 30 inches. These soils have low available moisture capacity. They respond well to application of fertilizer and to other good management practices.

Representative profile of Altmar gravelly fine sandy loam in the town of Wilson, 100 feet west of Daniels Road and 300 feet south of New Road; cultivated area:

Ap--0 to 10 inches, dark grayish-brown (10YR 4/2) gravelly fine sandy loam; weak, fine and medium, subangular blocky structure to weak, fine, granular structure; friable; abundant, fine roots; 20 percent gravel; neutral; abrupt, smooth boundary. 8 to 12 inches thick.

IIB2--10 to 16 inches, yellowish-brown (10YR 5/4) loamy fine sand; less than 5 percent fine gravel; common, medium, distinct, yellowish-red (5YR 5/6) and dark reddish-brown (5YR 3/4) mottles; some white (10YR 8/1) quartz sand grains; weak, very fine, granular structure or structureless (single grain); very friable to loose; plentiful, fine roots; neutral; clear, smooth boundary. 4 to 12 inches thick.

IIIC1--16 to 24 inches, brown to dark-brown (10YR 4/3) gravelly sand; very few fines finer than fine sand; many, white (10YR 8/1) and black (10YR 2/1), washed sand grains giving a salt-and-pepper appearance; structureless (single grain); loose; few to plentiful, fine roots; about 25 percent gravel, pebbles mostly less than 3 inches in diameter; neutral; abrupt, smooth boundary. 5 to 15 inches thick.

IVC2--24 to 27 inches, brown (10YR 5/3) loamy fine sand; many, medium, faint, yellowish-brown (10YR 5/4) mottles; structureless (single grain); loose; very few roots; a few pebbles; neutral; abrupt, broken boundary. 0 to 5 inches thick.

VC3--27 to 33 inches, brown to dark-brown (10YR 4/3) gravelly sand; structureless (single grain); loose; no roots; neutral; abrupt, smooth boundary. 3 to 8 inches thick.

VIC4--33 to 36 inches, grayish-brown (10YR 5/2) loamy fine sand; few, medium, distinct, brown (7.5YR 5/4) mottles; structureless (single grain); loose; no roots; very few pebbles; neutral; abrupt, smooth boundary. 2 to 7 inches thick.

VIIC5--36 to 50 inches, grayish-brown (10YR 5/2) gravelly sand; structureless (single grain); loose; no roots; neutral to moderately alkaline.

The solum ranges in thickness from 15 to 24 inches. Carbonates are generally at a depth of more than 30 inches. Reaction of the solum ranges from strongly acid to neutral. Reaction increases with depth and is slightly acid to moderately alkaline within 40 inches where the soil is unlimed. Coarse fragments range from a few pebbles to a content of as much as 60 percent in any one horizon below the Ap horizon, but the average content in the 10- to 40-inch section does not exceed 35 percent. Percentage of clay in any horizon below the Ap is less than 10 percent and typically is less than 5 percent. The average content of silt plus very fine sand below the Ap horizon is less than 30 percent. The Ap horizon is 10YR or 7.5YR in hue, 4 or 3 in value, and 2 or 3 in chroma; value when dry is more than 5.5. Texture of the Ap horizon ranges from loamy fine sand to gravelly fine sandy loam.

The B horizon ranges in hue from 10YR to 5YR, in value from 4 to 5, and in chroma from 3 to 6. The B horizon contains both high-chroma and

low-chroma mottles, but mottles with a chroma of 2 do not exceed 50 percent in any horizon below the Ap and at a depth of less than 20 inches. The hue of the C horizon ranges from 10YR to 5YR, value from 4 to 5, and chroma from 2 to 4. Any C horizon present at a depth of less than 20 inches has a chroma of 3 or 4. Texture is stratified loamy fine sand, sand, and gravel. The C horizon is commonly mottled. It is generally neutral or moderately alkaline but is slightly acid in places.

Altmar soils are associated with the excessively drained Otisville soils and formed in similar deposits. They resemble the Elnora and Stafford soils in texture, but the Elnora and Stafford soils lack the gravelly texture that is characteristic of the Altmar soils. Altmar soils are better drained and slightly coarser textured than the Fredon soils.

Altmar gravelly fine sandy loam (0 to 3 percent slopes) (Am).--This soil has the profile described as representative for the series. This soil occurs on or close to beach and offshore bars that were deposited in postglacial Lake Iroquois. The ground water table is seasonally high. Individual areas of this soil range from less than 5 acres to more than 50 acres in size. They are generally oblong in shape.

Included in mapping are small areas of the well-drained Otisville and somewhat poorly drained Fredon or Stafford soils. The Otisville soils are at highest elevations, and the Fredon or Stafford soils are in the depressions or at lower elevations. There are a few inclusions of finer textured Phelps soils, sandy Elnora soils, and Altmar loamy fine sand. In some areas are inclusions of soils that are similar to the Altmar soils but are less than 40 inches thick over glacial till, silt, or clay.

This soil is suited to most crops grown in the county. It is well suited to many vegetables and fruit crops under intensive management. Gravel interferes with the growth and cultivation of some crops but also increases the growth of some early crops, such as sweet corn and tomatoes, because of more favorable heat relationships in comparison to similar soils without a gravelly surface layer. (Capability unit IIw-1; woodland suitability group 4s1)

Altmar loamy fine sand (0 to 3 percent slopes) (Af).--This soil has a profile that differs from the representative profile mainly in that it has a loamy fine sand surface layer that is generally thinner and contains less organic matter. Lime needs are commonly greater. This soil occupies beach and offshore bars of postglacial Lake Iroquois. Individual areas are long and narrow or oblong in shape. They are mostly less than 20 acres in size.

The most common inclusions are small areas of Otisville, Elnora, Colonie, Fredon, and Stafford soils. In places the Stafford or Fredon soils occur along drainageways and in depressions. Near Ridge Road (U.S. Highway 104), common inclusions are of the well-drained, gravelly Otisville soils. North of Ridge Road in sandy areas, there are inclusions of deep, sandy Colonie and Elnora soils. Some areas have inclusions of soils that are similar to the Altmar soils but are less than 40 inches deep to glacial till, silt, or clay.

This soil is suited to all field and cash crops and is well suited to specialized vegetables or fruit crops. It needs protection from soil blowing where used intensively. Drainage of included wetter areas will improve the usability of this soil. (Capability unit IIw-1; woodland suitability group 4s1)

Appleton Series

The Appleton series consists of deep, somewhat poorly drained, medium-textured soils. These soils formed in calcareous glacial till that was derived mainly from sandstone and limestone. They are nearly level soils of the till plain, and they have slow runoff or occupy areas that receive runoff.

In a representative profile, a cultivated Appleton soil has a very dark grayish-brown, neutral gravelly loam plow layer 8 inches thick. This is underlain by light brownish-gray to pale-brown, neutral, firm loam that is distinctly mottled. The loam merges with a reddish brown, neutral heavy loam subsoil at a depth of 12 inches. The subsoil is distinctly mottled, is firm, and consists of about 10 percent coarse fragments. The substratum is calcareous and occurs at a depth of 20 inches. It is dense, compact, distinctly mottled, reddish-brown loam that restricts movement of water and air.

Early in the growing season and during rainy spells later in the season, free water is at a depth of 8 to 10 inches in some places. During dry periods, the water table drops to a depth of more than 20 inches. The slowly permeable, dense till substratum of Appleton soils is responsible for the perched water table. In spring, plant roots are confined to the 8- to 10-inch zone above the perched water table, and they extend to a depth of 15 to 24 inches as the season progresses. Available moisture capacity is moderate.

Representative profile of Appleton gravelly loam, 0 to 3 percent slopes, in an idle area, one-half mile south of Townline Road on west side of Quaker Road:

Ap--0 to 8 inches, gravelly loam that is very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) when broken and rubbed; moderate, medium, granular structure; friable; about 20 percent coarse fragments; abundant fine roots; neutral; abrupt, smooth boundary. 7 to 11 inches thick.

A2--8 to 12 inches, light brownish-gray (10YR 6/2) to pale-brown (10YR 6/3) loam; common, medium, distinct, yellowish-brown (10YR 5/6-5/8) and reddish-brown (2.5YR 4/4) mottles; weak, medium, subangular blocky structure; firm; about 10 percent coarse fragments; plentiful fine roots; neutral; gradual, irregular boundary. 2 to 7 inches thick.

B2t--12 to 20 inches, reddish-brown (5YR 4/3) heavy loam; dark reddish-gray (5YR 4/2) to reddish-gray (5YR 5/2) prism faces; dark grayish-brown (2.5Y 4/2) clay films; common, fine, distinct, strong-brown (7.5YR 5/6-5/8) mottles; interfingering of light brownish gray (10YR 6/2) in upper 3 inches; weak, coarse, prismatic structure breaking to moderate, medium, blocky structure; firm; about 10 percent coarse fragments; few to plentiful fine roots; neutral; clear, wavy boundary. 8 to 12 inches thick.

C--20 to 50 inches, reddish-brown (5YR 4/3) loam; few, medium, distinct, yellowish-red (5YR 5/6) mottles; gray carbonate streaks; moderate, medium, platy structure; firm; about 10 percent coarse fragment; very few fine roots; moderately alkaline and calcareous.

The solum ranges from 18 to 30 inches in thickness, and this thickness corresponds to the depth to carbonates. Content of coarse fragments ranges from less than 5 percent is 35 percent in any horizon, but the average content between depths of 10 and 40 inches is less than 15 percent. Reaction ranges from medium acid to neutral in the solum to moderately alkaline in the C horizon.

The Ap horizon is in a hue of 10YR or 7.5YR, a value of 3 or 4, and a chroma of 2 or 3. If the A horizon is dry, its value is more than 5.5. The Ap horizon ranges from silt loam to gravelly loam. The A2 horizon is 10YR or 7.5YR in hue, 5 to 6 in value, and 2 or 3 in chroma. It ranges from loam to silt loam and contains coarse fragments that make up from less than 5 percent to as much as 25 percent of the horizon. Because of the content of reddish sandstone, hues of the B horizon are 10YR, 7.5YR, and 5YR. Chroma is 3 or 4 in the matrix but is 2 on ped faces. Mottles with chroma of 2 or less and with chroma of more than 2 are common to many.

The Bt horizon ranges from silt loam to heavy loam and has a clay content ranging from 18 to 27 percent. Structure ranges from subangular blocky to prismatic. Clay films are present on horizontal and vertical ped faces and in pores. The B horizon is mostly neutral, but it becomes slightly alkaline with depth.

The C horizon ranges from 10YR to 5YR in hue and has values and chromas comparable to those in the B horizon. The C horizon is not mottled in some places. It normally has platy structure, but the structure can range to weak blocky. The C horizon is moderately alkaline and calcareous.

The Appleton soils formed in deposits similar to those of the moderately well drained Hilton soils and the poorly drained or very poorly drained Sun soils. Appleton soils are similar to Massena and Ovid soils but have a finer textured B2 horizon than Massena soils and a coarser textured Bt horizon than Ovid soils.

Appleton gravelly loam, 0 to 3 percent slopes (AnA).--This soil has the profile described as representative for the series. Individual areas range from less than 5 to more than 100 acres in size. The areas normally are oblong and have a northeast to southwest orientation.

Most commonly included with this soil in mapping are small areas of soils that formed in similar material, such as better drained Hilton soils on slight rises and knolls and wetter Sun soils in low spots and along drainageways. Also included are spots that have a nongravelly, very gravelly, sandy or stony surface layer. In some places there are small inclusions of Bombay or Massena soils where sand caps the glacial till. A few large inclusions of Massena soils occur, especially in the town of Newfane.

In some areas where the soil is finer textured, inclusions of Cazenovia or Ovid soils occur. In the eastern half of Wilson Township and in Newfane Township, included areas of gravelly outwash soils occur in some places.

This Appleton soil is suited to crops, pasture, or trees. Unless drained, it responds poorly to management. It is better suited to sod crops that grow well when the water table is high. Plantings are usually delayed if this soil is not drained.

Where this soil is artificially drained, and adequate lime and fertilizer are applied, the soil is suited to most crops grown in the county. The gravel and stones in the surface layer interfere with some vegetable root crops in many places and are hard on some types of farm machinery. (Capability unit IIIw-1; woodland suitability group 3w2)

Appleton silt loam, 0 to 3 percent slopes (ApA).--This soil has a profile that is similar to the one described as representative for the series, but it lacks the gravelly loam surface layer and generally contains more silt throughout. Individual areas range from less than 5 acres to more than 100 acres in size. Areas are normally oblong and are oriented in a general northeast-southwest direction.

Included with this soil in mapping are small areas of better drained Hilton and Bombay soils on slight rises. Also included, in landscapes similar to those of this soil, are somewhat poorly drained but coarser textured Massena soils and, in small depressions, spots of wetter Sun soils. Where lacustrine sediments cover the till, small included areas of silty Niagara and Collamer soils occur.

This soil is suited to crops, pasture, or trees. Drainage is needed for good crop growth. If drained, this soil is well suited to most crops grown in the area, including vegetables. (Capability unit IIIw-1; woodland suitability group 3w2)

Arkport Series

The Arkport series consist of deep, well-drained, medium-textured to moderately coarse textured soils. These soils formed in deltaic deposits of fine sand and very fine sand. Arkport soils occur in two main areas in Niagara County. One area is along the north face of the limestone escarpment between the village of Gasport and the city of Lockport. The other main area is a triangular deltaic deposit near

the outlet of Eighteenmile Creek in the town of Newfane. Arkport soils are nearly level to steep and have slopes that range from 0 to 30 percent.

In a representative profile, the plow layer is brown to dark-brown, neutral very fine sandy loam 8 inches thick. This is underlain by brown, very friable, neutral loamy very fine sand that is 12 inches thick and contains three, discontinuous, reddish-brown bands. At a depth of 20 inches, there is a band of reddish-brown very fine sandy loam that is slightly sticky when wet. It is slightly acid, firm when moist, and 5 inches thick. From 25 to 32 inches below the surface, there is neutral, brown loamy fine sand that is very friable or loose. At a depth of 32 inches, a 3-inch, slightly sticky band occurs that is similar to the band that is at a depth of 20 inches. Between depths of 35 inches and 48 inches, there is a loamy fine sand layer that contains a few reddish-brown firm bands that are less than 1 inch thick. This layer is neutral and very friable. The substratum is a neutral to moderately alkaline, brown fine sand and occurs at a depth of 48 inches.

Arkport soils are among the first in the county to be ready for tillage in spring. Although the soils may be saturated during rainy periods in spring, only 2 to 4 drying days are needed before they are ready for cultivation. They are among the easiest soils in the county to cultivate because they have good drainage, a sandy loam texture, and a stone-free surface layer. The root zone is mainly in the topmost 30 to 40 inches of soil, but a few deep-rooted crops obtain water at greater depths. Available moisture capacity is moderate to high. Maintenance of organic matter is one of the major management needs.

Representative profile of Arkport very fine sandy loam, 6 to 12 percent slopes, in an idle area seven-sixteenths of a mile west of State Route 18 and Hess Road and 200 yards north of State Route 18:

Ap--0 to 8 inches, brown to dark-brown (10YR 4/3) very fine sandy loam; weak, fine, granular structure; very friable; abundant fine roots; neutral; abrupt, smooth boundary. 6 to 9 inches thick.

A2--8 to 13 inches, brown (7.5YR 5/4) loamy very fine sand; weak, fine, granular structure; very friable; abundant fine roots; neutral; gradual, wavy boundary. 5 to 9 inches thick.

A3--13 to 20 inches, brown (7.5YR 5/4) loamy very fine sand that has three, discontinuous, reddish-brown (5YR 4/4) lamellae less than one-half inch thick; weak, fine, granular structure; very friable; plentiful, fine roots; neutral; abrupt, wavy boundary. 6 to 12 inches thick.

B21t--20 to 25 inches, reddish-brown (5YR 4/4) very fine sandy loam lamellae; weak, coarse, blocky structure or massive; firm, slightly sticky; distinct clay bridges between sand grains; clay films in pores; few fine roots; slightly acid; abrupt, smooth boundary. 2 to 6 inches thick.

B22--25 to 32 inches, brown (7.5YR 5/4) loamy fine sand; weak, fine, granular structure or single grain; very friable to loose; few fine roots; neutral; abrupt, wavy boundary. 6 to 12 inches thick.

B23t--32 to 35 inches, horizon is similar to B21t horizon in color, texture, structure, and consistence; few fine roots; abrupt, wavy boundary. 2 to 4 inches thick.

B24--35 to 48 inches, brown (7.5YR 5/4) loamy fine sand to fine sand; weak, fine, granular structure to single grain; contains a few reddish-brown (5YR 4/4) lamellae; very friable to loose; very few fine roots; neutral; clear, wavy boundary. 9 to 20 inches thick.

C--48 to 60 inches, brown (7.5YR 5/2) fine sand; single grain; loose; no roots; neutral to moderately alkaline.

The solum ranges from 36 to 60 inches in thickness, and depth to carbonates ranges from 40 to 60 inches. Reaction ranges from strongly acid to neutral in the A horizon, medium acid to neutral in the B horizon, and neutral to moderately alkaline in the C horizon. The profile ranges from very fine sandy loam to fine sand, and the average clay content is less than 18 percent.

The Ap horizon ranges from 6 to 9 inches in thickness. It is mainly 10YR in hue, 3 to 5 in value, and 2 or 3 in chroma. When the Ap horizon is dry, values are more than 5.5. The A2 and A3 horizons are 10YR, 7.5YR, and 5YR in hue, range from 3 to 6 in chroma, and from 4 to 5 in value. The A horizon is free of mottles and, in some places, contains discontinuous lamellae less than one-half inch thick. The B horizon contains zones of alternating lamellae and lamellar horizons. The interlamellar horizons have hues of 10YR, 7.5YR, and 5YR, chromas from 2 to 4, and values of 3 to 5. Clay content is less than 5 percent. The lamellae range from 1/16 to 5 inches in thickness. They have hues of 10YR, 7.5YR, and 5YR, values of 3 to 5, and chromas of 2 to 4. The lamellae contain 1 to 10 percent more clay than the interlamellar material. Consistence is slightly firm or firm in the lamellae and ranges from loose to friable in the interlamellar material. The lamellae are wavy and discontinuous. Roots are plentiful to few in the B horizon.

The Arkport soils formed in deposits similar to those of the moderately well drained Galen soils. Arkport soils are similar to Colonie soils but are finer textured and contain thicker lamellae. They have a coarser textured subsoil than the well-drained Dunkirk soils.

Arkport very fine sandy loam, 0 to 6 percent slopes (ArB).--This soil occupies sandy areas. It occurs in irregular areas that range from about 5 to 50 acres in size.

Included with this soil in mapping are small areas of the silty Dunkirk and Collamer soils, the moderately well drained Galen soils of origin similar to that of Arkport soils, and a few small areas of Claverack.

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soils that have a surface layer similar to that of this Arkport soil but have clay at less than 40 inches below the surface. Also included are areas near the village of Olcott that are underlain by gravel in some places. Areas that have gravel or wet spots included are indicated on the soil map by appropriate symbols.

This soil is well suited to crops, pasture, or trees. It is well suited to crops planted early in spring. Under a good management, this soil is well suited to vegetables and fruits. Lack of moisture during dry periods is a limitation in areas unprotected by vegetation. Water erosion is not normally a hazard, but soil blowing is a risk in cultivated orchards and in areas unprotected by vegetation. (Capability unit IIs-2; woodland suitability group 2o1)

Arkport very fine sandy loam, 6 to 12 percent slopes (ArC).--This soil has the profile described as representative for the series. It is undulating and moderately sloping. Areas are generally small in size and generally occur on upper slopes and knolls.

Included with this soil in mapping are areas of the more silty Dunkirk and Collamer soils and the coarser textured Colonie soils. Also included are a few areas that contain gravel above a depth of 40 inches and some areas that have silt and clay within 40 inches of the surface. Other inclusions are areas near the village of Olcott that are underlain by gravel.

This soil is suited to most crops, pasture, or woodland. The hazard of water erosion or soil blowing is moderate to severe if this soil is cultivated and not protected. Complex slopes are common, and the use of erosion control measures on the contour is not practical in many areas. (Capability unit IIIe-3; woodland suitability group 2o1)

Arkport fine sandy loam, gravelly substratum, 0 to 2 percent slopes (AsA).--This soil has a profile similar to the one described as representative for the Arkport series but in most places it has a small amount of gravel in the surface layer. In some places the substratum contains as much as 60 percent gravel, by volume. In most places the gravelly substratum is underlain by silt and clay at a depth of 50 inches or more. Areas range from about 5 to 30 acres in size. They are irregularly shaped but, in many places, are in narrow strips between the gravelly Howard soils and other Arkport soils.

Commonly included with this soil in mapping are areas of other soils in the Arkport series and of coarser textured Colonie soils. Small unmappable areas of Howard soils are included where the gravel is closer to the surface. In a few areas the surface layer is gravelly, and in other areas there is silt and clay within 40 inches of the surface. In these silty or clayey areas there may be small inclusions of Claverack or Collamer soils.

This soil is one of the best soils in the county for peaches and cherries. It is generally used intensively for fruit and vegetable crops, but it is suited to other crops as well. Maintenance of fertility and organic matter are major needs in farming this soil. A few wet spots may require draining. This soil is droughty during extended dry periods. (Capability unit IIs-1; woodland suitability group 2o1)

Arkport fine sandy loam, gravelly substratum, 2 to 6 percent slopes (AsB).--This soil has a profile similar to the one described as representative for the Arkport series but contains a small amount of fine gravel in the surface layer. In most places the substratum below a depth of 40 inches contains as much as 60 percent gravel, by volume. Areas range from about 5 to 30 acres in size and normally are irregular in shape.

Commonly included with this soil in mapping are other Arkport soils and coarser textured Colonie soils. Also included are small areas of Howard soils. Other inclusions are a few areas where the surface layer is gravelly. Wet spots or gravel spots generally are indicated by the appropriate symbols on the soil map.

This soil is one of the best soils in the county for peaches and cherries. It is generally used intensively for fruit and vegetable crops, but it is suited to other crops as well. This soil is susceptible to soil blowing and water erosion if left unprotected. Maintenance of fertility and organic matter is necessary. This soil is droughty during extended dry periods. (Capability unit IIs-2; woodland suitability group 2o1)

Bombay Series

The Bombay series consists of deep, moderately well drained, medium-textured to moderately coarse textured soils. These soils formed in calcareous glacial till deposits that are normally capped with or modified by postglacial lake deposits. They occupy areas of glacial till north of U.S. Highway No. 104 (Ridge Road) in the same general area as the Hilton and Appleton soils. Slopes range from 0 to 6 percent.

A representative profile of a Bombay soil has a brown to dark-brown fine sandy loam surface layer 8 inches thick. It is underlain by a leached layer of very friable, yellowish-brown fine sandy loam that is slightly acid to a depth of 15 inches. Below a depth of 15 inches, this leached layer is very friable, light yellowish-brown, slightly acid loamy fine sand. In the lower part, it contains a few distinct mottles and is firm. At a depth below 21 inches, the subsoil is firm, light-brown silt loam. In the upper part, the subsoil has thin films of loamy fine sand from the horizon above. It contains common, distinct mottles, is slightly acid, and is 8 inches thick. At a depth of 29 inches, a calcareous substratum occurs. It is a firm to very firm, reddish-brown loam that contains some gravelly fragments.

The seasonal high water table rises to within 18 inches of the surface early in spring and in other

excessively wet periods. It is perched above the slowly permeable substratum. Early in the growing season, roots are confined to the upper 18 inches of soil. As the water table falls, roots can extend downward to the firm, calcareous substratum. The available moisture capacity is moderate to low. These soils respond well to additions of lime and fertilizer.

Representative profile of Bombay fine sandy loam, 0 to 2 percent slopes, in town of Wilson, three-tenths of a mile south of the junction of Palmer Road and State Route 93; pastured area:

Ap--0 to 8 inches, brown to dark-brown (7.5YR 4/2) fine sandy loam; weak, fine, granular structure; very friable; medium acid; abundant fine roots; abrupt, smooth boundary. 7 to 10 inches thick.

A21--8 to 15 inches, yellowish-brown (10YR 5/6) fine sandy loam; weak, fine, granular structure; very friable; slightly acid; abundant fine roots; clear, wavy boundary. 2 to 10 inches thick.

A22--15 to 21 inches, light yellowish-brown (10YR 6/4) loamy fine sand; few, medium, distinct, yellowish-red (5YR 4/6 and 5/6) mottles; weak, fine, granular structure; very friable in upper part and firm in lower part; slightly acid; plentiful fine roots; abrupt, wavy boundary. 5 to 10 inches thick.

IIB&A--21 to 24 inches, light-brown (7.5YR 6/4) silt loam; weak, medium, subangular blocky structure; firm; few fine roots; peds have coats of light yellowish-brown (10YR 6/4) loamy fine sand, 1/4 to 1/2 inch thick, at top of horizon, but the coats decrease to less than 1 millimeter thick at the bottom; thin clay films on ped interiors; less than 10 percent coarse fragments; slightly acid; gradual, wavy boundary. 3 to 6 inches thick.

IIBt--24 to 29 inches, light brown (7.5YR 6/4) silt loam; common, medium, distinct, strong-brown (7.5YR 5/8), and brownish-yellow (10YR 6/6) mottles; weak, medium, subangular blocky structure; firm; less than 10 percent coarse fragments; patchy clay films on ped surfaces; thicker, more nearly continuous films in pores; slightly acid; few fine roots; abrupt, wavy boundary. 5 to 12 inches thick.

IIC--29 to 60 inches, reddish-brown (5YR 5/3) loam; strong, medium, platy structure; firm to very firm; 10 to 15 percent coarse fragments; calcareous; discontinuous gravelly sand layer that is 0 to 5 inches thick in upper part of horizon and has the appearance of a stone line.

The solum ranges from 24 to 40 inches in thickness, and this thickness corresponds well with the depth to carbonates. The solum ranges from medium acid to neutral. Content of coarse fragments ranges from 0 to 35 percent in any horizon below the A horizon. Bedrock is at a depth of more than 40 inches, and in most places, more than 5 feet.

The Ap horizon is 10YR to 7.5YR in hue, 3 or 4 in value, and 2 or 3 in chroma. The Ap horizon has values of more than 5.5 when it is dry. The A2 horizon has a hue of 10YR or 7.5YR, values of 4 to 6, and chromas of 4 to 6. It ranges from loamy fine sand to very fine sandy loam.

In the B&A horizon, the A part is 10YR to 7.5YR in hue, 4 to 6 in value, and 4 to 6 in chroma. Texture ranges from loamy fine sand to very fine sandy loam. The B part is 10YR to 5YR in hue, 3 to 6 in value, and 3 or 4 in chroma. It ranges from fine sandy loam to silt loam and is gravelly or non-gravelly. The Bt horizon is 10YR to 5YR in hue, 3 to 6 in value, and 3 or 4 in chroma. It is fine sandy loam to silt loam and is gravelly or nongravelly. Clay films occur but are continuous in only a few profiles. Clay content in the Bt horizon is less than 18 percent. The C horizon is typically a firm or very firm loam or gravelly loam glacial till.

In some areas the Bombay soils in Niagara County differ from normal Bombay soils because they are calcareous at a shallower depth than defined for the series. This difference does not alter their usefulness or behavior.

The Bombay soils formed in deposits similar to those of the somewhat poorly drained Massena soils. Bombay soils are similar to Hilton and Appleton soils but are coarser textured than those soils and are better drained than Appleton soils.

Bombay fine sandy loam, 0 to 2 percent slopes (BoA).--This soil has the profile described as representative for the series. It occurs in areas that are generally less than 20 acres in size. In many places these areas are oblong. They occur as slightly higher knolls in a till plain.

Most commonly included with this soil in mapping are the wetter Massena soils along drainageways or in depressional areas. Also included are many areas of Hilton and Appleton soils where there is a finer textured glacial till. Claverack soils are minor inclusions where this soil is underlain by fine textured sediments. A few included areas have loose gravel rather than glacial till in the substratum.

This soil is suited to most crops grown in the county. It is used more for dairy and grain crops than for fruit and vegetables. Because of the fine sandy loam surface layer and general lack of coarse fragments, this soil is easy to cultivate. Periodic additions of lime and fertilizer, and other management practices that supply organic matter, are needed. Slight wetness may delay planting briefly. Drainage of included wetter soils is desirable in many places. (Capability unit IIw-2; woodland suitability group 3o1)

Bombay fine sandy loam, 2 to 6 percent slopes (BoB).--This soil has a profile similar to the one

described as representative for the series, but it normally contains more coarse fragments. Areas are generally less than 20 acres in size. In most places these areas are oblong or circular, and they occupy the higher knolls in a glacial till plain that has been influenced by water and wave action.

Most commonly included with this soil in mapping are areas of the wetter Massena soils. These included areas are in depressions or along drainageways. Also included are small areas of sandy Elnora, Colonie, and Claverack soils. A few included areas have loose gravel instead of glacial till in the substratum.

This soil is used more for dairy and grain crops than for fruit and vegetables. The hazard of erosion is moderate if this soil is cultivated and not protected. Periodic additions of lime and fertilizer are needed along with other practices to maintain the content of organic matter. In some years slight wetness briefly delays planting in the spring. (Capability unit IIe-3; woodland suitability group 3o1)

Brockport Series

The Brockport series consists of moderately deep, medium-textured, somewhat poorly drained soils. These soils formed in residuum from highly alkaline or calcareous gray shale or in glacial till that was strongly influenced by the underlying shale. Locally, Rochester shale is the main underlying material. The topography of these level to nearly level soils is controlled by the underlying bedrock.

A representative profile of a cultivated Brockport soil in Niagara County has a very dark grayish-brown heavy silt loam surface layer 10 inches thick. The upper part of the subsoil is mottled, dark grayish-brown, firm, mildly alkaline silty clay about 8 inches thick. The lower part of the subsoil is mottled, gray, very firm, moderately alkaline silty clay. At a depth of 28 inches, there is slightly weathered, soft, calcareous shale that is gray to grayish brown.

The seasonal high water table is about 10 inches below the surface early in spring and late in fall or during long rainy periods. It is perched above the slowly permeable subsoil and shale substratum. The depth of rooting generally is in the top 15 to 18 inches of soil and is directly related to the water table. A few roots extend below 18 inches after the water table recedes. The available moisture capacity is moderate. During the growing season, plants may be damaged in any extended dry period because much of the water runs off the surface or is removed by evaporation or transpiration.

Representative profile of Brockport silt loam, 0 to 4 percent slopes, in road cut on north side of State Route 31, 3,200 feet east of Royalton Center Road; cultivated area:

Ap--0 to 10 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; light brownish gray (10YR 6/2) when dry; moderate, fine and very fine, subangular blocky structure; friable; abundant fine roots; neutral; clear, smooth boundary. 8 to 11 inches thick.

B2t--10 to 18 inches, dark grayish-brown (10YR 4/2) light silty clay; dark-gray (10YR 4/1) clay films on ped faces; ped interiors have many, medium, faint, brown (10YR 4/3) to dark yellowish-brown (10YR 4/4) mottles (45 percent of horizon); moderate to strong, medium and coarse, prismatic structure breaking to strong, fine, blocky structure; firm; plentiful fine roots; distinct clay films on ped faces and in pores; mildly alkaline; clear, wavy boundary. 6 to 17 inches thick.

B3--18 to 28 inches, gray (10YR 5/1) light silty clay; many medium, distinct, light olive-brown (2.5Y 5/4) mottles (45 percent of horizon); moderate, medium and coarse prismatic structure breaking to moderate, medium, blocky in upper part of horizon; lower part has weak, medium, platy structure; very firm; plentiful fine roots; moderately alkaline; clear, wavy boundary. 6 to 12 inches thick.

R--28 to 50 inches, gray (10YR 5/1) to grayish-brown (2.5Y 5/2), silty, slightly weathered, soft, calcareous shale; common, medium, distinct, light olive-brown (2.5Y 5/4) mottles; very firm; platy; calcareous.

The solum ranges from 20 to 40 inches in thickness and from slightly acid to moderately alkaline in reaction. Content of coarse fragment ranges from 0 to 15 percent in any horizon below the Ap horizon and above the weathered shale. The Ap horizon ranges from 10YR to 2.5Y in hue, is 4 or 3 in value, and is 2 or 1 in chroma. Value is greater than 5.5 when the Ap horizon is dry. Where an A2g horizon occurs, it ranges from 7.5YR to 2.5Y in hue. When the A2g horizon is moist, its matrix is 5 or 6 in value and 1 or 2 in chroma.

The B horizon ranges from 10YR to 5Y in hue, is 4 or 5 in value, and ranges from 4 to 1 in chroma. In 60 percent of this horizon, chromas of 2 or less are lacking in some part of the horizon, but chromas of 2 or less occur on ped and prism faces. The B horizon is clay loam to clay, and its average clay content is between 35 and 60 percent. Thin clay films are on vertical and horizontal ped faces, and thicker films are in the pores.

The C horizon, if present, has platy structure and a generally higher shale content than the B horizon. This horizon is calcareous. The R horizon consists of calcareous shale and normally is somewhat weathered in the upper part.

The Brockport soils are similar to Rhinebeck soils in texture and in drainage. The Brockport soils, however, are moderately deep to gray shale. The Rhinebeck soils are deeper and formed in lacustrine materials. Brockport soils are better drained than the deeper nearby Madalin soils. Except for color, Brockport soils are similar to Lockport soils, which formed in reddish shale material.

Brockport silt loam, 0 to 4 percent slopes (BrA).--Individual areas of this soil range from as small as 5 acres to more than 100 acres in size. They are roughly oblong or circular, and they follow the bedding planes of the underlying rock.

Included with this soil in mapping are some small areas of better drained soils on slight rises or knolls. Also included are small areas of Brockport soils that have slopes of more than 4 percent. Some areas have a gravelly glacial till smear that is less than 20 inches thick over the weathered shale. Also included, where the underlying shale is at a depth of more than 40 inches, are small areas of Rhinebeck or Madalin soils.

Unless drained, this soil is better suited to hay, small grains, pasture, and trees than to cultivated crops. Where this soil is used for cultivated crops, adequate surface drainage needs to be provided along with good cultural practices that maintain soil tilth. Irrigation or tile drainage generally is not suitable for this soil. (Capability unit IIIw-2; woodland suitability group 3w1)

Canandaigua Series

The Canandaigua series consists of deep, poorly drained and very poorly drained, medium-textured to moderately fine textured soils. These soils formed in lacustrine deposits of silt, very fine sand, and clay. Canandaigua soils are level or depressional and occupy areas where water ponds or runs off very slowly. Also, runoff is received from surrounding areas.

A representative profile of a Canandaigua soil has a dark-gray, neutral silty clay loam surface layer about 7 inches thick. It is underlain by an olive-gray, firm, neutral silty clay loam subsoil that is distinctly mottled. The subsoil extends to a depth of 24 inches. The substratum is calcareous. It is firm, platy, grayish-brown silt loam that is prominently mottled in the upper part. Below a depth of 35 inches, the substratum is fine sand, silt, and very thin lenses of clay.

Canandaigua soils, unless drained artificially, have water standing at the surface throughout spring and after each rainy period. The downward percolation of water is restricted by the high water table, as is the depth of rooting. In spring, roots are confined to a depth of about 6 inches. As the season progresses, the rooting depth extends to about 15 inches below the surface. The available moisture capacity is moderate to low.

Representative profile of Canandaigua silty clay loam (0 to 2 percent slopes), 30 feet south of Tonawanda Creek Road and five-eighths mile west of Riddle Road:

Ap--0 to 7 inches, very dark-gray (10YR 3/1) silty clay loam, very dark grayish-brown (2.5Y 3/2) when rubbed; moderate, fine and very fine, subangular blocky structure; friable; abundant fine roots; neutral; abrupt, smooth boundary. 6 to 9 inches thick.

B2g--7 to 24 inches, olive-gray (5Y 5/2) silty clay loam; gray (5Y 5/1) ped coats and common, medium and coarse, prominent, yellowish-brown (10YR 5/6) mottles in ped interiors; weak, coarse, prismatic structure breaking to moderate, medium and coarse, blocky structure; firm; plentiful roots in upper part and few fine roots in lower part; neutral; clear, wavy boundary. 12 to 21 inches thick.

C1g--24 to 35 inches, grayish-brown (2.5Y 5/2) silt loam; gray (5Y 5/1) ped coats and many (about 30 percent), fine and medium, prominent, yellowish-brown (10YR 5/6) mottles in ped interiors; few, white lime streaks; weak, fine, medium and thick, platy structure; firm; very few roots; calcareous; clear, wavy boundary. 6 to 15 inches thick.

IIC2--35 to 50 inches, light olive-brown (2.5Y 5/4), stratified or varved loamy fine sand, silt, and very thin clay lenses; lime streaks and lime concretions or nodules; many, coarse; distinct, yellowish-brown (10YR 5/6) mottles; very weak, platy structure; friable; calcareous.

The solum ranges from 20 to 30 inches in thickness, and depth to carbonates ranges from 18 to 40 inches. Depth to bedrock is more than 40 inches. To a depth of 30 inches, chroma is 2 or less in 60 percent of the matrix in the B and C horizons. Ped faces in the B and C horizons are 2 or less in chroma.

The Ap horizon ranges from 10YR to 2.5Y in hue, is 2 or 3 in value, and is 1 or 2 in chroma. Thickness of the Ap horizon does not exceed one-third the thickness of the solum. The Ap horizon ranges from silt loam to silty clay loam.

The B horizon ranges from 5YR to 5Y in hue, from 4 to 6 in value, and is 1 or 2 in chroma. It ranges from fine sandy loam to silty clay. The average clay content of the 10- to 40-inch control section is between 18 and 35 percent. The B horizon has moderate or weak, blocky structure that is within weak, coarse, prismatic structure in many places. Common to many, distinct and prominent mottles that have a higher chroma than that described occur in the B and C horizons in some places.

The Canandaigua soils formed in deposits similar to those of the moderately well drained Collamer soils and the somewhat poorly drained Niagara soils. Canandaigua soils are finer textured than Lamson soils and have a coarser textured B horizon than the Lakemont and Madalin soils. Canandaigua soils are wetter and have a finer textured B horizon than the Raynham soils. Canandaigua soils are wetter and have a coarser textured B horizon than Odessa and Rhinebeck soils.

Canandaigua silt loam (0 to 2 percent slopes) (Ca).--This soil occupies areas that receive runoff from adjacent soils. The surface layer of this soil contains less clay than that of the soil having the profile described as representative for the series. This soil occurs in irregularly shaped

areas that generally are less than 20 acres in size.

Commonly included areas are spots of better drained Raynham and Rhinebeck soils south of the limestone escarpment. Other common inclusions are finer textured Lakemont and Madalin soils that have drainage similar to that of this soil. In many places north of the limestone escarpment, there are included areas of somewhat poorly drained Appleton and poorly drained Sun soils that formed in glacial till. Areas near U.S. Highway No. 104 (Ridge Road) contain numerous sand lenses in the subsoil and substratum. In some depressional areas and potholes, spots of very poorly drained Canandaigua soils occur and have a mucky surface layer. Other spots of Canandaigua soils have a sandy surface layer.

This soil is not intensively used. Most areas are wooded, idle, or used for pasture. But this soil is well suited to crops, pasture, and trees if it is adequately drained and protected from flooding or from ponding caused by runoff from the surrounding uplands. It is particularly well suited to intensive use for some vegetable and row crops. Undrained areas can be used for pasture if management is good, but most areas cannot be used for other crops. (Capability unit IIIw-3; woodland suitability group 4w1)

Canandaigua silty clay loam (0 to 2 percent slopes) (Cb).--This soil has the profile described as representative for the series. The soil occurs in long, narrow drainageways and basinlike areas in the southern part of the county. Areas range from 10 to 50 acres in size.

Included with this soil in mapping are small areas of better drained Rhinebeck and Raynham soils. Also included are small areas of Lamson, Lakemont, and Madalin soils.

This soil is not used intensively. Most areas are wooded, idle, or in pasture. If this soil is adequately drained and fertilized, it is suited to crops. Because of the moderately fine textured surface layer, this soil puddles easily if tilled when wet. It crusts or forms hard clods as it dries. Maintaining good tilth is difficult. (Capability unit IIIw-3; woodland suitability group 4w1)

Cayuga Series

The Cayuga series consists of deep, moderately well drained to well drained, medium-textured soils. These soils developed in lacustrine silt and clay that is 20 to 36 inches thick over loamy calcareous glacial till. They are nearly level to moderately sloping or undulating and occur in areas that are adjacent to or within old glacial lakebeds. Cayuga soils occur throughout the county, mainly south of the Lockport limestone formation.

A representative Cayuga soil has a dark grayish-brown silt loam surface layer 8 inches thick. The next layer is reddish-brown silty clay loam 3 inches thick. The subsoil occurs at a depth of 11 inches and is firm, reddish-brown silty clay 14 inches thick. It contains a few coarse fragments and is plastic when wet and hard when dry. The reddish-brown gravelly loam substratum is at a depth of about 25 inches and has a few large stones. It is firm and calcareous.

These soils have a seasonal high water table that rises to within 18 inches of the surface. The water table is perched above the slowly permeable subsoil and underlying glacial till. In some places during extended rainy periods, water stays for a few days in small depressions.

Roots are confined mainly to the uppermost 25 inches of the Cayuga soils. The available moisture capacity is high. Because of the clay in the surface layer and subsoil, care must be taken to maintain good tilth. If these soils are plowed when wet, they become compact and cloddy.

Representative profile of a Cayuga silt loam having slopes of 0 to 2 percent, in a hayfield 1,000 feet west of the junction of Packard and Lockport Roads and 125 feet north of Lockport Road:

Ap--0 to 8 inches, dark grayish-brown (10YR 4/2) heavy silt loam; moderate, fine, and medium, subangular blocky structure; friable; abundant roots; neutral; abrupt, smooth boundary. 6 to 10 inches thick.

B&A--8 to 11 inches, reddish-brown (5YR 4/3) silty clay loam; moderate, fine to medium, subangular blocky structure within weak, coarse, prismatic structure; firm; plentiful fine roots; common root and worm channels; patchy clay films on ped surfaces; a few fragments larger than 2 millimeters; thin coats of brown (10YR 5/3) loam on blocks and prisms; neutral; clear, wavy boundary. 2 to 6 inches thick.

B2t--11 to 25 inches, reddish-brown (5YR 4/3) silty clay; moderate, fine to medium, subangular blocky structure within weak, coarse, prismatic structure; firm; plentiful fine roots; a few fragments larger than 2 millimeters; thin clay films on most ped surfaces; thick films in the pores; neutral; abrupt, wavy boundary. 8 to 20 inches thick.

IIC--25 to 50 inches, reddish-brown (5YR 4/4) gravelly loam of which about 25 percent is fragments larger than 2 millimeters; weak, thick, platy structure; firm; very few fine roots; calcareous.

The solum ranges in thickness from 20 to 36 inches, and this is the same as the depth to carbonates. Content of coarse fragments in the solum ranges from 0 to about 10 percent. The IIC horizon has a content of coarse fragments ranging from 5 to 35 percent. The solum is neutral to medium acid, and the IIC horizon is calcareous.

The Ap horizon has a hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. When the Ap horizon is dry, values are more than 5.5. Where the Ap horizon is thin, there is an A2 horizon in some places.

The B&A horizon is 2.5Y to 5YR in hue, 4 or 5 in value, and 3 or 4 in chroma. The coatings on the prism faces range from 1 to 2 millimeters in thickness. The B&A horizon is combined with the B2t horizon in some places. In the B2t horizon, hues range from 2.5Y to 5YR, value is 4 or 5, and chroma is 3 or 4. The B2t horizon is silty clay or clay. It has more than 35 percent and less than 55 percent clay. Mottles range from none to common and generally have a chroma that is 1 or 2 units higher than that of the matrix.

The IIC horizon ranges from 2.5Y to 5YR in hue. It is dominantly loam or gravelly loam.

The Cayuga soils formed in deposits similar to those of the somewhat poorly drained Churchville soils and the poorly drained to very poorly drained Madalin soils, loamy subsoil variant. Cayuga soils are better drained than Odessa or Rhinebeck soils and occur on thinner clay deposits. They are better drained and have a finer textured Bt horizon than Ovid soils. Cayuga soils are similar to Hilton and Cazenovia soils in drainage but have a finer textured Bt horizon.

Cayuga and Cazenovia silt loams, 0 to 2 percent slopes (CcA).--Any given area of this mapping unit is made up of either the Cayuga soil or the Cazenovia soil, or both of these soils. The Cayuga soil has the profile described as representative for the Cayuga series. South of the limestone escarpment, the Cayuga soil is dominant in this undifferentiated group. North of the escarpment, the Cazenovia soil is dominant. These soils occur on slight rises and, in most places, are surrounded by soils that have thicker lacustrine deposits of clay. Most areas are oblong and less than 30 acres in size.

Most commonly included in mapping south of the limestone escarpment are small areas of the Hilton soils. Most commonly included north of the limestone escarpment are small areas of the Hudson and Collamer soils. Other included areas are of Churchville or Ovid soils in depressions or along drainways. Ontario soils make up small included areas south of the limestone escarpment. A few large stones or boulders are present in areas that are within 1 mile of the limestone escarpment.

South of the limestone escarpment, this mapping unit is used mostly for corn, hay, and small grains. Locally, it is used for grapes. North of the limestone escarpment, this mapping unit is used for most of the crops grown in the county, including fruits. Only a little of the unit is used for vegetables.

Although the soils of this unit are well drained to moderately well drained, some improvement of drainage is needed if the soils are used intensively. (Capability unit IIw-2; woodland suitability group 2o1)

Cayuga and Cazenovia silt loams, 2 to 6 percent slopes (CcB).--Any given area mapped as this unit contains either the Cayuga soil or the Cazenovia soil, or both of these soils. The Cazenovia soil has the profile described as representative for the Cazenovia series. The Cayuga soil is dominant in areas south of the limestone escarpment, and the Cazenovia soil is dominant in areas north of the escarpment. Most areas of this mapping unit are less than 30 acres in size. They either have an oblong shape or occur as narrow strips along drainageways.

Most commonly included in mapping south of the limestone escarpment are small areas of the Hilton soils. Most commonly included north of the escarpment are small areas of Hudson, Collamer, and Hilton soils. Other inclusions are Churchville and Ovid soils in depressions or along drainageways. Many large stones or boulders occur where this soil is near limestone bedrock.

South of the limestone escarpment this mapping unit is used mostly for corn, hay, and small grains. Locally it is used for grapes. North of the limestone escarpment, the mapping unit is used for most of the crops grown in the county, including fruits. Drainage may be needed for included wet spots. Erosion is a hazard if these soils are cultivated and not protected. (Capability unit IIe-3; woodland suitability group 2o1)

Cayuga and Cazenovia silt loams, 6 to 12 percent slopes (CcC).--Areas of this mapping unit contain either the Cayuga soil or the Cazenovia soil, or both of these soils. The unit occurs mainly along the north slope of the limestone escarpment. Areas are generally less than 20 acres in size. The Cazenovia soil is dominant.

Included with these soils in mapping are small areas of the Schoharie, Hudson, and other soils that formed in deep lacustrine deposits. Some included areas are severely eroded. Other included areas have a gravelly or stony surface layer, contain springs or seeps, or consist of soils that are less than 40 inches to rock.

This mapping unit is used for most crops grown in the county. Erosion is a serious hazard in intensively cultivated areas. Erosion also is a severe hazard in areas north of the limestone escarpment where grapes are planted up and down slope. (Capability unit IIIe-1; woodland suitability group 2o1)

Cazenovia Series

The Cazenovia series consists of well drained and moderately well drained soils that have a medium-textured surface layer and a moderately fine textured subsoil. These soils formed in loamy, calcareous glacial till that was derived mainly from limestone and shale. In most places the glacial till is modified somewhat by glacial lake sediments of silt and clay. These soils are nearly level to moderately sloping.

A representative profile of a Cazenovia soil has a very dark grayish-brown, medium acid silt loam surface layer 8 inches thick. This is underlain by a brown and yellowish-brown silt loam leached layer that extends to a depth of 11 inches. The

next layer is a dark reddish-brown silty clay loam subsoil 17 inches thick. It is slightly acid, firm, and faintly mottled. At a depth of 28 inches, a calcareous substratum occurs. It is firm, reddish-brown silt loam that contains some gravelly fragments.

The seasonal high water table is at a depth of 18 to 24 inches in spring and in other excessively wet periods. It is perched above the slowly permeable underlying glacial till. In spring, roots are confined mainly to this 18- to 24-inch depth. As the growing season progresses and the water table falls, roots extend downward until they reach the calcareous glacial till. These soils have a high available moisture capacity. Permeability is moderate in the surface layer and moderately slow to slow in the subsoil. Locally, coarse fragments or the underlying rock, or both, are problems.

Representative profile of Cazenovia silt loam, 3 to 8 percent slopes, in an abandoned apple orchard, three-fifths mile east of State Route 270 (Campbell Blvd.) and 125 yards north of Hinman Road:

Ap--0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; dark grayish brown (10YR 4/2) when rubbed; weak, medium and fine, granular structure; friable; abundant fine roots; less than 5 percent coarse fragments; medium acid; abrupt, smooth boundary. 6 to 11 inches thick.

A2--8 to 11 inches, brown (10YR 5/3) to yellowish-brown (10YR 5/4) silt loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; weak, medium, granular structure; friable; plentiful fine roots; less than 5 percent coarse fragments; medium acid; clear, broken boundary. 0 to 5 inches thick.

B2t--11 to 28 inches, dark reddish-brown (5YR 3/4) light silty clay loam; interfingering of brown (10YR 5/3) in upper 4 inches of this horizon; reddish-brown (5YR 5/3) ped coats; many, fine, faint, brown to dark-brown (7.5YR 4/4) mottles; thin, continuous clay films on ped surfaces; thicker in pores, and a few clay films along root channels; moderate, medium and coarse, subangular blocky structure; firm; plentiful roots; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary. 10 to 24 inches thick.

C--28 to 65 inches, dark reddish-brown (5YR 3/4) silt loam; between 10 and 15 percent coarse fragments; weak, thick, platy structure; firm; very few roots; calcareous.

Thickness of the solum and depth to carbonates range from 20 to 40 inches. Bedrock is more than 40 inches from the surface. Content of coarse fragment ranges from 2 to 25 percent in the solum and from 10 to 30 percent in the substratum. Mottles range from none to many in the B and C horizons and are mainly 1 or 2 units higher in chroma than the matrix. Mottles having a chroma of 2 or less do not occur in the upper part of the B2t horizons.

The Ap horizon ranges from 10YR to 7.5YR in hue. When the Ap horizon is moist, value is 3 or 4 and chroma is 2 or 3. A dry Ap horizon has values of more than 5.5. Texture ranges from silt loam to gravelly silt loam. Reaction is medium acid to neutral. The A2 horizon is absent in some places. Where present, it ranges from 10YR to 5YR in hue, is 5 or 6 in value, and is 3 or 4 in chroma. It contains few or no mottles. Texture is the same as that of the Ap horizon.

The B2t horizon ranges from 7.5YR to 2.5YR in hue, from 3 to 5 in value, and is 3 or 4 in chroma. This horizon is clay loam to silty clay loam and has an average clay content between 27 and 35 percent. Coarse fragments and sand coarser than very fine sand make more than 15 percent of the B2t horizon. Reaction ranges from medium acid to neutral in the upper part of the B horizon and increases with depth. The A2 horizon interfingers into the upper part of the B horizon. Structure is subangular or angular blocky.

The C horizon ranges from 7.5YR to 2.5YR in hue, from 3 to 5 in value, and is 3 or 4 in chroma. The C horizon is calcareous.

The Cazenovia soils formed in deposits similar to those of the somewhat poorly drained Ovid soils. The B horizon of Cazenovia soils is finer in texture than that of Hilton soils and coarser in texture than the B horizon of Cayuga soils. Cazenovia soils are better drained than Churchville or Lockport soils and have a coarser textured B horizon.

Cazenovia gravelly silt loam, 0 to 3 percent slopes (CeA).--This soil has a profile that is similar to the one described as representative for the series but contains more gravel throughout. Areas are mostly less than 10 acres in size.

Most commonly included with this soil in mapping are small areas of gravelly Hilton soils or wetter Ovid soils. In some included areas, shale is less than 6 feet from the surface. In a few included areas, rock is less than 40 inches from the surface. Some areas have a very gravelly or stony surface layer.

This soil can be used for most of the crops commonly cultivated in Niagara County. It is well suited to pasture, trees, or the development of some kinds of wildlife areas. The pebbles and stones in this soil interfere with the tillage of some crops, especially vegetable root crops. Coarse fragments are hard on some types of tillage equipment.

This soil has slow runoff and may require some means of artificial drainage for best crop response. (Capability unit IIw-2; woodland suitability group 2o1).

Cazenovia gravelly silt loam, 3 to 8 percent slopes (CeB).--The profile of this soil has a higher gravel content throughout than the profile described as representative for the series. This soil occupies knolls within large, nearly level areas. Areas are dominantly less than 10 acres in size. They are generally oblong and have a northeast-southwest orientation.

Most commonly included with this soil in mapping are small areas of the coarser textured, moderately well drained Hilton soils. Wetter inclusions are Ovid or Appleton soils, and drier inclusions are Ontario or Howard soils. Some areas have a thin cap of sand, and some areas have a very gravelly or stony surface layer. In a few spots rock is at a depth of less than 40 inches.

This soil is moderately well suited to most crops commonly cultivated and is well suited to pasture or trees. It also is generally well suited to most fruit crops.

The hazard of erosion is moderate if this soil is cultivated and not protected. Random drainage of the wetter included areas is desirable if cropping is intensive. (Capability unit IIe-3; woodland suitability group 2o1)

Cazenovia gravelly silt loam, shale substratum, 0 to 3 percent slopes (CgA).--The profile of this soil has shale bedrock between depths of 40 and 72 inches. It also has a gravelly surface layer and generally contains more coarse fragments throughout than the profile described as representative. In most places this soil is intermingled with the Lockport soils, which are moderately deep to red shale. Most areas of this soil are about 20 acres in size. They are roughly rectangular.

Included with this soil in mapping are areas where the shale is less than 40 inches below the surface. Also included are areas of the coarser textured Hilton soils. In some small included areas, there are sand caps or thick gravel deposits. In many places spots of the wetter Ovid, Appleton, and Lockport soils occur.

This soil is suited to most crops grown in the county. Drainage may be needed for the wetter inclusions, especially if use is intensive. Coarse fragments are hard on machinery and interfere slightly with tillage and the growing of some vegetable crops. (Capability unit IIw-2; woodland suitability group 2o1)

Cazenovia gravelly silt loam, shale substratum, 3 to 8 percent slopes (CgB).--This soil has a profile that differs from the profile described as representative for the Cazenovia series because the surface layer is gravelly and shale bedrock is at a depth ranging from 40 to 72 inches. Areas are generally less than 20 acres in size. They occur along drainageways or are sloping and border generally more nearly level areas. They are normally in fairly narrow strips.

Included with this soil in mapping are areas that are less than 40 inches to shale. Also included are small areas of coarser textured Hilton soils. In some included areas, there are sand caps or thick gravel deposits. In many places spots of wetter Ovid, Appleton, and Lockport soils occur.

This soil is suited to most crops grown in the county. In some places coarse fragments interfere with cultivation and growth of crops. Drainage of included wet spots is needed in some places. (Capability unit IIe-3; woodland suitability group 2o1)

Cheektowaga Series

The Cheektowaga series consists of deep, poorly drained and very poorly drained, moderately coarse textured soils. These soils developed in a sandy lacustrine deposit that is underlain by lacustrine calcareous clay. They are level to slightly depressed and occur in widely scattered areas north of the limestone escarpment. These soils are of minor extent and are in small areas.

In a representative profile the surface layer is black, neutral fine sandy loam 9 inches thick. This is underlain by grayish-brown loamy fine sand that has distinct yellowish-brown mottles. This layer is neutral and 7 inches thick. At a depth of 16 inches, the subsoil occurs. It is grayish-brown, very friable loamy fine sand that is distinctly mottled with yellowish brown. The subsoil is neutral, contains 10 to 15 percent fine gravel, and is 6 inches thick. The substratum is calcareous and is at a depth of 22 inches. It is brown, firm silty clay that is distinctly mottled with brown and dark yellowish brown.

The seasonal high water table is immediately below the surface layer, and it remains there until late in spring or early in summer if drainage is not provided. The water table is perched above the slowly permeable clayey substratum. These soils receive surface runoff from adjacent areas and remain ponded for extended periods. The depth of soil available for rooting ranges from 6 to 20 inches. In undrained areas rooting depth is related directly to the depth to the water table at any given time during the growing season. The available moisture capacity is low.

Representative profile of Cheektowaga fine sandy loam in a cultivated area in the town of Wilson, 20 feet north of Willow Road and about 220 yards west of Irish Road:

Ap--0 to 9 inches, black (10YR 2/1) fine sandy loam; weak, medium, granular structure; very friable; abundant fine roots; neutral; abrupt, smooth boundary. 8 to 10 inches thick.

A2g--9 to 16 inches, grayish-brown (10YR 5/2) loamy fine sand; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; very weak, fine, granular structure; very friable; few fine roots; neutral; abrupt, smooth boundary. 3 to 7 inches thick.

B2g--16 to 22 inches, grayish-brown (10YR 5/2) loamy fine sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; very weak, fine, granular structure or single grain; very friable; few fine roots; 10 to 15 percent fine gravel; neutral; clear, smooth boundary. 5 to 13 inches thick.

IICg--22 to 50 inches, brown (7.5YR 5/2) silty clay; many (about 30 percent) brown (7.5YR 5/4) and dark yellowish-brown (10YR 4/4) mottles; gray to light-gray (10YR 6/1) ped faces; weak, thick, platy structure; firm; no coarse fragments; no roots; calcareous.

Depth to silty clay ranges from 20 to 30 inches and corresponds to the thickness of the solum. Depth to bedrock is more than 40 inches. The average texture of the sandy material below a depth of 10 inches is loamy fine sand or coarser. The contrasting underlying material contains more than 35 percent clay.

The Ap horizon ranges from very dark gray to black and has a value of 5 or less when crushed and dry. Thickness of the Ap horizon is more than one-third the thickness of the solum. Reaction ranges from strongly acid to neutral. The A2g horizon ranges from 5YR to 2.5Y in hue, from 4 to 6 in value, and is 1 or 2 in chroma. Mottles of higher chroma are few to common.

The B horizon ranges from 5YR to 2.5Y in hue, is 4 to 5 in value, and is 1 or 2 in chroma. Few to many mottles of both higher and lower chroma are present, but the percentage of mottles that have chroma of more than 2 is less than 40 percent. The B horizon is loamy fine sand or coarser. Horizons below the Ap horizon are less than 7 inches thick and are very fine sand, loamy very fine sand, and fine sandy loam. Reaction is slightly acid to neutral.

The IIC horizon ranges from 2.5YR to 5Y in hue, from 3 to 5 in value, and from 2 to 4 in chroma. The chroma is 2 or less in 60 percent of the matrix to a depth of 30 inches. Average clay content is more than 35 percent. The IIC is normally calcareous. It is massive or has platy structure.

The Cheektowaga soils formed in deposits similar to those of the somewhat poorly drained Cosad soils and the moderately well drained to well drained Claverack soils. Cheektowaga soils are coarser textured in the A and B horizons than Lakemont or Madalin soils. Cheektowaga soils are wetter than Stafford and Minoa soils and are moderately deep to clay and silt. They differ from Lamson soils mainly by being moderately deep to clay and silt.

Cheektowaga fine sandy loam (0 to 2 percent slopes) (Ch).--This soil is level to slight depressed. It receives runoff from slightly higher adjacent areas. It is of limited extent in Niagara County and occurs in widely scattered areas throughout the northern part. The areas range from 5 to 20 acres in size. Shapes of the areas range from roughly rectangular in depressed, basinlike areas to oblong in drainageways.

Commonly included with this soil in mapping are small areas of somewhat poorly drained Cosad soils at slightly higher elevations. In spots where the sand deposit is deeper than 40 inches, areas of the poorly drained Lamson soils and the somewhat poorly drained Minoa soils are included. Areas associated with Canandaigua soils have a high proportion of very fine sands and silts. In a few areas in the county, there are inclusions of soils underlain by silty clay loam glacial till rather than clay. Small areas that have sandy deposits less than 20 inches thick are included with this soil in places.

This soil is not intensively used. Most areas are in woods, are idle, or are used for pasture. If drainage and use of fertilizer are adequate, this soil is suited to many cultivated crops. (Capability unit IIIw-3; woodland suitability group 5w1)

Churchville Series

The Churchville series consists of deep, somewhat poorly drained, medium-textured soils. These soils are level and gently sloping. They formed in lacustrine clay. The clayey subsoil is underlain by loamy calcareous glacial till at a depth ranging from 20 to 36 inches. These soils occur adjacent to or within areas of former glacial lakes. Dominant south of the limestone escarpment are reddish colors, and north of the escarpment browner colors are dominant.

A representative profile of a Churchville soil has a very dark grayish-brown silt loam surface layer 9 inches thick. It is neutral. The subsoil is firm, brown silty clay loam and silty clay that are mottled. The subsoil extends from 9 to 31 inches below the surface. It is neutral in the upper part and calcareous in the lower part. The substratum is at a depth of 31 inches. It consists of calcareous, reddish-brown, loamy glacial till that contains less than 10 percent coarse fragments.

During wet weather, the seasonal high water table rises to about 9 inches below the surface and, in some places, is at the surface for short periods. It is perched above the slowly permeable subsoil and underlying glacial till. Rooting is to a depth of 20 inches in most places. Early in the growing season, the seasonal high water table restricts the downward penetration of roots. The rooting zone has a moderate available moisture capacity. Because the clay content is relatively high, care must be taken to maintain good tilth. If the soils are plowed when too wet, they become compact and cloddy.

Representative profile of Churchville silt loam, 0 to 2 percent slopes, on the east side of Bear Road; one-half mile south of U.S. Highway No. 104 (Ridge Road); pasture:

Ap--0 to 9 inches, very dark grayish-brown (10YR 3/2); heavy silt loam; dark grayish brown (10YR 4/2) when rubbed; moderate, fine and medium, granular structure; friable; abundant fine roots; neutral; abrupt, smooth boundary. 7 to 10 inches thick.

B2t--9 to 23 inches, brown (10YR 5/3) heavy silty clay loam and silty clay; many (about 40 percent), medium, distinct, dark yellowish-brown (10YR 4/4 to 5/6) mottles; dark grayish-brown (10YR 4/2) coats on structural faces; moderate, coarse, prismatic structure to strong, fine and medium, angular blocky structure; numerous clay films on ped faces and in pores; firm; plentiful roots; neutral; clear, wavy boundary. 10 to 18 inches thick.

B3--23 to 31 inches, brown (10YR 5/3) silty clay loam and silty clay that has grayish-brown (10YR 5/2) ped faces; many (about 35 percent), medium, faint, dark yellowish-brown (10YR 4/4)

to yellowish-brown (10YR 5/8) mottles; moderate, medium, prismatic structure to strong, medium, subangular blocky structure; numerous lime streaks; firm; few roots; calcareous; clear, smooth boundary. 0 to 12 inches thick.

IIC--31 to 50 inches, reddish-brown (5YR 4/4) heavy loam; moderate, medium, platy structure; very firm; 10 percent coarse fragments; very few roots; calcareous; upper part of horizon is a discontinuous layer of light olive-brown (2.5Y 5/4) silt loam that is 5 inches thick and contains less than 10 percent coarse fragments.

Thickness of the solum and depth to carbonates range from 20 to 36 inches. Content of coarse fragments ranges from 0 to 5 percent in the solum and from 5 to 30 percent in the substratum. Reaction ranges from medium acid to neutral in the Ap horizon and from slightly acid to moderately alkaline in the B horizon. The C horizon is calcareous.

The Ap horizon ranges from 7.5YR to 2.5Y in hue and is 2 or 3 in chroma. The Ap horizon has a value of 3 or 4 when moist and of more than 5.5 when dry. If material in the Ap horizon is rubbed or crushed, values are more than 3. An A2 horizon occurs in some profiles, but in most places the A2 horizon has been destroyed by cultivation.

The B2t horizon ranges from 2.5YR to 2.5Y in hue, is 4 or 5 in value, and is 3 or 4 in chroma. The ped faces have a chroma of 2 or less. Ped interiors are mottled. Clay films are on most of the ped surfaces. The B2t horizon ranges from silty clay loam to clay and has an average clay content between 35 and 55 percent. The B3 horizon is similar to the B2t, except that the B3 horizon does not have a concentration of clay films and it is calcareous and has numerous lime streaks. The B3 horizon does not occur in some profiles, and instead there may be a horizon more similar to the B2t.

The IIC horizon is firm glacial till. The range in color is the same as that of the B horizon. Texture is loam and silt loam.

The Churchville soils formed in deposits similar to those of the moderately well drained Cayuga soils and the poorly drained to very poorly drained Madalin soils, loamy subsoil variant. The Churchville soils formed in thinner clayey deposits than did the Odessa and Rhinebeck soils. Drainage is better and the clayey deposits are thinner in the Churchville soils than in the Lakemont and Madalin soils. Churchville soils have a finer textured Bt horizon than Ovid soils. They are wetter than Cazenovia or Hilton and have a finer textured Bt horizon.

Churchville silt loam, 0 to 2 percent slopes (C1A).--This soil has the profile described as representative for the series. It occurs in drainways or at the base of adjacent sloping soils, from which it receives runoff. Areas range from 3 to more than 50 acres in size. They do not have a definite shape, but in many places are in strips between deep clay in the glacial lake basin and soils on glacial till in higher surrounding areas.

Most commonly included with this soil in mapping are areas of soils formed in deep clay deposits, such as poorly drained Lakemont and Madalin soils and somewhat poorly drained Odessa and Rhinebeck soils. Also included are wetter Madalin soils, loamy subsoil variant, and drier Cayuga soils. Other inclusions are coarser textured Appleton, Ovid, Hilton, and Cazenovia soils.

If adequately drained, this soil is well suited to hay and grain crops and fairly well suited to some fruits. Even in drained areas, however, this soil is not well suited to cherries, peaches, and many kinds of vegetables. In areas not drained, the soil is suited to hay, pasture, trees, or wildlife. Because the clay content is fairly high, care must be taken to maintain good tilth. If this soil is cultivated when too wet, it crusts or becomes hard and cloddy. (Capability unit IIIw-2; woodland suitability group 3w1)

Churchville silt loam, 2 to 6 percent slopes (C1B).--This soil occurs along drainways and on lower foot slopes of adjacent higher areas. Runoff is moderately rapid. Areas range from 2 to 50 acres in size, but most areas are less than 15 acres.

Most commonly included in mapping are areas of similar but better drained Cayuga soils. Also included are coarser textured Ovid soils of the same drainage class as this Churchville soil. Other inclusions are small areas of Odessa and Rhinebeck soils where clay deposits are thicker than 40 inches.

This soil has nearly the same suitability for use as Churchville silt loam, 0 to 2 percent, but drainage needs are not so great and normally are easier to meet. Erosion is a hazard if this soil is cultivated and not protected. (Capability unit IIIw-5; woodland suitability group 3w1)

Claverack Series

The Claverack series consists of deep, moderately well drained to well drained soils that developed in sandy lacustrine deposits. The sandy deposits are underlain by lacustrine silt and clay at a depth ranging from 20 to 40 inches. Claverack soils are in areas scattered throughout the county, but most areas are north of the Niagara Escarpment. They are nearly level to gently sloping or undulating and occur in areas that were occupied by glacial lakes.

In a representative profile, a cultivated Claverack soil has a brown to dark-brown, neutral loamy fine sand surface layer 8 inches thick. The subsoil is between depths of 8 and 32 inches. It is strong-brown, brown, and light-brown loamy fine sand that is very friable and slightly acid. The subsoil contains a few yellowish-red mottles in the upper part and many strong-brown mottles in the lower part. The substratum is at a depth of 32 inches and consists of brown silty clay that has a few yellowish-red mottles. It is firm and neutral to moderately alkaline.

Water percolates moderately rapidly to rapidly throughout the sandy surface layer and subsoil. A seasonal high water table is perched above the slowly permeable, firm, clayey substratum and is about 18 inches below the surface in spring and in excessively wet periods. Rooting is to a depth of 24 inches in most places, but a few roots extend to a greater depth as the water table falls. The sandy surface layer and subsoil have a low available moisture capacity. This soil is droughty during extended dry periods.

Representative profile Claverack loamy fine sand, 2 to 6 percent slopes, 0.7 mile east of Johnson Creek Road and 800 feet south of Haight Road; pasture:

Ap--0 to 8 inches, brown to dark-brown (10YR 4/3) loamy fine sand; weak, very fine, granular structure; very friable; abundant fine roots; neutral; abrupt, smooth boundary. 7 to 8 inches thick.

B21--8 to 14 inches, strong-brown (7.5YR 5/6) loamy fine sand; few, fine, yellowish-red (5YR 4/6) iron nodules that have a dark reddish-brown (5YR 3/3) center; weak, fine and medium, granular structure; very friable; abundant fine roots; slightly acid; clear, smooth boundary. 5 to 7 inches thick.

B22--14 to 28 inches, brown (7.5YR 5/4) loamy fine sand; many, fine and medium, faint, strong-brown (7.5YR 5/6) mottles; weak, fine and medium, granular structure; very friable; plentiful fine roots; slightly acid; clear, smooth boundary. 8 to 20 inches thick.

B23--28 to 32 inches, light-brown (7.5YR 6/4) loamy fine sand; many, medium, prominent, yellowish-red (5YR 5/6 to 5/8) mottles; few, dark reddish-brown (5YR 3/3) and yellowish-red (5YR 4/6) stains; lower part of this horizon mixed with some material from the IIC horizon; weak, fine and medium, granular structure; very friable; few roots; slightly acid; clear, broken boundary. 0 to 5 inches thick.

IIC--32 to 50 inches, brown (7.5YR 5/4) silty clay; few, fine, distinct, yellowish-red (5YR 4/6) mottles; many brown (7.5YR 5/2) to pinkish gray (7.5YR 6/2) lime streaks; weak, thick, platy structure; no roots; neutral to moderately alkaline.

Thickness of the solum and depth to clay range from 20 to 40 inches. Depth to bedrock is more than 40 inches. The soil is free of stones in most places. The A and B horizons range from medium acid to neutral, and the underlying fine material ranges from neutral to moderately alkaline.

The Ap horizon is dominantly 10YR in hue, is 3 or 4 in value when moist, and is 2 to 3 in chroma. When dry, the Ap horizon is more than 5.5 in value.

The B21 horizon ranges from 2.5Y to 5YR in hue, from 4 to 6 in value, and from 3 to 6 in chroma. In some places, yellowish-red to red iron nodules occur in the B21 horizon. The B22 horizon ranges from 2.5Y to 5YR in hue, from 4 to 6 in value, and is 3 to 4 in chroma. The B horizon ranges from loamy fine sand to fine sand.

The IIC horizon contains more than 35 percent clay and ranges from heavy silty clay loam to clay. It ranges from 2.5YR to 5Y in hue, from 3 to 5 in value, and from 2 to 4 in chroma.

The Claverack soils formed in deposits similar to those of somewhat poorly drained Cosad soils and poorly drained to very poorly drained Cheektowaga soils. Claverack soils are similar to Colonie and Elnora but are moderately deep to clayey lake deposits. They are coarser textured in the A and B horizons than Arkport and Galen soils and have a finer textured C horizon. Claverack soils are better drained and have coarser textured A and B horizons than Odessa, Rhinebeck, and Lockport soils.

Claverack loamy fine sand, 0 to 2 percent slopes (CmA).--This soil occupies areas at the base of gently sloping, adjacent soils, and it receives some runoff from these soils. Areas are irregularly shaped and are generally less than 20 acres in size.

Commonly included with this soil in mapping are basinlike, depressional areas of similar but somewhat poorly drained Cosad soils. Also included, where the depth to underlying clay varies, are areas of deep, sandy Galen and Elnora soils or of Hudson, Rhinebeck, and similar clayey soils. Near the beach ridge along U.S. Highway No. 104 are areas of a soil that, in many places, contains small pebbles mixed with the sandy mantle. The symbol for gravel is used on the soil map to indicate gravelly profiles. Where this Claverack soil occurs with moderately deep Lockport soils, red shale bedrock is within a depth of 6 feet in many included areas. In the northeastern part of the county, included areas are of a soil underlain with heavy silt rather than clay. In areas parallel to the lake and associated with outwash soils, inclusions have some gravel in the surface layer and, in many places, have a 2- to 4-inch gravel layer just above the clay. In some included areas, the soil is underlain by calcareous till rather than clay.

This soil is suited to crops, pasture, or trees. It is well suited to vegetables and fruit if management is good. During dry periods, lack of moisture may be critical for vegetables. Soil blowing is a hazard in some areas if they are left unprotected. Maintenance of fertility and organic matter is important for good crop growth. (Capability unit IIw-1; woodland suitability group 3s1)

Claverack loamy fine sand, 2 to 6 percent slopes (CmB).--This soil has the profile described as representative for the series. It occupies convex topography and is in areas of less than 10 acres in many places. The areas are generally oblong or circular.

Commonly included with this soil in mapping are small knobs of well drained soils. Also included, in areas where sandy deposits are thicker than 40

inches, are small areas of Colonie, Elnora, Arkport, and Galen soils. The symbol for gravel is used on the soil map to indicate included soils that have a fine gravelly surface layer. The main areas where included soils have been influenced by gravel are near the beach ridge and adjacent to other outwash or beach areas. In some parts of the county, included soils are underlain by compact silt layers rather than clay. In areas near soils derived from outwash or near Lake Erie, included soils have some pebbles mixed throughout the profile and, in a few places, have a 2- to 4-inch gravel layer just above the clay. Where this soil occurs with Lockport soils, the red shale bedrock normally is within a depth of 6 feet. In areas of glacial till, included soils are underlain by glacial till rather than clay.

This soil is suited to crops, pasture, or trees. It is well suited to vegetables and fruits if management is good. Some practices for controlling water erosion may be needed in areas that have long slopes, but the primary problems are droughtiness during dry periods and susceptibility to soil blowing in unprotected areas. (Capability unit IIw-1; woodland suitability group 3s1)

Collamer Series

The Collamer series consists of deep, moderately well drained, medium-textured soils that developed in neutral or calcareous, silty lacustrine deposits. These soils are in areas widely scattered in the county. One principal area is located near the eastern end of Slayton Settlement Road in the town of Lockport. Collamer soils are nearly level to gently sloping and have slopes ranging from 0 to 6 percent.

A representative profile of a Collamer soil has a dark grayish-brown silt loam surface layer 8 inches thick. Directly under this dark surface layer, there is a brown leached layer of silt loam that contains strong-brown mottles. It is medium acid. The subsoil is between depths of 15 and 29 inches. It is brown, mottled silt loam and is slightly acid in the upper part and neutral in the lower part. A weakly calcareous substratum occurs at 29 inches below the surface. It consists of reddish-brown, firm silt loam that is mottled.

The seasonal water table in Collamer soils rises to within 18 inches of the surface early in spring and in extended rainy periods. In most places it is perched over moderately slowly or slowly permeable layers in the subsoil and substratum. In spring, roots are restricted to the uppermost 20 inches. As the water table recedes, a few roots extend downward to the calcareous substratum. The available moisture capacity is high.

Representative profile of Collamer silt loam, 2 to 6 percent slopes, 400 feet north of Slayton Settlement Road and 500 yards southwest of Hartland Road; cultivated area:

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

A2--8 to 15 inches, brown (10YR 5/3) silt loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; friable; few to plentiful roots; medium acid; gradual, wavy boundary. 5 to 9 inches thick.

B&A--15 to 19 inches, brown (7.5YR 5/4) silt loam; common, fine, distinct yellowish-red (5YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; tongues and interfingering of brown (10YR 5/3) A2 material; some clay films evident on ped surfaces in lower part of horizon; slightly acid; clear, wavy boundary. 2 to 6 inches thick.

B2t--19 to 29 inches, brown (7.5YR 5/4) heavy silt loam; common, fine to medium, distinct, yellowish-red (5YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; nearly continuous, reddish-brown (5YR 5/3) clay films on ped surfaces and in pores; few roots; neutral; clear, wavy boundary. 8 to 15 inches thick.

C--29 to 58 inches, reddish-brown (5YR 5/3) silt loam; many (50 percent), medium, distinct, yellowish-red (5YR 5/6 to 5/8) mottles; weak, thick, platy structure to weak, coarse, subangular blocky structure; firm; no roots; weakly calcareous.

The solum ranges from 22 to 40 inches in thickness, and depth to carbonates ranges from 22 to 60 inches. These soils typically are free of coarse fragments, but a few stones or pebbles are present in some profiles. The A and B horizons range from medium acid to neutral. The C horizon is neutral to moderately alkaline. It is calcareous in some places.

The Ap horizon has a hue of 10YR or 7.5YR and chroma of 2 or 3. The Ap horizon has values of 3 to 5 when moist and of more than 5.5 when dry. It ranges from fine sandy loam to silt loam. The A2 horizon ranges from 5YR to 2.5Y in hue, is 5 or 6 in value, and is 3 or 4 in chroma. Mottles are few to common.

In the B&A horizon, the B part has the same range in color and texture as the B2t horizon, and the A part has the same range in color and texture as the A2 horizon. The B2t horizon ranges from 2.5Y to 5YR in hue, is 4 or 5 in value, and is 3 or 4 in chroma. Mottles are few to many and faint to distinct, and their chroma is 1 to 2 units higher than in the matrix. The B2t horizon ranges from silt loam to silty clay loam and has an average clay content ranging from 18 to 35 percent. Clay films occur on vertical and horizontal faces of peds and in the pores. Structure is subangular blocky and ranges from weak to moderate and from medium to coarse.

The C horizon has the same range in color as the B horizon in most places, but colors outside of this range occur in some places. The C horizon is dominantly silt or silt loam, but thin layers or bands

that have a wide range in texture are in the horizon in some profiles.

Collamer soils formed in deposits similar to those of the well-drained Dunkirk, the somewhat poorly drained Niagara, and the poorly and very poorly drained Canandaigua soils. Collamer soils have a finer textured Bt horizon than Galen soils and a coarser textured Bt horizon than Hudson or Schoharie soils. The Bt horizon in the Collamer soils is coarser textured than that in the Odessa and Rhinebeck soils.

Collamer silt loam, 0 to 2 percent slopes (CnA).--This soil has a profile similar to the one described as representative for the series. Areas range from less than 5 to about 50 acres in size. Most areas are less than 20 acres in size and are roughly oblong.

Included with this soil in mapping, in about one-third or the total acreage, are areas where the surface layer is very fine sandy loam. Also included are a few areas of similar but coarser textured soils that have a fragipan. Other common inclusions are the coarser textured Galen and Minoa soils, the finer textured Hudson and Rhinebeck soils, and the better drained Dunkirk and Niagara soils. Locally, there are some included areas of a soil underlain by glacial till. Some areas near Newfane and Olcott contain gravel in the surface layer or elsewhere in the profile.

This soil is well suited to most crops grown in the area. It is especially well suited to fruits and vegetables. In most places both drainage and irrigation are needed, as well as other practices of good management. (Capability unit IIw-2; woodland suitability group 2o1)

Collamer silt loam, 2 to 6 percent slopes (CnB).--This soil has the profile described as representative for the series. It is on knolls or slight rises and, in many places, is along small drainageways. Areas range from less than 5 to about 50 acres in size and have no characteristic shape.

Included with this soil in mapping are areas of similar well-drained Dunkirk soils on knolls and of wetter Niagara and Canandaigua soils in depressions and along drainageways. Also included, in about one-fourth of the total acreage, are areas where the surface layer is very fine sandy loam. In some included areas is a similar but coarser textured soil that has a fragipan. Other inclusions are of the coarser textured Arkport and Galen soils and the finer textured Hudson soils. Included in areas adjacent to till areas are Collamer soils underlain by till. This soil is associated with gravelly soils in places, and in many of these areas, gravel is on the surface or in the profile.

If adequate fertilizer is applied and other practices of good management are used, this soil is well suited to most crops grown in the area and is especially well suited to fruits and vegetables. If the soil is used intensively, protection from erosion is needed. For best crop growth, both drainage and irrigation are also needed. (Capability unit IIe-2; woodland suitability group 2o1)

Colonie Series

The Colonie series consists of deep, well-drained to excessively drained, coarse-textured soils. These soils formed in lacustrine or wind-deposited fine sands. They are level to gently sloping soils that occur in deposits on the beaches, sand bars, or deltas of old postglacial lakes. No large areas are in Niagara County. These soils occur principally on or north of U.S. Highway No. 104 (Ridge Road).

A representative profile of a Colonie soil has a brown to dark-brown loamy fine sand surface layer 8 inches thick. The upper part of the subsoil is very friable, strong-brown to brown loamy fine sand about 19 inches thick. The lower part of the subsoil begins at a depth of 27 inches and extends to 50 inches. It is a brown fine sand that is loose and contains a few, slightly firm, reddish-brown bands less than 1 inch thick. This layer contains very few roots. It is strongly acid in the upper part and medium acid in the lower part. At a depth of 50 inches, a substratum of loose, brown fine sand occurs. It is medium acid.

The seasonal high water table rarely rises above a depth of 3 feet, but the water table normally is more than 5 feet below the surface. Permeability is rapid to a depth of 3 feet or more. Rooting depth is not restricted, but most roots are in the uppermost 3 feet of soil. The available moisture capacity is low to moderate. All areas that are not protected by vegetation are susceptible to soil blowing. Maintenance of organic matter is important in the cultivation of these soils.

Representative profile of Colonie loamy fine sand, 0 to 6 percent slopes, 1 mile southwest of Gasport Village, one-half mile south of State Route 31, and 265 yards east of Kayner Road; cultivated area:

Ap--0 to 8 inches, brown to dark-brown (10YR 4/3) loamy fine sand; weak, fine, granular structure; very friable; abundant fine roots; neutral (limed); abrupt, smooth boundary. 6 to 10 inches thick.

B21--8 to 18 inches, strong-brown (7.5YR 5/6) loamy fine sand; very weak, very fine, granular structure; very friable; plentiful fine roots; neutral (limed); gradual, wavy boundary. 6 to 12 inches thick.

B22--18 to 27 inches, brown (7.5YR 5/4) loamy fine sand; very weak, fine, granular structure or single grain; very friable; few roots; medium acid; clear, smooth boundary. 8 to 15 inches thick.

B23--27 to 50 inches, brown (7.5YR 5/4 and 7.5YR 5/2) fine sand that has fine reddish-brown (5YR 4/4) and dark reddish-brown (5YR 3/4) layers ranging from one-fourth to three-fourths of an inch in thickness; washed sand grains and dark-colored sand grains give a salt-and-

pepper color to the lower part of horizon; structureless; primary material is loose, and thin layers are slightly firm; very few fine roots; strongly acid in upper part to medium acid in lower part. 20 to 30 inches thick.

C--50 to 55 inches, brown (7.5YR 5/2) fine sand; few, medium, distinct, strong-brown (7.5YR 5/6) mottles; single grain; loose; medium acid.

The solum ranges from 40 to 65 inches in thickness. The pH increases with depth unless these soils are limed, and it is more than 5.5 at a depth ranging from 30 to 50 inches. Fine sand is dominant, and very fine sand and finer material make up less than 15 percent between depths of 10 and 40 inches (control section). Bedrock is at a depth of more than 40 inches. Most profiles are free of coarse fragments, but some contain gravel.

The Ap horizon has a hue of 7.5YR or 10YR and chroma of 2 or 3. The Ap horizon has a value of 3 or 4 when moist and of more than 5.5 when dry.

The B horizon ranges from 5YR to 10YR in hue and from 4 to 6 in value. Chroma ranges from 3 to 6 in upper horizons but fades to 3 to 5 in lower horizons. The B horizon is loamy fine sand to fine sand. It has weak or very weak, granular structure or is structureless. The thin bands (lamellae) in the B horizon range from very fine sandy loam to loamy fine sand. In most of the thin bands, an increase in clay over the layers between them is difficult to detect. Some of the thin bands have a 3 percent increase in clay content.

The C horizon, where present, has the same color and texture as the layers between the thin bands in the B horizon. The C horizon is mottled in some places. Contrasting layers of silt, clay, gravel, and glacial till occur below a depth of 40 inches in some places. Mottling is mostly below a depth of 40 inches.

Colonie soils formed in deposits similar to those of the moderately well drained Elnora soils and the somewhat poorly drained Stafford soils. Colonie soils lack the gravel that occurs in the Otisville soils. The Colonie soils are coarser textured than the Arkport soils, which have thick bands. Colonie soils are similar to the Claverack soils in texture but are better drained and lack the underlying, clayey lake sediments. Colonie soils are better drained and coarser textured than Galen soils.

Colonie loamy fine sand, 0 to 6 percent slopes (CoB).--This soil occurs in deposits of postglacial lakebeds on the tops of beaches, sandbars, and deltas. Areas range from less than 5 to about 20 acres in size, and the average size is less than 10 acres. These areas are roughly circular in many places.

Most commonly included with this soil in mapping are areas of the finer textured, thicker banded Arkport soils. Also included are areas of the similar but moderately well drained Elnora soils. Areas near or on the beach ridge have inclusions of gravelly Otisville soils. Near fine-textured lacustrine deposits, included areas of Claverack soils are common. In a few included spots, there are moderately sloping Colonie soils that are more droughty than this soil.

This soil is suited to most crops if it is well managed. During dry periods most crops are damaged by lack of moisture unless irrigated. This soil can be planted earlier in spring than most other soils in the county, and it is important locally for vegetables that mature early. It is one of the better soils for cherries, peaches, and other stone fruits.

Soil blowing is a hazard in many cultivated and unprotected areas. Maintenance of fertility is an important management need. (Capability unit IIIs-1; woodland suitability group 4s1)

Cosad Series

The Cosad series consists of deep, somewhat poorly drained, moderately coarse textured soils that developed in sandy lacustrine deposits underlain by calcareous silt and clay. These soils are in areas scattered throughout the county but are located mostly north of the Niagara Escarpment. They are level to nearly level. Areas generally are less than 20 acres in size. Slopes are 2 percent or less.

A representative profile of a Cosad soil has a very dark grayish brown, slightly acid fine sandy loam surface layer 9 inches thick. The upper part of the subsoil is 5 inches thick and consists of pale-brown, neutral loamy fine sand that is distinctly mottled with strong brown and light brownish gray. The lower part of the subsoil is about 12 inches thick and is brown, neutral loamy fine sand that is distinctly mottled with strong brown and has a few, reddish-brown stains. The substratum occurs at a depth of 26 inches. It is reddish-brown, calcareous silty clay that has many, yellowish-red and strong-brown mottles.

Percolation of water through the sandy surface layer and subsoil is moderately rapid or rapid. In spring, however, and during wet periods, the water table is within 6 inches of the surface. It is perched on the slowly permeable, firm, clayey substratum. The main depth for rooting ranges from 8 to 20 inches in undrained areas and corresponds to the height of the seasonal high water table. The available moisture capacity is low.

Representative profile of Cosad fine sandy loam, one-half mile west of Irish Road and 50 feet north of Willow Road; idle area:

Ap--0 to 9 inches, very dark grayish brown (10YR 3/2) fine sandy loam; grayish brown (10YR 5/2) when dry; weak, fine, granular structure; very friable; abundant fine roots; slightly acid; abrupt, smooth boundary. 7 to 9 inches thick.

B21--9 to 14 inches, pale-brown (10YR 6/3) loamy fine sand; common, medium, distinct, strong-brown (7.5YR 5/6) and light brownish-gray (10YR 6/2) mottles; very weak, fine, granular

structure or single grain; very friable; plentiful fine roots; neutral; clear, wavy boundary. 3 to 8 inches thick.

B22--14 to 26 inches, brown (10YR 5/3) loamy fine sand; many, coarse, distinct strong-brown (7.5YR 5/6) stains; weak, medium, platy structure; friable; plentiful fine roots; neutral; abrupt smooth boundary. 8 to 20 inches thick.

IIC--26 to 50 inches, reddish-brown (5YR 4/3) silty clay; greenish-gray (5GY 6/1) ped coats and many yellowish-red (5YR 4/6) and strong-brown (7.5YR 5/6) mottles; weak, thick, platy structure; firm; very few fine roots; calcareous.

Depth to contrasting material ranges from 18 to 36 inches. Depth to bedrock is more than 40 inches. The average texture between a depth of 10 inches and the contrasting silty clay is loamy fine sand or coarser. The contrasting material contains more than 35 percent clay. Reaction ranges from medium acid to neutral in the B21 horizon and is slightly acid to neutral in the B22 horizon. These soils are generally free of coarse fragments.

The Ap horizon is 10YR in hue, 2 or 3 in value, and 1 or 2 in chroma. Mottles that have a chroma of 2 or less are at the base of the Ap horizon, but are not dominant above a depth of 18 inches. The Ap horizon is less than 10 inches thick, or less than one-third the thickness of the solum.

The B21 horizon ranges from 5YR to 2.5Y in hue, from 4 to 6 in value, and is 3 or 4 in chroma. Mottles are more than 4 and less than 3 in the B21 horizon. The B22 horizon ranges from 5YR to 2.5Y in hue, is 4 or 5 in value, and is 3 or 4 in chroma. Few to many mottles that have chroma of more than that of the matrix are in the B22 horizon. The B horizon ranges from loamy fine sand to fine sand.

The contrasting material in the IIC horizon ranges from heavy silty clay loam to clay. It ranges from 2.5YR to 5Y in hue, from 3 to 5 in value, and from 2 to 4 in chroma. The contrasting material is massive or layered; prismatic or blocky structure is not present.

Cosad soils formed in deposits similar to those of moderately well drained and well drained Claverack soils and poorly drained and very poorly drained Cheektowaga soils. Clayey lake sediments underlie the Cosad soils but are lacking in the Stafford and Minoa soils. Cosad soils are wetter than Elnora and Galen soils and are moderately deep to clayey lake sediments. They are better drained and have coarser textured A and B horizons than Lakemont and Madalin soils.

Cosad fine sandy loam (0 to 2 percent slopes) (Cs).--This soil normally occupies areas where runoff is slow or has accumulated. Areas range from less than 5 to 50 acres in size. The average size is about 10 acres. Shape of the areas is mostly irregular.

Commonly included with this soil in mapping are small knolls of better drained Claverack soils and depressional areas of Cheektowaga, Lakemont, or Madalin soils. Also included in some areas are sandy soils over silt. Where the sand deposit is thin, there are inclusions of Odessa or Rhinebeck soils; where thicker, inclusions of Minoa or Stafford soils occur. Some gravel is on the surface or in the profile in areas close to glacial beach or outwash deposits, such as those near U.S. Highway No. 104 (Ridge Road). Soil areas adjacent to Lockport soils generally have shale within 6 feet of the surface. Other inclusions are of sandy soils over glacial till.

This Cosad soil is not well suited to cultivated crops unless it is drained. Both planting and harvesting generally are difficult because of wetness. If adequately drained, this soil is suited to most crops grown in the area. Maintenance of fertility is essential to good crop growth. During dry periods, plants may be damaged because moisture is lacking. (Capability unit IIIw-4; woodland suitability group 4w1)

Cut and Fill Land

Cut and fill land (Cu) consists of areas that have had the original soil stripped and removed or covered with soil materials to a depth of 3 feet or more. These cut and fill areas are a result of construction operations, such as those for the New York State power project, the Robert Moses Parkway, the Barge Canal, and various quarry areas. They include borrow areas, fill areas, dikes, canal spoil, dredgings, and the like. These areas are mainly a mixture of soil materials that have had little or no profile development.

In many places, these areas are in some kind of farm or nonfarm use. Because the soil materials vary, most areas require onsite investigation if any changes in land use are contemplated. (Capability unit and woodland suitability group not assigned)

Dunkirk Series

The Dunkirk series consists of deep, well-drained, medium-textured soils that formed in medium-lime to high-lime lacustrine deposits in which silt and very fine sand are dominant and the amount of clay is moderated. These soils are in areas widely scattered throughout the county on the lake plain. They are gently sloping to strongly sloping and have both simple and complex slopes. Slopes range from 2 to 20 percent.

A representative profile of a Dunkirk soil has a dark grayish-brown silt loam surface layer 9 inches thick. The surface layer is underlain by a brown, friable, slightly acid leached layer of silt loam that extends to a depth of 14 inches. The subsoil is between depths of 14 and 32 inches. It is a reddish-brown, firm, medium acid silt loam. Some intermixing with the leached layer occurs in the upper part of the subsoil. The substratum is at a depth of 32 inches. It is reddish brown,

medium acid, firm silt loam to a depth of 42 inches. Below this depth the substratum is very fine sandy loam to silt loam that is neutral in the upper part and calcareous at a depth of 65 inches.

The seasonal high water table is generally at a depth of more than 36 inches. Most roots are concentrated in the uppermost 30 inches of soil, but some roots, especially tap roots, extend deeper. The available moisture capacity is high. Permeability is moderate in the surface layer and moderately slow in the subsoil.

Representative profile of Dunkirk silt loam, 2 to 6 percent slopes, on the west side of Sand Pit Road and 300 yards south of the New York State Barge Canal.

Ap--0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, crumb structure; very friable; abundant fine roots; slightly acid; clear, wavy boundary. 6 to 10 inches thick.

A2--9 to 14 inches, brown (10YR 5/3) silt loam; weak, fine, subangular blocky structure; friable; abundant fine roots; slightly acid; clear, wavy boundary. 0 to 8 inches thick.

B&A--14 to 17 inches, reddish-brown (5YR 4/3) silt loam; moderate, fine, subangular blocky structure; firm; abundant fine roots; brown (10YR 5/3) silt and very fine sand coat the blocky peds; patchy clay films in the ped interiors; medium acid; gradual, wavy boundary. 3 to 6 inches thick.

B2t--17 to 25 inches, reddish-brown (5YR 4/3) heavy silt loam; moderate, fine, subangular blocky structure; firm; abundant fine roots; patchy clay films on ped faces and clay films in most of the pores; medium acid; gradual, wavy boundary. 8 to 13 inches thick.

B3--25 to 32 inches, reddish-brown (5YR 4/3) silt loam; common, fine, faint, reddish-brown (5YR 5/3) mottles; weak, medium, subangular blocky structure; firm; abundant fine roots; medium acid; gradual, smooth boundary. 3 to 8 inches thick.

C1--32 to 42 inches, reddish-brown (5YR 5/3) silt loam that contains a reddish-brown (2.5YR 4/4) band that is slightly finer textured than silt loam and is 1 inch thick; very weak, medium, subangular blocky structure or massive; firm; band is very firm; few fine roots; medium acid; abrupt, smooth boundary. 9 to 12 inches thick.

C2--42 to 70 inches, brown (10YR 5/3) very fine sandy loam to light silt loam; very weak, subangular blocky structure or single grain; friable; few fine roots; neutral to depth of 65 inches, mildly alkaline below.

The solum ranges from 20 to 40 inches in depth to material that retains its original stratification and lacks moderate blocky structure and clay films. Depth to carbonates ranges from 2 to 6 feet. Coarse fragments are generally absent, but where they occur their content ranges to as much as 10 percent in any horizon. Reaction ranges from strongly acid to neutral in the B2t and B3 horizons and from medium acid to moderately alkaline in the C horizon.

The Ap horizon has a hue of 10YR or 7.5YR and chroma of 2 or 3. The Ap horizon is 3 or 4 in value when wet and more than 5.5 when dry. The A2 horizon may be absent in severely eroded profiles. Hues of the A2 horizon range from 5YR to 10YR, value is 5 or 6, and chroma is 3 or 4. Texture ranges from a fine sandy loam to silt loam.

The B horizon ranges from 5YR to 2.5Y in hue, is 4 or 5 in value, and is 3 or 4 in chroma. Below a depth of 20 inches, there are few to common mottles of high chroma in some profiles. The B horizon ranges from silt loam to silty clay loam. The average clay content is 18 to 35 percent. The B2t horizon is at least 8 inches thick.

The range in color of the C horizon is similar to that of the B horizon. Texture of the C horizon is fairly variable but is not highly contrasting.

Dunkirk soils formed in deposits similar to those of the moderately well drained Collamer, the somewhat poorly drained Niagara, and the poorly and very poorly drained Canandaigua soils. Dunkirk soils have a finer textured B horizon than Arkport soils and a coarser textured B horizon than Hudson of Schoharie soils.

Dunkirk silt loam, 2 to 6 percent slopes (DuB).--This soil has the profile described as representative for the series. Slopes are generally short. Most areas range from less than 5 to about 25 acres. The average size is between 5 and 10 acres. Some areas are oblong, but most areas have no characteristic shape.

Most commonly included with this soil in mapping are small areas of the moderately well drained Collamer soils and the somewhat poorly drained Niagara soils that formed in materials similar to those of this Dunkirk soil. Also included are small areas of coarser textured Arkport or Galen soils and finer textured Hudson soils.

This is one of the better soils for cropping in Niagara County. It can be planted early in spring, is easily cultivated, and responds well to applications of lime and fertilizer. Because it is very susceptible to erosion, erosion is a major hazard, even on gentle slopes. Some random drainage may be needed for wet inclusions. Supplemental irrigation is necessary in dry years, especially for shallow-rooted crops. (Capability unit IIe-2; woodland suitability group 2o1)

Dunkirk silt loam, 6 to 12 percent slopes, eroded (DuC3).--This soil has a profile similar to the one described as representative for the series, but the original surface layer has been removed in many areas. For this reason, the present surface layer is finer textured than that of this soil in some areas and contains less organic matter. Some areas have shallow gullies and a few deep ones. Areas range from about 5 to 25 acres in size; the average is about 18 acres. The areas are roughly rectangular in many places and occur near streams and drainageways in dissected areas.

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Most commonly included with this soil in mapping are uneroded areas. Commonly included are areas of the coarser textured Arkport soils and the moderately well drained Collamer soils. In some included areas, the surface layer is silty clay loam.

The hazard of erosion is continuing on this eroded soil. Measures of erosion control are essential if this soil is cultivated. This soil is poorly suited to intensive cropping, but it is fairly well suited to long-term hay, pasture, trees, and development for some kinds of wildlife habitat. Because complex slopes are common, the use of contour cultivation for erosion control is not feasible in many places. This soil is fairly well suited to peaches and cherries, which require good soil drainage. (Capability unit IVe-2; woodland suitability group 2r1)

Dunkirk and Arkport soils, 12 to 20 percent slopes, eroded (DvD3).--Areas of this undifferentiated group consists of Dunkirk soil, Arkport soil, or both. They have profiles similar to those described as representative for their respective series, except that the original surface layer has been removed by erosion over many of the areas. Both soils contain shallow gullies or deep gullies in some places. Areas range from about 5 to 50 acres in size; the average size is about 20 acres. The areas are roughly oblong.

Most commonly included with this group in mapping are uneroded areas. Commonly included are areas of the finer textured Hudson soils or the coarser textured Colonie soils. In a few areas Howard, Otisville, or similar gravelly soils are included. A few areas have slopes of more than 20 percent.

These eroded soils are best suited to pasture or trees. Because the hazard of erosion is continuing, cultivation should be limited mainly to renovating hay and pasture seedlings. The soils can be used for fruits if equipment that does not cause serious erosion can be used. (Capability unit VIe-1; woodland suitability group 2r3)

Elnora Series

The Elnora series consists of deep, moderately well drained, coarse-textured soils. These soils formed in water-laid or windblown deposits of fine sand. Elnora soils have short, slightly convex slopes and occur on landforms that formerly were sand bars or beaches in the old lake plain. They occur mainly in the eastern half of the town of Newfane. Scattered areas extend westward to Twelvemile Creek and eastward to the Orleans County line. Slopes range from 0 to 6 percent.

In a representative profile a cultivated Elnora soil has a brown to dark-brown, strongly acid loamy fine sand plow layer 6 inches thick. Just below the plow layer is the subsoil consisting of yellowish-brown loamy fine sand to fine sand. It is very friable and strongly acid or medium acid. The subsoil extends to a depth of 20 inches. The substratum is medium acid, brown loamy fine sand or fine sand. It is loose, is stone free, and contains common, medium and coarse, distinct, light brownish-gray mottles.

In spring and in other wet periods, the water table is 18 to 20 inches below the surface. The main depth of rooting is 24 inches and is directly related to the depth of the water table. As the water table falls, roots can extend to a depth greater than 24 inches. These soils have a low available moisture capacity and rapid permeability. They are subject to soil blowing in exposed areas.

Representative profile of Elnora loamy fine sand, 0 to 2 percent slopes, in the town of Newfane, 75 feet west of Brown Road and about 475 yards south of Charlotteville Road; idle area:

Ap--0 to 6 inches, brown to dark-brown (10YR 4/3) loamy fine sand; weak, fine, granular structure; very friable; abundant fine roots; strongly acid; abrupt, smooth boundary. 6 to 8 inches thick.

B21--6 to 9 inches, yellowish-brown (10YR 5/6) loamy fine sand to fine sand; very weak, platy structure or single grain; very friable; plentiful fine roots; strongly acid; diffuse, wavy boundary. 2 to 6 inches thick.

B22--9 to 20 inches, yellowish-brown (10YR 5/4) loamy fine sand; very weak, platy structure or single grain; few roots; very friable; medium acid; clear, wavy boundary. 8 to 16 inches thick.

C--20 to 50 inches, brown (10YR 5/3) loamy fine sand or fine sand; common, medium and coarse, distinct, light brownish-gray (10YR 6/2) mottles enclosed in strong-brown (7.5YR 5/8) and reddish-yellow (7.5YR 6/6), elliptical bodies; many, very fine, black (10YR 2/1) concretions; single grain; loose; medium acid, but ranging to neutral at a depth of 50 inches.

Thickness of the solum ranges from 18 to 30 inches. Depth to carbonates ranges from 40 to 60 inches. The solum ranges from strongly acid to slightly acid and is less acid as depth increases. Depth to distinct mottles ranges from 12 to 36 inches.

The Ap horizon has a hue of 10YR and chromas ranging from 2 to 4. It is 3 or 4 in value when moist and more than 5.5 when dry. In some undisturbed profiles, a thin A1 horizon is present and has slightly lighter colors than the colors of the Ap horizon.

The B and C horizon are dominantly 10YR in hue but range from 5YR to 10YR. The matrix is 4 or 5 in value and ranges from 3 to 6 in chroma. Mottles range from few to common and from faint to distinct, and they range from 4 to 6 in value and generally from 2 to 6 in chroma above a depth of 40 inches. The B and C horizons are dominantly loamy fine sand and fine sand. The overall texture between depths of 10 and 40 inches is coarser than loamy very fine sand.

Elnora soils formed in deposits similar to those of the well-drained to excessively drained Colonie

soils and the somewhat poorly drained Stafford soils. Elnora soils lack the clayey IIC horizon of Claverack and Cosad soils. They are coarser textured than the Galen soils. Elnora soils are better drained and coarser textured than Minoa soils and lack the gravel that is characteristic of the Altmar soils.

Elnora loamy fine sand, 0 to 2 percent slopes (ElA).--This soil has the profile described as representative for the series. Areas are irregular or roughly rectangular. Most areas are less than 20 acres in size.

Most commonly included with this soil in mapping are small knolls of well-drained Colonie soils. Also included are Minoa or Stafford soils in areas along drainageways and in depressional areas. Areas of similar Galen soils are included where thin, finer textured layers are present in the lower part of the subsoil. Claverack and Cosad soils are in small included areas. Included near the town of Newfane are areas of a soil that has gravel layers within a depth of 40 inches. The symbol for gravel is used on the soil map to indicate areas where gravel is in the surface layer. Other inclusions are a few areas where the soil is moderately deep to glacial till.

This Elnora soil is suited to most field crops and cash crops. It is well suited to specialized vegetable or fruit crops. If this soil is cropped intensively, random drainage of the wetter inclusions is essential. In some places a complete drainage system is desirable. Soil blowing is a hazard, and the soil is droughty during dry periods in some places. A most important need is adequate liming and fertilizing. (Capability unit IIw-1; woodland suitability group 4s1)

Elnora loamy fine sand, 2 to 6 percent slopes (ElB).--This soil has more complex slopes than Elnora loamy fine sand, 0 to 2 percent slopes. It dries out fairly quickly in the spring and it is often more droughty in summer than that soil. Areas are generally circular or roughly oblong and normally are less than 20 acres in size.

Included with this soil in mapping are the somewhat poorly drained Minoa soils or Stafford soils in the lower, wetter areas. Also included, in the northeastern part of the county near areas of Lockport and Claverack soils, are many areas of soils that are similar to this Elnora soil but are underlain by clay. Near the village of Newfane are included areas of soils that have gravel layers or are underlain by gravel. In some places inclusions of Altmar or Fredon soils occur. Also included are slightly higher knolls of well-drained Colonie soils. In a few scattered areas, inclusions are underlain by glacial till at a depth of less than 40 inches. Galen soils similar to this Elnora soil are common inclusions where thin, finer textured layers are present in the lower part of the subsoil.

This soil is suited to most field crops and cash crops. It is well suited to vegetables or fruit crops. A most important need is the timely use of adequate amounts of lime and fertilizer. Protection against soil blowing is needed, and there is a slight hazard of erosion by water. Random drainage of included wet areas is desirable if this soil is used intensively. During dry periods, this soil is droughty in some places. (Capability unit IIw-1; woodland suitability group 4s1)

Farmington Series

The Farmington series consists of shallow, well-drained, medium-textured soils. These soils are nearly level to moderately sloping. They formed in thin glacial till deposits over limestone bedrock that is within 20 inches of the surface. These soils are on bedrock-controlled landscapes influenced by the Lockport limestone formation. Slopes range from 0 to 8 percent.

A representative profile of a Farmington soil that is idle has a very dark grayish brown silt loam surface layer 8 inches thick. This layer contains a few limestone fragments and is slightly acid to neutral. Between depths of 8 to 16 inches, the subsoil is brown to yellowish-brown, friable silt loam. At a depth of 16 inches a 2-inch layer of the subsoil occurs, and it is brown, friable loam that is neutral. Gray, hard limestone occurs at a depth of 18 inches. It is fractured, and some soil material and roots penetrate the small cracks.

Water is sometimes present above the limestone rock early in spring or in very rainy periods. As the growing season progresses, and the soil above the limestone dries out, these soils become droughty. Roots are confined mostly to the soil above the limestone, but a few fine roots penetrate cracks. Permeability is moderate to moderately rapid and the available moisture capacity is low. Cultivation is difficult because of stones on the surface and in the profile and because of the limestone bedrock near the surface.

Representative profile of Farmington silt loam, 0 to 8 percent slopes, 900 feet east of the junction of State Routes 93 and 31 and 200 yards south of State Route 31, about one-half mile north of Frontier Dolomite Limestone Quarry; idle area:

Ap--0 to 8 inches, very dark grayish brown (10YR 3/2) silt loam; dark grayish brown (10YR 4/2) when rubbed; moderate, medium, granular structure; friable; abundant fine roots; few limestone fragments; slightly acid; clear, smooth boundary. 6 to 9 inches thick.

B21--8 to 16 inches, brown (10YR 5/3) to yellowish-brown (10YR 5/4) silt loam; weak, fine and medium, subangular blocky structure that has pressure faces; friable; plentiful fine roots; few limestone fragments; slightly acid to neutral; clear, wavy boundary. 4 to 10 inches thick.

B22--16 to 18 inches, brown (10YR 5/3) loam; weak, fine, subangular blocky structure; friable; plentiful fine roots; few limestone and sandstone fragments; neutral; abrupt, wavy boundary. 0 to 5 inches thick.

IIR--18 inches, fractured limestone bedrock; some soil material and roots penetrate the small cracks.

Thickness of the solum and depth to limestone range from 10 to 20 inches. The solum ranges from fine sandy loam to silt loam. Clayey material may be more abundant in joints and cracks in the rock where the underlying rock is fractured than it is in other parts of the profile. The solum ranges from 10 to 27 percent in clay content. Content of coarse fragments ranges from less than 5 to about 25 percent in any horizon above the rock.

The Ap horizon has a hue of 10YR and chroma of 2 or 3. Value is 3 or 4 when the horizon is moist and is more than 5.5 when it is dry. Unless limed, the Ap horizon is medium acid or slightly acid.

The B horizon has hues ranging from 2.5Y to 7.5YR; value of 4 or 5, and chroma of 3 or 4. Reaction below a depth of 12 inches or within 2 inches of the bedrock is slightly acid to neutral.

The Farmington soils have formed in materials similar to those of soils derived from glacial till, such as the Ontario, Hilton, Cayuga, Ovid, and Appleton soils. Farmington soils lack the Bt horizon of these soils and are less than 20 inches deep to rock.

Farmington silt loam, 0 to 8 percent slopes (FaA).--Areas of this soil range from less than 5 to more than 50 acres in size. The dominant slope is less than 5 percent.

Included in this soil in mapping are areas of soils that are more than 20 inches deep to rock and of soils that are less than 10 inches to rock. Also included are some small areas of Rock land. Wet spots are included in some areas, and most of them are shown on the soil map by the symbol for wet spots.

Runoff is slow to moderately rapid and depends on the slope. The hazard of erosion is moderate in the more sloping areas.

This soil is poorly suited to most long-season cultivated crops because it is shallow, stony, and droughty. In some areas where the underlying bedrock is well fractured, this soil is suited to grain, pasture, and hay. (Capability unit IIIs-2; woodland suitability group 5d1)

Fonda Series

The Fonda series consists of deep, very poorly drained, medium-textured soils. These soils formed in calcareous, lake-laid clay and silt. The silt and clay were deposited in fairly shallow areas of postglacial lakes. These soils occupy swampy, depressional areas that are mainly south of the limestone escarpment.

A representative profile of a Fonda soil that has been cultivated has a black, neutral mucky silt loam surface layer 7 inches thick. The upper part of the subsoil is greenish-gray silty clay 8 inches thick. It is neutral and contains prominent, yellowish-red mottles. The lower part of the subsoil is olive-gray, neutral to moderately alkaline silty clay that is firm when moist and sticky when wet. It extends to a depth of 29 inches. This layer is distinctly mottled with light olive brown. The substratum is brown and grayish-brown, firm silty clay loam to silty clay that is strongly calcareous.

These soils have a seasonal high water table that is perched above the slowly permeable subsoil and substratum. Unless these soils are artificially drained, the water table remains on or just under the surface for about 9 months a year. Runoff from Fonda soils is very slow, and many areas are ponded. The depth of soil available for rooting is related to the depth to the water table. The root zone is mainly the uppermost 10 inches of soil. If drainage is adequate, roots may extend to a depth of 30 inches or more. The available moisture capacity is low to moderate.

Representative profile of Fonda mucky silt loam in the town of Cambria, 200 feet east of State Route 425 and one-fourth mile north of State Route 31; idle area:

Ap--0 to 7 inches, black (10YR 2/1) mucky silt loam, very dark gray (10YR 3/1) when dry; moderate, medium and coarse, granular structure; friable; abundant roots; neutral; abrupt, smooth boundary. 6 to 8 inches thick.

B21g--7 to 15 inches, greenish-gray (5GY 5/1) silty clay; few, fine, prominent, yellowish-red (5YR 5/6) mottles; moderate, very coarse, prismatic structure; firm; few fine roots along prism faces; few fine pores; neutral; gradual, smooth boundary. 3 to 9 inches thick.

B22g--15 to 29 inches, olive-gray (5Y 5/2) silty clay; greenish-gray (5GY 5/1) and gray (10YR 5/1) ped coats; common, medium, distinct, light olive-brown (2.5Y 5/4), mottled ped interiors; moderate, very coarse, prismatic structure breaking to weak, coarse, blocky structure; unmottled ped faces have few to no clay films; firm, sticky; very few roots; neutral to moderately alkaline; clear, smooth boundary. 12 to 20 inches thick.

Cg--29 to 50 inches, brown (7.5YR 5/2) and grayish-brown (10YR 5/2) silty clay loam and silty clay; common, medium, faint, brown (7.5YR 5/4) mottles; weak, thick, platy structure; firm; strongly calcareous.

The solum ranges from 24 to 36 inches in thickness. Depth to carbonates generally corresponds to this thickness, but the lower part of the B horizon is calcareous in some profiles. Depth to bedrock is more than 40 inches and typically is more than 6 feet. Coarse fragments are normally absent, but erratic pebbles and stones are present in some profiles. Clay content between depths of 10 and 40 inches (control section) averages between 35 and 55 percent.

The Ap horizon is 10YR or 7.5YR in hue and 1 or 2 in chroma. It ranges from 1 to 3 in value when moist and is 4 or 5 when dry. Thickness of the Ap

horizon is less than 10 inches, or less than one-third the thickness of the solum. The Ap horizon ranges from slightly acid to neutral.

The B21g horizon ranges from 5GY to 5YR in hue, from 4 to 6 in value, and is 2 or less in chroma. Mottles range from none to common and, if present, are distinct or prominent. The B21g horizon is silty clay to clay and is slightly acid to neutral. The B22g horizon ranges from 5Y to 5YR in hue, from 4 to 6 in value, and is 2 or less in chroma. Chroma of 2 or less is dominant in 60 percent or more of the matrix between the base of the Ap horizon and a depth of 30 inches. Ped faces have a chroma of 2 or less, but mottles of high chroma are in the peds. The B22g horizon ranges from fine silty clay loam to clay and from slightly acid to moderately alkaline in the lower part. Structure is prismatic; it ranges from weak to strong and is coarse or very coarse. The B horizon lacks distinct clay films.

The C horizon typically is calcareous varved sediments.

The Fonda soils formed in deposits similar to those of the somewhat poorly drained Odessa or Rhinebeck soils and the poorly drained Lakemont or Madalin soils. The Fonda soils lack the underlying glacial till of the Madalin soils, loamy subsoil variant. They are wetter than Churchville soils and lack the underlying glacial till.

Fonda mucky silt loam (0 to 2 percent slopes) (Fo).--This soil is in the lower basinlike areas and the long, narrow, cutoff meanders. It also occupies a few slack water areas that are flooded. Some areas in the cutoff meanders of streams are long and narrow. The largest areas are basinlike and are roughly circular. Areas range from about 5 to more than 100 acres in size.

Most commonly included with this soil in mapping are areas of the poorly drained Madalin soils, Lakemont soils, and Canandaigua soils. Also included in some areas are the somewhat poorly drained Odessa soils. Other inclusions are of a soil covered by thin sandy deposits, and these are indicated on the soil map by the symbol for sand spots. In many included areas the mucky surface layer is more than 8 inches thick.

In undisturbed areas this soil is suited to a small number of grasses for pasture and to a few kinds of trees that are adapted to wet soil. It is well suited to management for wetland wildlife.

If adequately drained, this soil can be used for many kinds of cultivated crops. Where the organic matter in the surface layer has been oxidized and destroyed, however, maintaining the soil in good tilth is generally difficult. Because of the high content of clay below the mucky surface layer, locating a suitable outlet for draining this soil is difficult in many places. (Capability unit IVw-1; woodland suitability group 5w1)

Fredon Series

The Fredon series consists of deep, somewhat poorly drained to poorly drained, medium-textured soils that have a coarse-textured substratum. These soils developed in neutral to calcareous glacial outwash and beach deposits of sand and gravel. Most areas are in the towns of Newfane, Hartland, and Wilson and in the northern part of Cambria. Slopes are 3 percent or less.

A representative profile of a Fredon soil has a very dark grayish brown gravelly loam surface layer 8 inches thick. It is slightly acid. The upper part of the subsoil is grayish-brown, friable gravelly loam. This layer is slightly acid and contains many yellowish-brown and strong-brown mottles. At a depth of 12 inches, this part of the subsoil grades to brown, friable, slightly sticky gravelly loam that contains many brown and yellowish-brown mottles. The substratum begins at a depth of 22 inches. It consists of brown, loose, stratified sand and gravel. It is neutral in the upper part and is calcareous below a depth of 30 inches.

The seasonal high water table is near the surface in spring and late in fall. In many places Fredon soils collect runoff and underground seepage from surrounding higher areas. The depth of soil available to roots depends upon the fluctuating water table. In spring, this depth is limited to the surface layer. As the growing season progresses and the water table falls, roots can extend to a depth of 20 inches or more. The available moisture capacity is moderate, and permeability is moderately rapid to rapid.

Representative profile of Fredon gravelly loam in the town of Newfane, about three-fifths mile east of Hess Road and 20 feet south of Bishop Road; idle area:

Ap--0 to 8 inches, very dark grayish brown (10YR 3/2) gravelly loam, gray (10YR 6/1) when dry; weak, fine and medium, granular structure; friable, nonsticky; abundant fine roots; 15 percent gravel; slightly acid; abrupt, smooth boundary. 6 to 10 inches thick.

B21g--8 to 12 inches, grayish-brown (10YR 5/2) gravelly loam; many (35 percent), medium and coarse, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; plentiful fine roots; 20 percent gravel; slightly acid; clear, wavy boundary. 0 to 8 inches thick.

B22--12 to 22 inches, brown (10YR 5/3) gravelly loam; many (40 percent), medium, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4 and 5/6) mottles; weak, medium and coarse, subangular blocky structure; friable, slightly sticky; grayish-brown (10YR 5/2) ped faces; no clay films; plentiful roots in upper part, few in lower part; 25 percent gravel; slightly acid to neutral; clear, wavy boundary. 8 to 20 inches thick.

IIC--22 to 50 inches, brown (10YR 5/3), stratified sand and gravel; few, medium and coarse, distinct, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) mottles; single grain; loose;

neutral in the upper part and moderately alkaline below depth of 30 inches.

The solum ranges from 20 to 36 inches in thickness. It averages less than 18 percent clay. The solum ranges from 15 to 35 percent in average gravel content, by volume. Depth to carbonates ranges from 20 to 40 inches. In the solum a chroma of 2 or less is dominant on ped faces or in the matrix in some horizons above a depth of 20 inches, but a chroma of 3 or more is generally dominant in the matrix of most horizons and in some places all the horizons between depths of 20 and 30 inches.

The Ap horizon ranges from 7.5YR to 10YR in hue and from 1 to 3 in chroma. The Ap horizon is 3 or 4 in value when moist and is more than 5.5 when dry. The Ap horizon ranges from medium acid to neutral.

The B horizon ranges from 7.5YR to 2.5Y in hue, is 4 or 5 in value, and is generally 2, 3, or 4 in chroma, but chroma of 2 or less occurs on ped faces. Texture is typically gravelly loam or gravelly silt loam. Structure is generally weak, and reaction ranges from medium acid to neutral in the upper part of the B horizon and is slightly acid to neutral in the lower part.

The IIC horizon ranges from 7.5YR to 5Y in hue, is 4 or 5 in value, and is 2 or 3 in chroma. It consists of structureless sand and gravel that ranges from neutral to moderately alkaline.

The Fredon soils formed in deposits similar to those of the well drained and somewhat excessively drained Howard soils and the moderately well drained Phelps soils. Fredon soils have a finer textured B horizon than Altmar soils. They are underlain by deeper deposits of sand and gravel than the gravelly Hilton and Appleton soils, and they lack the Bt horizon of those soils. Fredon soils are better drained than Lamson, Sun, and Canandaigua soils and contain more gravel.

Fredon gravelly loam (0 to 3 percent slopes) (Fr).--Areas of this soil range from 3 to 90 acres or more in size. The average size is between 10 and 20 acres.

Most commonly included with this soil in mapping are areas of coarser textured, better drained Altmar soils and similarly textured, better drained Phelps soils. Also commonly included are small areas of Stafford soils, especially the Stafford soil that has a gravelly substratum. Small included areas of gravelly Hilton and Appleton soils are near glacial till areas. Areas of the poorly drained Lamson soil that has a gravelly substratum also are included. Other included areas are of soils derived from lacustrine material. These included soils are similar to Fredon soils but are underlain by silt and clay at a depth of less than 40 inches.

In areas not drained, use of this Fredon soil for cultivated crops is limited, but these areas are suited to hay, pasture, trees, and development for some kinds of wildlife habitat. In adequately drained areas, this soil is suited to most kinds of crops. It is a desirable soil for certain vegetables and fruits that have high moisture requirements. Locally, gravel may interfere with some root crops and also may be hard on machinery. (Capability unit IIIw-1; woodland suitability group 3w2)

Galen Series

The Galen series consists of deep, moderately well drained, moderately coarse textured soils. These soils formed in neutral to moderately alkaline lacustrine deposits of fine sand and very fine sand and some silt. They occur mainly north of U.S. Highway No. 104 (Ridge Road) on sandbars and deltaic deposits of postglacial Lake Iroquois. Nearly all the acreage of Galen soils in this county is in the towns of Wilson, Newfane, Somerset, and Hartland. Slopes range from 0 to 6 percent.

A representative profile of a Galen soil has a dark grayish-brown, slightly acid very fine sandy loam surface layer 8 inches thick. The surface layer is underlain by a leached layer of light yellowish-brown, slightly acid, very friable very fine sandy loam or loamy very fine sand that contains a few faint mottles and is 6 inches thick. The upper part of the subsoil, between depths of 14 and 27 inches, consists of brown, slightly acid, friable very fine sandy loam that contains a few, 2- to 4-inch, reddish-brown bands that are slightly sticky when wet and firm when dry. The lower part of the subsoil is between depths of 27 and 35 inches and is light reddish-brown, neutral, loose loamy fine sand that contains many, strong-brown mottles and reddish-brown bands that are 1/2 to 2 1/2 inches wide and are similar to those in the layer above. The substratum is at a depth of 35 inches and is calcareous. It consists of loose, reddish-brown loamy very fine sand and contains some silt pockets and mottles.

The seasonal high water table rises to within 18 inches of the surface early in spring and in excessively wet periods. The firm bands in the subsoil impede the downward movement of water, and some water moves laterally along them, especially in the gently sloping Galen soil. Roots are confined to the layers above the water table early in spring. As the season progresses and the water table falls, roots move downward but are impeded by firm bands. Few roots extend below a depth of 24 inches. The available moisture capacity is moderate.

Representative profile of Galen very fine sandy loam, 0 to 2 percent slopes, in the town of Newfane on east side of Murphy Road, 375 yards north of Hatter Road; cultivated area:

Ap--0 to 8 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, weak, fine, granular structure; very friable; abundant fine roots; slightly acid; abrupt, smooth boundary. 6 to 9 inches thick.

A2--8 to 14 inches, light yellowish-brown (10YR 6/4) very fine sandy loam to loamy very fine sand; few, medium, faint, yellowish-brown (10YR 5/6) mottles; weak, fine, granular structure; very friable; plentiful fine roots; slightly acid; clear, wavy boundary. 6 to 12 inches thick.

B21--14 to 27 inches, brown (10YR 5/3); very fine sandy loam; few, fine, distinct, reddish-brown (5YR 4/4) mottles; very weak, medium, subangular blocky structure; friable; few, 2- to 4-inch, reddish-brown (5YR 4/3), slightly sticky, discontinuous bands; bands are firm; some clay bridging on sand grains; few fine roots; slightly acid; gradual, wavy boundary. 10 to 20 inches thick.

B22--27 to 35 inches, light reddish-brown (5YR 6/3) loamy fine sand; many, coarse, distinct, strong-brown (7.5YR 5/6) mottles; horizontal, reddish-brown (5YR 4/3) very fine sandy loam layers that are 1/2 inch to 2 1/2 inches thick and have a total thickness of about 4 inches; weak, platy structure or single grain between thin layers; thin layers are massive; friable to firm; thin layers contain clay bridging on sand grains, and most of the sand grains have clay coats; few roots; neutral; diffuse, smooth boundary. 6 to 12 inches thick.

C--35 to 50 inches, light reddish-brown (5YR 6/3) loamy very fine sand and some silt bands or pockets; common, coarse, distinct, strong-brown (7.5YR 5/6) mottles; weak, thick, platy structure or single grain; very friable; moderately alkaline and calcareous.

Thickness of the solum ranges from 30 to 50 inches. Depth to carbonates ranges from 30 to 72 inches. Fine sand and very fine sand are dominant throughout the solum. Within the bands, content of very fine sand and silt ranges from 30 to 80 percent and that of sand coarser than very fine is more than 15 percent. Coarse fragments are normally absent.

The Ap horizon is 10YR or 7.5YR in hue and 2 or 3 in chroma. Value is 3 or 4 when the Ap horizon is moist and is more than 5.5 when it is dry. The Ap horizon ranges from medium acid to neutral. The A2 horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value, and is 3 to 5 in chroma. It ranges from loamy fine sand to very fine sandy loam and from medium acid to neutral.

In the area between the bands, the B horizon ranges from 10YR to 5YR in hue, from 4 to 6 in value, and is 3 or 4 in chroma. The bands generally are redder than the material between them and range from 10YR to 2.5YR in hue. The bands have a total thickness more than one-tenth the thickness of the overlying horizons. The sand within the bands has clay films coating it, and most of it has clay bridges between particles. The texture between the bands normally is loamy fine sand, but in some places it is slightly finer or coarser. The colors and texture of the C horizon are in the same range as in the B horizon above a depth of 40 inches. Thin banding occurs in the C horizon in some profiles that show no evidence of clay increase or clay movement. Reaction is neutral to moderately alkaline.

Galen soils formed in deposits similar to those of the well-drained Arkport soils and the somewhat poorly drained Minoa soils. The Galen soils are better drained than the Niagara soils and have a coarser textured Bt horizon. Galen soils are finer textured than Elnora soils but have similar drainage. They have a coarser textured Bt horizon than Collamer soils.

Galen very fine sandy loam, 0 to 2 percent slopes (GnA).--This soil has the profile described as representative for the series. It occupies areas on postglacial sandbars and deltaic deposits. Areas are roughly oblong and range from 10 to 20 acres in size.

Most commonly included with this soil in mapping are areas of Minoa soils along drainageways or in small depressions and of Colonie or Arkport soils on small knolls. Commonly included are areas of the coarser textured Elnora and Claverack soils and the silty Collamer soils. Some small inclusions are of the gravelly Phelps and Altmar soils near sandbars that contain gravel. There are soils similar to Galen soils with gravel above a depth of 40 inches included in some areas.

This soil is suited to most crops grown in the area. It is an especially good soil for vegetables and certain kinds of fruit. Some drainage of included wet areas may be needed. Irrigation is desirable during dry periods. Because of the sandy nature and lack of coarse fragments, this soil is one of the easiest to cultivate. However, it is susceptible to soil blowing under intensive cultivation during dry periods. (Capability unit IIw-1; woodland suitability group 2o1)

Galen very fine sandy loam, 2 to 6 percent slopes (GnB).--This soil is commonly located on the side slopes or in areas surrounding the more nearly level Galen soils. In many places this soil occupies small knolls within large areas of Minoa or Niagara soils. Individual areas of this soil range from less than 5 to about 30 acres in size. Some of these areas occur as narrow strips, and others are roughly circular in shape.

The most common inclusions are well drained Arkport or Colonie soils on higher areas and wetter Minoa or Niagara soils in depressions or along drainageways. Coarser textured Elnora and Claverack soils and finer textured Collamer soils are included in some places. In places there are inclusions of a soil that is moderately deep to gravel. Small areas of Altmar soils are commonly included near areas of gravel.

This soil is suited to most crops grown in the county. It is an especially good soil for vegetables and fruit. Some random tile drainage is needed in some places. Irrigation is needed during dry periods. Because of the sandy nature and lack of coarse fragments, this soil is one of the easiest to cultivate. It is susceptible to soil blowing where it is intensively cultivated. It also is susceptible to erosion by water, especially on the longer slopes. (Capability unit IIw-1; woodland suitability group 2o1)

Hamlin Series

The Hamlin series consists of deep, well-drained, medium-textured soils. These soils formed in stream deposits. They are level or nearly level and occupy flood plains near large streams. Slopes are 3 percent or less.

A representative profile of a Hamlin soil has a dark reddish-gray, slightly acid silt loam surface layer 8 inches thick. The subsoil is reddish-brown, very friable, slightly acid silt loam that contains faint, reddish-brown mottles to a depth of 29 inches. Between depths of 29 and 40 inches, the subsoil is mottled, reddish-brown, neutral silt loam that is friable to firm and contains a few roots. At a depth of 40 inches, there is a firm silty clay loam substratum that is neutral to mildly alkaline.

The seasonal high water table is regulated by the level of water flowing in the stream. In spring when there is much runoff, many areas of Hamlin soils are flooded for short periods. Rooting depth corresponds to the depth of the water table. The water table is seldom above a depth of 20 inches during the growing season. The available moisture capacity is high, and permeability is moderate.

Representative profile of Hamlin silt loam (0 to 3 percent slopes) in the town of Lockport, on the east bank of East Branch Eighteenmile Creek, 50 yards south of U.S. Highway No. 104 (Ridge Road); pasture:

Ap--0 to 8 inches, dark reddish-gray (5YR 4/2) silt loam; pinkish gray (5YR 6/2) when dry; moderate, fine and very fine, subangular blocky structure to fine and medium, granular structure; very friable; abundant fine roots; slightly acid; diffuse, smooth boundary. 6 to 10 inches thick.

B21--8 to 16 inches, reddish-brown (5YR 4/3) silt loam; moderate, fine and very fine, subangular blocky structure to fine and medium, granular structure; very friable; some mixing of Ap and B21 horizons along ped faces and root and worm channels; abundant fine roots; slightly acid; diffuse, smooth boundary. 5 to 10 inches thick.

B22--16 to 29 inches, reddish-brown (5YR 4/3) silt loam; few, fine, faint, reddish-brown (5YR 4/4) mottles in interiors of peds; moderate, fine and medium, subangular blocky structure; friable; dark reddish-gray (5YR 4/2) ped faces imparted by material from the Ap horizon; plentiful fine roots; slightly acid; diffuse, smooth boundary. 6 to 16 inches thick.

B3--29 to 40 inches, reddish-brown (5YR 5/3) silt loam; common, medium, faint, reddish-brown (5YR 4/4) mottles; weak, medium, subangular blocky structure; friable to firm; few roots; neutral; clear, smooth boundary. 5 to 12 inches thick.

IIC--40 to 50 inches, reddish brown (5YR 5/3) silty clay loam; weak, coarse, subangular blocky structure; firm; a few black (10YR 2/1) concretions; neutral to mildly alkaline.

The solum ranges from 20 to 50 inches in thickness. Reaction ranges from slightly acid to moderately alkaline and increases with increasing depth. Bedrock is at a depth of more than 40 inches but, in many places, is between depths of 4 and 6 feet. Hamlin soils typically are free of coarse fragments but may contain up to 15 percent coarse fragments in any layer.

The Ap horizon ranges from 5YR to 2.5Y in hue and, when moist, is 3 or 4 in value and 2 or 3 in chroma. Value is more than 5.5 when the Ap horizon is dry. The Ap horizon has weak or moderate and blocky or granular structure. It is friable or very friable.

The B horizon ranges from 5YR to 10YR in hue and, when moist, from 4 to 6 in value. Chroma is 3 or 4. Mottles that have chroma of 2 or less do not occur above a depth of 24 inches. The B horizon is fine sandy loam to silt loam. The average clay content of the B horizon is less than 18 percent, and the content of sand coarser than very fine sand is more than 15 percent. Structure of the B horizon is weak or moderate and blocky or platy. Consistence is friable or firm.

The C horizon is neutral or mildly alkaline. Depth to carbonates is more than 40 inches. The C horizon has the same hue, value, and chroma as the B horizon. Texture ranges from fine sandy loam to silt loam above a depth of 40 inches and varies below that depth.

The Hamlin soils formed in deposits similar to those in which the poorly drained and very poorly drained Wayland soils formed.

Hamlin silt loam (0 to 3 percent slopes) (Ha).--This soil normally occupies fairly narrow strips that parallel streams. The areas range from less than 5 to more than 50 acres in size.

Included with this soil in mapping are areas of soils that are similar to this soil but are moderately well drained or somewhat poorly drained. These wetter included soils are in depressions, in cross channels caused by flooding, and in low areas along the banks of flood plains that receive seepage water from the surrounding higher soils. In places, areas are included where shale or limestone is less than 40 inches below the surface. Other inclusions are small spots of poorly drained or very poorly drained Wayland soils.

This soil is suited to most crops grown in the county. Periodic flooding is a limitation. Many areas of this soil in Niagara County are small and are dissected by cross channels in most places. Wet inclusions are near the outer edge of the flood plain in many places. The wetter included areas are hard to drain because of periodic flooding and high water levels. The larger soil areas that are along Tonawanda Creek, Eighteenmile Creek, and other of the larger creeks have the greatest potential for farming because the larger, more workable units are in these areas.

This soil is naturally fertile. It is well suited to pasture, and it produces forage when drought restricts growth in other pasture areas. (Capability unit IIw-3; woodland suitability group 2o2)

Hilton Series

The Hilton series consists of deep, moderately well drained, medium-textured soils. These soils formed in calcareous glacial till containing sandstone and limestone fragments. They are nearly level to gently sloping and are on the till plain in all parts of the county. The largest acreage is in three general areas of the county. One is parallel to the limestone escarpment, another is in the west-central part of Newfane, and the other is near the southeastern part of Somerset.

A representative profile of a Hilton soil has a dark-brown gravelly loam surface layer 9 inches thick. The surface layer is underlain by brown, friable loam that has a few light yellowish-brown mottles and is 6 inches thick. This layer is medium acid and contains some angular and semirounded rock fragments. At a depth of 15 inches, it merges with a reddish-brown subsoil that is firm heavy loam and contains reddish-yellow mottles. The subsoil also contains semirounded rock fragments, is slightly acid in the upper part, and is neutral in the lower part. At a depth of 30 inches a calcareous substratum occurs. It is a reddish-brown gravelly light loam that is about 20 percent semirounded fragments.

Permeability is moderate or moderately rapid in the upper part of Hilton soils and is moderately slow or slow in the lower part of the subsoil and in the substratum. The seasonal high water table rises to within 18 inches of the surface and is perched above the slowly permeable underlying glacial till. The Hilton soils are wet for brief but significant periods after prolonged wet weather. The depth of soil available for rooting is restricted mainly to the uppermost 15 to 24 inches early in the growing season, but as the water table drops, a few fine roots extend to as much as 40 inches below the surface or to the depth of the underlying glacial till. The available moisture capacity is high. In some areas there are enough coarse fragments to interfere with tillage and other cultural operations. These soils generally are well suited to most crops grown in the county.

Representative profile of Hilton gravelly loam, 0 to 3 percent slopes, in the town of Somerset, 100 feet south of West Somerset Road and three-tenths of a mile west of its junction with Hartland Road; cultivated area:

Ap--0 to 9 inches, brown to dark-brown (10YR 4/3) gravelly loam, pale brown (10YR 6/3) when dry; weak, fine and medium, granular structure; friable; abundant fine roots; 15 to 20 percent coarse fragments; medium acid; clear, smooth boundary. 6 to 10 inches thick.

A2--9 to 15 inches, brown (10YR 5/3) light loam; few, fine, faint, light yellowish-brown (10YR 6/4) mottles; weak, thin, platy structure or massive; friable; plentiful fine roots; about 10 percent coarse fragments; medium acid; clear, irregular boundary. 0 to 8 inches thick.

B&A--15 to 19 inches, reddish-brown (5YR 5/3) loam; moderate, medium and coarse, subangular blocky structure; firm; interfingering of brown (10YR 5/3) silt and very fine sand coatings that are thickest in upper part; patchy clay films on about 10 percent of ped faces; plentiful roots; about 10 percent coarse fragments; slightly acid; clear, wavy boundary. 2 to 6 inches thick.

B2t--19 to 30 inches, reddish-brown (5YR 5/3) heavy loam; common, medium, distinct, reddish-yellow (7.5YR 6/6) mottles; moderate, medium and coarse, subangular blocky structure; firm; thin clay films on about 20 percent of ped faces and thicker films in the pores; few clay flows along vertical channels; plentiful roots in upper part of horizon and few roots in lower part; about 10 percent coarse fragments; slightly acid in upper part, neutral in lower part; clear, wavy boundary. 8 to 17 inches thick.

C--30 to 60 inches, reddish-brown (5YR 5/3) gravelly light loam; weak, medium and thin, platy structure; firm; about 20 percent coarse fragments; no roots; calcareous.

Thickness of the solum and depth to carbonates range from 24 to 36 inches. Bedrock is at a depth of more than 40 inches. Content of coarse fragments ranges from less than 5 percent to as much as 35 percent in any horizon. Coarse fragments typically are more than 5 percent throughout the solum and are more than 10 percent in the underlying glacial till. The Ap horizon ranges from gravelly loam to silt loam. It is 10YR or 7.5YR in hue and, when moist, 3 or 4 in value. Chroma is 2 or 3. When the Ap horizon is dry, values are more than 5.5. Reaction ranges from medium acid to neutral. The A2 horizon ranges from fine sandy loam or gravelly fine sandy loam to loam or gravelly loam. It ranges from 10YR to 5YR in hue and has a matrix value of 4 or 5 and a chroma of 4 or 3. The A2 horizon is faintly mottled in some places. It has platy or weak, blocky structure, or it is massive. Reaction is medium acid to slightly acid. The A2 horizon is absent in some places where the soil is plowed deeply or is eroded.

In the B&A horizon, the A part has the same range in color, texture, and other characteristics as the A2 horizon, and the B part has the same range as the B horizon. The B horizon is loam or silt loam averaging 18 to 27 percent clay. Hue ranges from 10YR to 2.5YR, value of the matrix is 4 or 5, and chroma is 3 or 4. In the B horizon the chroma of mottles is more than the chroma of the matrix. Mottles of low chroma are present in some profiles, but mottles that have a chroma of 2 do not occur in the upper 10 inches of the B2t horizon. Clay films are patchy or nearly continuous on the ped surfaces of some profiles. The B horizon has moderate, medium or coarse, blocky structure. It ranges from medium acid to neutral.

The C horizon is generally firm or very firm gravelly fine sandy loam or loam, but it is stony

or nongravelly in places. Hues range from 10YR to 2.5YR, value of the matrix is 4 or 5, and chromas range from 2 to 4. The C horizon is mottled in some profiles. It is calcareous.

Hilton soils formed in deposits similar to those of the well-drained Ontario, the somewhat poorly drained Appleton, and the poorly to very poorly drained Sun soils. Hilton soils have a coarser textured Bt horizon than Cazenovia and Cayuga soils. They are finer textured in the A horizon than Bombay soils. Hilton soils are better drained and have a coarser textured Bt horizon than Ovid and Churchville soils.

Hilton gravelly loam, 0 to 3 percent slopes (HgA).--This soil has the profile described as representative for the series. The soil occurs mostly in areas that range from less than 3 to about 30 acres in size and are normally oblong. These areas occupy the tops of knolls and foot slopes where water accumulates for short periods.

Most commonly included with this soil in mapping are areas of Appleton and Sun soils in wet spots or along drainways. Also included are areas of Howard or Phelps soils. Other inclusions are small areas of Cazenovia soils that contain more clay in the subsoil than this Hilton soil. Small areas of Bombay soils also are included, but these soils have less clay in the subsoil than the Hilton soil. The included Bombay soils are principally in the town of Newfane. In some places soils that have a nongravelly or very gravelly surface layer are included.

This soil is suited to most crops grown in the county and to pasture or trees. The gravel may interfere with some kinds of cultivation, and it is hard on machinery in many places. The gravel content may interfere with the growth of certain vegetable crops. Because runoff is slow, random drainage of included wet spots may be needed. (Capability unit IIw-2; woodland suitability group 2o1)

Hilton gravelly loam, 3 to 8 percent slopes (HgB).--This gently sloping soil is similar to the one described as representative but has a higher gravel content in places. Most areas of this soil range from less than 3 to about 10 acres in size. The soil occupies small knolls in a generally flat landscape or occurs in narrow strips along drainageways.

Most commonly included with this soil in mapping are wetter associates, such as the Appleton and Sun soils in drainways. Also included are areas of a Hilton soil that has less than 15 percent gravel in the surface layer. In some places, especially where this Hilton soil is associated with the Howard soils, there are small included areas of gravel deposits. Included areas of coarser textured Bombay soils are in the town of Newfane. Other inclusions are small areas where the soil is very gravelly, cobbly, or stony. Most of these inclusions are the result of the modification of the original glacial till by water, wind, or wave action.

This soil can be used for crops, pasture, or trees. It is suited to most crops grown in the county. The gravel interferes with some kinds of cultivation, and it is hard on machinery in many places. The gravel interferes with the growth of some vegetable root crops. Runoff is moderate, and erosion is a hazard, especially where slopes are long. Random drainage may be needed for included wet spots. (Capability unit IIe-3; woodland suitability group 2o1)

Hilton silt loam, 0 to 3 percent slopes (HlA).--This soil has a profile similar to that described as representative for the series, except that it lacks the gravelly loam surface layer. The surface or plow layer normally has some coarse fragments, mostly less than 15 percent by volume. The individual areas range from less than 5 to more than 100 acres in size. They occupy the tops of ridges and, in some places, make up the entire glacial till ridge.

Included in mapping, within large areas of this soil near Colonial Village in the southern part of Lewiston, are areas of Cayuga soils and areas of a soil that is less than 40 inches to limestone rock. Also included are areas of better drained Ontario soils on knolls or of wetter Appleton, Ovid, or Churchville soils in depressions or along drainageways. Other inclusions are fairly large areas of soils that are less than 6 feet to rock, especially near the limestone escarpment. Inclusions that have a gravelly or stony surface layer occur and are indicated on the soil map by the appropriate symbol.

This soil is suited to most crops grown in the county and to pasture and trees. The seasonal wetness may briefly delay planting. The soil is easily cultivated. It is not used so much for vegetables and fruit as the gravelly Hilton soils, because the largest areas are south of the escarpment, away from the climatic influence of Lake Ontario. Random drainage may be needed for included wet spots. (Capability unit IIw-2; woodland suitability group 2o1)

Hilton silt loam, 3 to 8 percent slopes (HlB).--This soil has a profile that is similar to the profile described as representative for the series, but it lacks the gravelly surface layer. The surface or plow layer normally contains some coarse fragments, but less than 15 percent by volume. This soil commonly occupies narrow strips along the side of a ridge similar to the one along Chestnut Ridge Road in the town of Royalton. It also is on small knolls in a generally flat landscape, and some large areas make up an entire ridge. Areas range from less than 5 to more than 50 acres in size.

Included in mapping are areas of the better drained Ontario soils on knolls. Also included, in the general area of Slayton Settlement Road, are areas of a soil that contains much more silt than this Hilton soil, as well as small areas of Collamer soils. Inclusions of Cayuga soils occur where clay caps the glacial till. Other inclusions are the wetter Appleton or Ovid soils along drainageways; some spots that have a gravelly or stony soil surface layer; and soils that are less than 40 inches deep to hard rock.

This soil is well suited to most crops grown in the county and to pasture or trees. Erosion is a serious hazard if this soil is cultivated and not protected. The seasonal wetness may briefly delay planting. Random drainage of included wetter soils normally is desirable, especially if this soil is used intensively for cultivated crops. Erosion control is needed on long slopes. This soil is especially well suited to hay and grain crops. (Capability unit IIe-3; woodland suitability group 2o1)

Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes (HmA).--Areas of this undifferentiated group are all Hilton soil, all Cayuga soil, or some of both. The Hilton soil has a profile similar to that described as representative for the series, except that it lacks the gravelly surface layer. Both soils are underlain by hard bedrock, mainly 3 1/2 to 6 feet below the surface. They have more large stones or boulders in or on the surface layer than representative Hilton and Cayuga soils.

This mapping unit is near to the limestone escarpment. Most areas parallel the escarpment and are within 1 mile either to the north or south of the main escarpment area. One of the largest areas is between the villages of Pekin and Sanborn. Areas range from about 5 to 50 acres in size.

Most commonly included in mapping are areas of similar soils that are less than 40 inches deep to rock. One fairly large included area of these similar soils is east of Bond Lake. Another is between Gasport and Middleport and south of State Route 31. In this area the soil is underlain in many places by the softer Rochester shale formation instead of the hard Lockport dolomitic limestone. Also included are spots of better drained Ontario soils and areas of wetter Ovid soils. Both kinds of soil are over rock. Other inclusions are areas of soils that are coarser textured than either the Hilton or the Cayuga soil and areas of Cazenovia soils that are finer textured than the Hilton soils but coarser textured than the Cayuga. In areas close to the limestone escarpment, spots of shallow Farmington soils are common inclusions.

The soils in this mapping unit can be used for crops, pasture, or trees, though in most places they are not so desirable for cropping as the deeper Hilton and Cayuga soils. Limestone near the surface causes droughty spots. Stones and a few rock outcrops interfere with cultivation in some areas. The drainage of included wet spots is difficult because of stones or bedrock.

Corn, alfalfa, and small grains are the principal crops. Crops are generally not so well suited to these soils as they are to the deeper Hilton or Cayuga soils. (Capability unit IIw-2; woodland suitability group 2o1)

Hilton and Cayuga silt loams, limestone substratum, 3 to 8 percent slopes (HmB).--Areas of this undifferentiated group consist of Hilton silt loam, Cayuga silt loam, or both soils. The soils have profiles similar to those described for their respective series, except that hard bedrock is at a depth of 3 1/2 to 6 feet. Large stones or boulders are more common in areas of this mapping unit than in areas of typical Hilton or Cayuga soils.

Most commonly included in this mapping unit are small areas of similar soils that are less than 40 inches to hard rock. Major areas of these moderately deep or shallow included soils are near Bond Lake and along the escarpment between Gasport and Middleport. Also included are spots of better drained Ontario and of Ovid soils. Both kinds of soil are over rock.

The soils in this mapping unit can be used for crops and pasture, though they are not so desirable for these uses as normal Hilton or Cayuga soils. Limestone near the surface causes droughty spots. Stones and a few rock outcrops interfere with cultivation in some areas. (Capability unit IIe-3; woodland suitability group 2o1)

Howard Series

The Howard series consists of deep, well-drained to somewhat excessively drained, medium-textured, gravelly soils. These soils developed in glacial outwash or in glacial beach deposits of sand and gravel. The gravel deposits were derived from sandstone and some limestone and shale. These soils occupy the better drained parts of postglacial beaches and glacial outwash areas. Most of the acreage is north of U.S. Highway No. 104 (Ridge Road). Howard soils are level to sloping and have slopes of 0 to 15 percent.

In a representative profile, a level Howard soil has a dark-brown, slightly acid gravelly loam surface layer 8 inches thick. It is underlain by brown, friable, slightly acid gravelly loam 5 inches thick. The subsoil begins at a depth of 13 inches. The upper part consists of brown to dark-brown, friable, slightly acid gravelly loam that is 16 inches thick and contains tongues of the soil material from the layer above. Between depths of 24 and 29 inches, the subsoil is reddish-brown, firm, neutral gravelly loam. Between depths of 29 inches and 44 inches, the subsoil is brown to dark-brown, firm very gravelly loam that is sticky when wet and neutral. The calcareous substratum is at a depth of 44 inches and consists of grayish-brown, stratified sand and gravel.

The water table is generally below a depth of 40 inches in these soils. The depth to water depends upon the thickness of the gravel deposit and position in the landscape. The available moisture capacity is low to moderate. Rooting depth is generally unrestricted, and deep-rooted plants can obtain moisture below normal rooting depth. Permeability is moderately rapid in the surface layer and rapid in the subsoil.

Representative profile of Howard gravelly loam, 0 to 3 percent slopes, in the town of Newfane, 100 feet north of Hoffman Road and 400 yards east of Hess Road; cultivated area:

Ap--0 to 8 inches, dark-brown (7.5YR 3/2) gravelly loam, brown to dark-brown (7.5YR 4/2) when rubbed; weak, fine, granular structure; friable; abundant fine roots; 25 percent gravel; slightly acid; abrupt, smooth boundary. 6 to 9 inches thick.

A2--8 to 13 inches, brown (10YR 5/3) gravelly loam; very weak, medium, subangular blocky structure or single grain; friable; abundant fine roots; 25 to 30 percent gravel; slightly acid; clear, irregular boundary. 0 to 10 inches thick.

B&A--13 to 24 inches, brown to dark-brown (10YR 4/3) gravelly loam; thick coats of brown (10YR 5/3) on peds and some interfingering of A2 material; very weak, medium, subangular blocky structure or single grain; friable; plentiful fine roots; 25 to 35 percent gravel; clay films in some pores; slightly acid; gradual, irregular boundary. 5 to 14 inches thick.

B21t--24 to 29 inches, reddish-brown (5YR 4/3) gravelly loam; weak, medium, subangular blocky structure; firm; few roots; clay films on pebbles and lining pores; 30 percent gravel; thin, brown (10YR 5/3) coats (interfingering); neutral; clear, irregular boundary. 3 to 14 inches thick.

B22t--29 to 44 inches, brown to dark-brown (7.5YR 4/4) very gravelly loam; weak, medium, subangular blocky structure; firm, sticky; few roots; clay films on pebbles and lining pores; about 50 percent coarse fragments, mostly gravel but a few cobblestones; neutral; clear, irregular boundary. 8 to 20 inches thick.

IIC--44 to 57 inches, dark grayish-brown (10YR 4/2) sand and gravel; single grain; loose; neutral to mildly alkaline.

Thickness of the solum and depth to carbonates range from 24 to 60 inches. Bedrock is at a depth of more than 40 inches. The solum ranges from medium acid to neutral. The pH increases with depth in soils not limed. The substratum is neutral or calcareous.

The Ap horizon is 10YR or 7.5YR in hue, 3 or 4 in value, and 2 or 3 in chroma. When dry, the Ap horizon has values of more than 5.5. The A2 horizon is absent in some areas. Where present, the A2 horizon ranges from 10YR to 5YR in hue, is 4 or 5 in value, and is 3 or 4 in chroma. Texture has the same range as in the Ap horizon. In some places there is an A&B horizon rather than a B&A. The A&B or B&A horizon ranges from 10YR to 5YR in hue, from 4 to 6 in value, and 3 or 4 in chroma. These horizons are fine sandy loam to loam and are gravelly or nongravelly.

The Bt horizon ranges from 10YR to 5YR in hue, is 4 or 5 in value, and is 3 or 4 in chroma. It ranges from fine sandy loam to loam and is gravelly or very gravelly. Clay films are on peds or pebbles. The average clay content is less than 35 percent in the finest part of the B horizon.

The C horizon has the same range in color as the B horizon above a depth of 40 inches. The C horizon consists of structureless sand and gravel in most profiles.

Howard soils formed in deposits similar to those of moderately well drained Phelps soils and somewhat poorly drained Fredon soils. Howard soils contain gravel throughout the profile, but gravel is lacking in the Arkport soils. Howard soils are finer textured than Otisville soils and are better drained and deeper to gravel deposits than gravelly Hilton soils.

Howard gravelly loam, 0 to 3 percent slopes (HoA).--This soil has the profile described as representative for the series. It occurs in outwash areas. Areas normally are between 5 and 50 acres in size and, in many places, are roughly circular or oblong.

Most commonly included with this soil in mapping are small areas of the moderately well drained Phelps soils and coarser textured Otisville soils. Also included, where the gravel has been influenced by deltaic deposits, are areas of Arkport soils that have a gravelly substratum. Hilton or Appleton gravelly soils are included in some areas associated with glacial till. In places, other inclusions are of soils that are moderately deep to silt and clay.

This soil is suited to most crops grown in the county. It is especially well suited to cherries and peaches. It is a slightly droughty soil, especially for shallow-rooted crops. This soil is one of the best in the county for early vegetables and fruit. Locally, the gravel content of the surface layer interferes with cultivation and growth of some vegetable crops. (Capability unit IIs-1; woodland suitability group 2o1)

Howard gravelly loam, 3 to 8 percent slopes (HoB).--This soil has a profile similar to that described as representative for the series, but in the profile of this soil the gravel content of the surface layer is greater and depth to the subsoil is less.

This soil occupies knolls in outwash areas, or it is downslope from the nearly level Howard soil. Areas range from less than 5 to about 50 acres in size. Areas have an average size of about 10 acres. These areas have no characteristic shape, and they range from roughly circular where they occur on a knoll to fairly narrow in strips where associated with Howard gravelly loam, 0 to 3 percent slopes.

Most commonly included with this soil in mapping are areas of the coarser textured Otisville soils and the moderately well drained Phelps soils. Also included in some areas, especially those near Olcott, are areas of the Arkport soils that have a gravelly substratum. In some places adjacent to glacial till, areas of Hilton gravelly loam or Appleton gravelly loam are included. Locally, there are inclusions of soils that are moderately deep to silt and clay.

This soil, though more susceptible to drought, has about the same farming potential as Howard gravelly loam, 0 to 3 percent. Water erosion and soil blowing are slight to moderate hazards if this soil is cultivated and not protected.

This soil is one of the best soils in the county for early vegetables and fruit. Irrigation is needed for best crop growth. Locally, the gravel in the

surface layer interferes with cultivation and growth of some vegetable crops. (Capability unit IIs-2; woodland suitability group 2o1)

Howard gravelly loam, 8 to 15 percent slopes (HoC).--This soil has a profile similar to that described as representative for the series, except that it is lower in organic-matter content and generally has a slightly coarser textured subsoil that is nearer the soil surface.

This soil is of limited extent in this county. It occupies the most sloping areas of beach bars or outwash areas. Areas are generally less than 10 acres in size and are roughly oblong.

Most commonly included with this soil in mapping are areas of Otisville soils and small spots of strongly sloping Howard soils. Also included adjacent to till areas are areas of gravelly Ontario soils. Other inclusions are areas of Arkport soils that have a gravelly substratum and of Colonie soils.

This soil is suited to most crops grown in the county. It is droughty, however, and erosion is a moderate to severe hazard if this soil is cultivated and not protected. The more steeply sloping areas are difficult to work with modern equipment. During dry periods, irrigation is needed for vegetable crops. Peaches and cherries are nearly as well suited to this soil as to the less sloping Howard soils. (Capability unit IIIe-2; woodland suitability group 2o1)

Hudson Series

The Hudson series consists of deep, moderately well drained soils that have a medium-textured or moderately fine textured surface layer and a moderately fine textured or fine textured subsoil. These soils formed in glacial lake sediments that are chiefly high-lime silt and clay. The soils are level to steep and occupy glacial lake areas where the landscape is being dissected by erosion. The moderately sloping and strongly sloping Hudson soils are severely eroded in most places. Slopes range from 2 to 45 percent.

A representative profile of a Hudson soil has a dark grayish-brown silt loam surface layer that is slightly acid and 8 inches thick. The surface layer is underlain by a brown silt loam leached layer that is friable, slightly acid, and 4 inches thick. The subsoil is between depths of 12 and 30 inches. It is brown to dark-brown, firm silty clay loam to a depth of 20 inches and is firm, brown silty clay below that depth. The upper part of the subsoil is slightly acid to neutral, and the lower part is neutral to mildly alkaline (calcareous). The calcareous substratum is firm, brown heavy silt loam.

The seasonal high water table rises to about 18 inches below the surface during the excessively wet periods early in spring. It is perched above the moderately slowly permeable or slowly permeable subsoil and substratum. Rooting is mainly in the uppermost 24 inches, but a few roots extend below this depth. The available moisture capacity is moderate to high. These soils clod and puddle if cultivated when wet. Seed germination is poor if these soils are planted when too dry.

Representative profile of Hudson silt loam, 2 to 6 percent slopes, in the town of Porter, two-fifths mile south of shoreline of Lake Ontario and 1 mile east of Fort Niagara; cultivated area:

Ap--0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; abundant fine roots; few coarse fragments; slightly acid; abrupt, smooth boundary. 6 to 10 inches thick.

A2--8 to 12 inches, brown (10YR 5/3) silt loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; many roots; few coarse fragments; slightly acid; broken, irregular boundary. 0 to 8 inches thick.

B21t--12 to 20 inches, brown to dark-brown (10YR 4/3); heavy silty clay loam; moderate, medium, blocky structure; firm; interfingering of brown (10YR 5/3) A2 material into upper 4 inches of this horizon; thin, patchy clay films on ped surfaces and thicker, more continuous films in pores; plentiful fine roots; neutral; gradual, wavy boundary. 6 to 11 inches thick.

B22t--20 to 30 inches, brown (10YR 5/3) silty clay; moderate, medium, prismatic structure breaking to moderate, medium, blocky; firm; thin clay films cover about 40 percent of the peds, thicker films in pores; few clay films along vertical channels; few roots; neutral or weakly calcareous in lower part; gradual, wavy boundary. 6 to 12 inches thick.

C--30 to 50 inches, brown (10YR 5/3) heavy silt loam; weak, medium and thick, platy structure; firm; few, coarse fragments; calcareous.

The solum ranges from 24 to 40 inches in thickness. Depth to carbonates ranges from 20 to 40 inches. The solum is medium acid to neutral. It is mottled in some places. Where the solum is mottled, chromas of the mottles are more than 2. The solum is generally free of coarse fragments, but in some places up to 5 percent occur in any horizon.

The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It ranges from silt loam to silty clay loam. The A2 horizon is absent in some places. Where an A2 horizon occurs, hues range from 10YR to 2.5Y, values range from 4 to 6, and chroma is 3 or 4. Texture is slightly coarser than in the Ap horizon. Some profiles have faint mottles. The B horizon ranges from 7.5YR to 2.5Y in hue, is 4 or 5 in value, and is 3 or 4 in chroma. It ranges from silty clay loam to clay. The average clay content of the B2t horizon ranges from 35 to 55 percent.

The C horizon has the same range in color as the B horizon, at least to a depth of 40 inches. In

uniform material, the C horizon ranges from silt loam to silty clay, but varves of nearly pure silt and nearly pure clay are common at depths below 30 inches.

Hudson soils formed in deposits similar to those of somewhat poorly drained Rhinebeck soils and poorly drained to very poorly drained Madalin soils. Hudson soils have a finer textured Bt horizon than Dunkirk or Collamer soils. They are better drained than the Churchville soils and lack the underlying loamy glacial till of those soils.

Hudson silt loam, 2 to 6 percent slopes (HsB).--This soil has the profile described as representative for the series. It is in areas near Lake Ontario and in other areas where the landscape is dissected. Areas range from less than 5 to about 200 acres in size. The average-sized area is about 35 acres. In many places the large areas are roughly oblong and the small areas are roughly circular.

Most commonly included with this soil in mapping are areas of silty Collamer or Dunkirk soils within the same landform and the similar but wetter Rhinebeck soils or silty Niagara soils along drainageways and in depressions. Less commonly included are areas of the Churchville, Ovid, Cayuga, Cazenovia, and Claverack soils. In some included areas gravel is on the surface or mixed in the profile.

This soil is suited to most crops grown in the county. Because most areas are within a few miles of Lake Ontario, the soil is commonly used intensively for fruit, especially apples and grapes. In cultivated areas some measures are needed for erosion control.

This soil needs to be cultivated at the suitable moisture content because it is sticky when wet and fairly hard when dry. Hard clods and a crusty surface forms if the soil is cultivated when wet. Runoff is rapid during intense rains. (Capability unit IIe-2; woodland suitability group 2o1)

Hudson silty clay loam, 6 to 12 percent slopes, eroded (HtC3).--This soil has a profile that is similar to the profile described as representative for the series, except that most of the original surface layer has been eroded away. Consequently, part of the original subsoil is now mixed into the present surface layer, which is finer textured and contains less organic matter than is typical for the Hudson series. This soil occupies the convex slopes in dissected areas. In many mapped areas several drainageways of gullies occur. Areas range from about 5 to 50 acres in size. Many of them are roughly oblong.

Included with this soil in mapping are many areas of the similar but wetter Rhinebeck soils or the silty Niagara soils. These included areas are in drainageways. Also included are Dunkirk or Collamer soils in silty areas. Less commonly included are the Cayuga, Cazenovia, and Claverack soils. In many included areas, slopes are less than 6 percent or more than 12 percent. In many inclusions, the soil is only slightly eroded and has a silt loam surface layer.

This soil has serious limitations to use for most cultivated crops. It is eroded and is susceptible to continued erosion if not protected. Runoff is very rapid, especially during intense rains or early in spring when the snow is melting rapidly. If adequately fertilized and limed, this soil is well suited to fruit. Cropping systems should have a large proportion of sod-forming crops, most of which are well suited. Good tilth is difficult to maintain. This soil clods easily if worked when too wet. Vegetables generally are not suited, even though good conservation practices are used. (Capability unit IVe-2; woodland suitability group 2r1)

Hudson soils, 20 to 45 percent slopes, eroded (HuF3).--These soils have a dominantly silt loam or silty clay loam surface layer. The largest acreage of these soils is south of Gasport on the north face of the Lockport limestone escarpment. The rest of the acreage is mostly along stream-dissected areas. Areas are mostly less than 20 acres in size. They are in long, narrow strips along streambanks and other dissected areas.

Commonly included with these soils in mapping are areas of steep Schoharie and Cazenovia soils and soils that are moderately deep to shale bedrock.

These Hudson soils are too steep for cropping. They have rapid runoff and slow permeability. They can be used for pasture, woodland, and development for some kinds of wildlife habitat. Near urban areas there are scenic spots and a potential for recreational use. Trails should be protected from erosion and established across the slope where possible. (Capability unit VIe-1; woodland suitability group 2r3)

Lairdsville Series

The Lairdsville series consists of moderately deep, well drained to moderately well drained soils. These soils have a medium-textured surface layer and a moderately fine textured or fine textured subsoil. They formed in material weathered primarily from red Queenston shale. Many areas of these soils have thin glacial deposits overlying the red shale. Sandstone and granite fragments are scattered over the surface in some places. These soils occur north of areas of the Lockport limestone formation where Queenston shale is within 3 1/2 feet of the soil surface. Slopes range from 2 to 6 percent.

A representative profile of a Lairdsville soil has a brown to dark-brown silt loam surface layer that is medium acid and 8 inches thick. The upper part of the subsoil is reddish-brown silty clay 6 inches thick. It is firm and medium acid. The lower part of the subsoil begins at a depth of 14 inches and extends to 26 inches. It is dusky-red silty clay that is firm and medium acid. This layer contains a few, faint, reddish-brown mottles. The substratum begins at a depth of 26 inches and

extends to 32 inches. It consists of dark reddish-brown silty clay and a few slightly weathered shale fragments. It is very firm and is neutral or weakly calcareous at a depth of 30 inches. Slightly weathered, dark reddish-brown shale occurs at a depth of 32 inches. It is extremely firm, contains a thin layer of greenish-gray shale, and is calcareous.

The seasonal high water table rises to about 18 inches below the surface early in spring and in excessively wet periods. The water table is perched above the slowly permeable subsoil and very slowly permeable substratum. As the growing season progresses and the water table falls, these soils are often droughty.

Depth of soil available to roots is limited by the depth to the perched water table and the underlying slightly weathered shale. Available moisture capacity is moderate to high. Locally, stones in the surface layer are troublesome. In other areas maintaining the soil in good tilth is difficult.

Representative profile of Lairdsville silt loam, 0 to 6 percent slopes, in the town of Lockport on the east side of Day Road and two-fifths mile north of Slayton Settlement Road:

Ap--0 to 8 inches, brown to dark-brown (7.5YR 4/2) silt loam; moderate, fine and medium, granular structure; friable; abundant fine roots; about 5 percent coarse fragments; medium acid; abrupt, smooth boundary. 6 to 9 inches thick.

B21t--8 to 14 inches, reddish-brown (2.5YR 4/4) silty clay; moderate, medium and coarse, prismatic structure breaking to moderate, medium, blocky structure; firm; thin, light reddish-brown (5YR 6/3) material interfingers around peds in upper 4 inches of horizon; some dark reddish-brown (2.5YR 3/4) clay films on ped faces, films thicker in pores; plentiful fine roots along ped faces; few shale fragments; medium acid; gradual, wavy boundary. 4 to 12 inches thick.

B22t--14 to 26 inches, dusky-red (2.5YR 3/2) silty clay; moderate, medium and coarse, prismatic structure breaking to moderate, medium blocky structure; firm, hard; the dusky red with low chroma is inherited from the parent shale; few, medium, faint, dark reddish-brown (2.5YR 3/4) mottles; thin clay films on most ped faces, thicker films in pores; few clay flows along vertical channels; plentiful roots; few shale fragments; medium acid; clear, wavy boundary. 8 to 20 inches thick.

C--26 to 32 inches, dark reddish-brown (2.5YR 3/4) silty clay; weak, coarse, subangular blocky structure and weak, thick, platy structure; very firm, very hard; very few roots; numerous shale fragments; neutral to weakly calcareous at depth of 30 inches.

R--32 to 50 inches, dark reddish-brown (2.5YR 3/4), slightly weathered shale; thin layer of greenish-gray (5GY 5/1) shale; extremely firm, extremely hard; calcareous.

Thickness of the solum and depth to slightly weathered shale range from 20 to 40 inches. Content of coarse fragments ranges from very few to about 25 percent.

The Ap horizon ranges from 5YR to 10YR in hue, is 4 or 5 in value, and is 2 to 4 in chroma. An A2 horizon is present in undisturbed areas, but it is commonly absent or occurs as thin remnants in cultivated areas. Where present the A2 horizon ranges from 5YR to 10YR in hue, is 5 or 6 in value, and is 2, 3, or 4 in chroma. Texture is in the same range as in the Ap horizon.

The B horizon ranges from 2.5YR to 5YR in hue, from 4 to 6 in value, and from 2 to 6 in chroma. Faint mottles are normally present in some part of the B horizon. The B horizon ranges from silty clay loam to clay and has an average clay content between 35 and 60 percent. Reaction ranges from medium acid to moderately alkaline. Thin silt coats occur as interfingering in the upper part of the B horizon, and clay films are in the lower part. The C horizon does not occur in some places. The C horizon is similar to the B horizon, but it has platy structure and is neutral or mildly alkaline (calcareous). The R horizon consists of interbedded shale. Some shale layers are very hard, but others can be readily penetrated with a spade. In many places greenish shale layers are in the underlying shale. The shale is neutral or calcareous.

The Lairdsville soils formed in deposits similar to those of the Lockport soils. Lairdsville soils are moderately deep to shale, but shale is lacking under the Schoharie soils. The Bt horizon is finer textured in the Lairdsville soils than in Cazenovia soils, and depth to shale is less. Lairdsville soils are better drained than Ovid soils and have a finer textured Bt horizon and less depth to rock.

Lairdsville silt loam, 0 to 6 percent slopes (LaB).--This soil occurs in the slightly elevated areas of a general landform that is influenced by the underlying shale rock. It also occurs along some streambanks where the stream has cut down to the underlying shale. Many areas are roughly rectangular. Areas range from less than 5 to 100 acres or more in size. The average size is about 15 acres.

Most commonly included are areas of wetter Lockport soils in small depressions and along drainageways. Commonly included, on small knolls where sand deposits are thick, are sandy Claverack soils. In some included areas where glacial till deposits occur and are fairly thick over the shale are the Hilton, Cazenovia, Appleton, Ovid, and similar soils. Some included areas are eroded and have slopes of more than 6 percent.

This soil is suited to many kinds of crops, but depth to shale, poor workability, and droughtiness are limitations that have to be considered. The hazard of erosion is moderate in the more sloping areas of this soil. Runoff is medium in the more nearly level areas and rapid in the more sloping

areas. Because the rooting depth is shallow, this soil is often droughty during extended dry periods. Locally, stones in the surface layer make cultivation difficult and slow the growth of root crops. Also, this soil clods and puddles if it is cultivated when wet. (Capability unit IIe-4; woodland suitability group 3o1)

Lakemont Series

The Lakemont series consists of deep, poorly drained to very poorly drained, moderately fine textured soils that have a moderately fine textured to fine textured subsoil. These soils formed in calcareous lacustrine deposits in which clay and silt are dominant. They are level to slightly depressional and occur in large areas within old glacial lake basins. The principal area of Lakemont soils is south of the limestone escarpment. Slopes are less than 3 percent.

A representative profile of a Lakemont soil that has been cultivated has a black, neutral silty clay loam surface layer 8 inches thick. The upper part of the subsoil is gray to light-gray silty clay that has few, prominent, reddish-yellow mottles. It is firm, neutral, and 9 inches thick. The lower part of the subsoil is between depths of 17 inches and 26 inches. It is a pinkish-gray silty clay that has few, prominent, reddish-yellow mottles. This layer is firm and neutral. The lower 4 inches is calcareous in some places. The substratum is reddish-gray and reddish-brown, calcareous silty clay loam that is firm.

These soils have a seasonal high water table at or just under the surface early in spring and in other excessively wet periods. Lakemont soils that are not artificially drained are normally ponded during wet periods because of their position in the landscape and their slowly permeable subsoil. The depth available for rooting depends on the water table. In undrained areas of these soils, the roots are confined mainly to a depth of 15 inches. The available moisture capacity is moderate. Permeability is moderately slow in the surface layer and slow in the subsoil.

Representative profile of Lakemont silty clay loam in the town of Wheatfield, two-thirds mile north of Lockport Road and three-fourths mile west of State Route 429 (Ward Road); cultivated:

Ap--0 to 8 inches, black (10YR 2/1) silty clay loam; very dark gray (10YR 3/1) when rubbed; moderate, medium, subangular blocky and moderate, medium, granular structure; friable; abundant fine roots; neutral; abrupt, irregular boundary. 6 to 9 inches thick.

B21tg--8 to 17 inches, gray to light-gray (5YR 6/1) silty clay; few, medium, prominent, reddish-yellow (7.5YR 6/6) mottles; strong, coarse, prismatic structure breaking to moderate, coarse, blocky structure; firm, plastic; black (10YR 2/1) coats along vertical channels or cracks in upper 2 to 3 inches; gray (10YR 5/1) and dark-gray (10YR 4/1) coats on prisms; few fine roots; distinct clay films on most of the ped surface area; few, large clay-lined pores; neutral; clear, wavy boundary. 8 to 12 inches thick.

B22tg--17 to 26 inches, pinkish gray (5YR 6/2) silty clay; few, medium, prominent, reddish-yellow (7.5YR 6/6) mottles; strong, coarse, prismatic structure breaking to moderate, coarse, blocky structure; firm, plastic; gray (10YR 5/1) and dark-gray (10YR 4/1) coats on prisms; very few roots; thin clay films on ped faces, thicker films along prism faces; neutral or calcareous in lower part; clear, wavy boundary. 8 to 20 inches thick.

Cg--26 to 50 inches; 50 percent dark reddish-gray (5YR 4/2) and 50 percent reddish brown (5YR 4/4) silty clay loam; weak, thick, platy structure; firm; no roots; calcareous.

Thickness of the solum ranges from 24 to 40 inches, and depth to carbonates ranges from 20 to 40 inches. Bedrock is more than 40 inches below the surface and normally is at a depth of more than 6 feet. Coarse fragments are normally absent, but a few pebbles and stones occur in some places.

The Ap horizon is 10YR or 7.5YR in hue and 1 or 2 in chroma. The Ap horizon ranges from 1 to 3 in value when moist and has a dry value of 5 or less. Thickness of the Ap horizon is less than one-third that of the solum. Reaction ranges from slightly acid to neutral.

The B horizon has hues redder than 7.5YR, values ranging from 3 to 6, and chromas ranging from 1 to 4. Between the base of the Ap horizon and a depth of 30 inches, chromas of 2 or less are in less than 60 percent of the soil in some horizon. Ped faces have chromas of 2 or less, and mottles are in the peds. Texture ranges from clay to heavy silty clay loam. The clay content of the Bt horizon ranges from 35 to 55 percent. Structure ranges from strong, coarse, prismatic, to moderate, medium, blocky. The B horizon generally is slightly acid to neutral, but it is moderately alkaline in the lower part.

The C horizon has hues redder than 7.5YR. It ranges from bedded clay and silt to massive silty clay. The C horizon is calcareous.

The Lakemont soils formed in deposits similar to those of the moderately well drained to well drained Schoharie soils, the somewhat poorly drained Odessa soils, and the very poorly drained Fonda soils. Lakemont soils are wetter than Churchill soils and lack the underlying glacial till. Lakemont soils are redder than Madalin soils. They are wetter and redder than Rhinebeck soils and have a finer textured B horizon than the Canandaigua soils.

Lakemont silty clay loam (Lc).--This nearly level soil occupies fairly broad flats in basins of old glacial lakes. A few areas are in narrow

drainageways of slack water areas that pond. Areas range from about 5 to more than 100 acres in size and average about 50 acres. The areas normally are roughly circular or oblong.

Most commonly included with this soil in mapping are areas of the better drained Odessa soils that are at slightly higher elevations. Also included are areas of Fonda soils in depressions or along drainageways. Madalin or Rhinebeck soils are included in some areas. In silty areas Canandaigua soils are included. In some areas that have sand smears, there are inclusions of Cosad or Cheektowaga soils. In some places near glacial till areas, there are included areas of Churchville or other soils that have lacustrine deposits less than 40 inches thick over glacial till. About one-third of the acreage in Lakemont soils has a silt loam rather than a silty clay loam surface layer. A few included areas contain stones or gravel in the surface layer. These areas are indicated on the soil map by the appropriate symbol.

Undrained areas of this soil are better suited to pasture, woods, or wetland wildlife than to cultivated crops. In adequately drained and well-managed areas, cultivated crops can be grown. This soil needs to be cultivated when the moisture content is favorable. Hard clods or a crusty surface forms if this soil is cultivated when wet. Also, if this soil is cultivated and planted when too dry, seed germination and crop growth are poor. Use of measures that maintain a high organic-matter content is desirable. Runoff is slow, and this soil is difficult to drain in many places. (Capability unit IVw-1; woodland suitability group 5w1)

Lamson Series

The Lamson series consists of deep, poorly drained and very poorly drained, moderately coarse textured and medium-textured soils. These soils formed in moderately alkaline lacustrine deposits in which fine sand and very fine sand are dominant. They are level or nearly level and occur in depressional areas that were occupied by glacial lakes. Slopes are less than 3 percent.

A representative profile of a Lamson soil has a very dark gray very fine sandy loam surface layer that is slightly acid and 8 inches thick. The upper part of the subsoil is light brownish-gray fine sandy loam to loamy fine sand that is very friable, slightly acid, and 4 inches thick. It contains few, fine, distinct, brownish-yellow and yellowish-brown mottles. The lower part of the subsoil is between depths of 12 and 30 inches. This layer consists of friable, brown fine sandy loam that is slightly acid in the upper part and neutral in the lower part. It contains a few irregularly shaped masses of silt and fine sand, and it has common, medium, distinct mottles of yellowish brown, olive brown, and dark gray. The substratum is at a depth of 30 inches. It contains layers of sand, very fine sand, and silt. The substratum has common, medium, distinct, yellowish-brown mottles and a few pebbles. It is friable and moderately alkaline.

The seasonal high water table is at or immediately below the surface early in spring, and it remains there until May or June unless the soil is artificially drained. Lamson soils receive water in surface runoff from surrounding higher soils and are often ponded early in spring or in excessively wet periods. The depth of soil available to roots depends on the depth to the water table. In undrained areas the roots are mostly confined to the surface layer, but in drained areas roots can extend to a depth of 3 feet or more. The available moisture capacity in the root zone is low unless these soils are artificially drained.

Representative profile of Lamson very fine sandy loam in the town of Hartland, on west side of Hosmer Road about one-half mile south of the Somerset-Hartland Townline Road; idle area:

Ap--0 to 8 inches, very dark gray (10YR 3/1), very fine sandy loam, gray (10YR 5/1) when dry; weak, fine and medium, granular structure; very friable; abundant fine roots; slightly acid; clear, smooth boundary. 6 to 9 inches thick.

B21g--8 to 12 inches, light brownish-gray (10YR 6/2) fine sandy loam; few, fine, distinct, brownish-yellow (10YR 6/6) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, granular structure; plentiful fine roots; slightly acid; clear, wavy boundary. 3 to 6 inches thick.

B22g--12 to 30 inches, brown (10YR 5/3) fine sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6), olive-brown (2.5Y 4/4), and dark-gray (10YR 4/1) mottles; very weak, blocky structure to massive; friable; few irregularly shaped masses of silt and fine sand; few roots in upper 6 inches, but no observable roots in lower 12 inches; slightly acid in upper part and neutral in lower part; gradual, wavy boundary. 15 to 30 inches thick.

Cg--30 to 50 inches, pale-brown (10YR 6/3) and dark-gray (10YR 4/1) layers of fine sand, very fine sand, and silt; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; structureless to weak, platy structure; friable and loose; no roots; few pebbles; moderately alkaline.

Thickness of the solum and depth to carbonates range from 28 to 40 inches. Depth to bedrock is more than 40 inches. Between the Ap horizon and a depth of 40 inches, the average clay content is less than 18 percent and the average content of sand coarser than very fine sand is more than 15 percent. The solum ranges from medium acid to neutral.

The Ap horizon is 10YR to 7.5YR in hue, 2 or 3 in value, and 1 or 2 in chroma. Thickness of the Ap horizon is less than one-third that of the solum. The Ap horizon ranges from very fine sandy loam to fine sandy loam.

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The B21g horizon ranges from 2.5Y to 5YR in hue, is 5 or 6 in value, and is 2 or 1 in chroma. The B21g horizon is mottled in some places. The mottled part that has chromas of more than 2 is less than 40 percent. The B22g horizon ranges from 5YR to 5Y in hue, is 5 or 6 in value, and is 2 or 3 in chroma. If chroma is 2, a horizon at a depth of less than 30 inches has chromas of more than 2. The B horizon contains mottles that have a chroma of 2 or less in some profiles. It ranges from loamy very fine sand to very fine sandy loam and fine sandy loam and contains pockets or thin layers of silt and fine sand.

The C horizon ranges from 5Y to 5YR in hue, is 4 to 6 in value, and is 2 or 3 in chroma. It is mottled in some profiles. The C horizon generally consists of layers of fine sand, very fine sand, and silt. In some areas Lamson soils are underlain by gravel at a depth of 40 inches or more.

Lamson soils form in deposits similar to those of the well drained Arkport soils, the moderately well drained Galen soils, and the somewhat poorly drained Minoa soils. Lamson soils have a coarser textured B horizon than Canandaigua soils. They are wetter and have a coarser textured B horizon than Niagara soils. Lamson soils lack the underlying glacial till that is characteristic of the Sun soils. The organic surface layer that occurs in muck areas is lacking in Lamson soils.

Lamson very fine sandy loam (Ld).--This level soil has the profile described as representative for the series. It is in old glacial lake basins in which the main deposits are sandy. Areas range from about 5 to more than 100 acres in size and average about 50 acres.

Most commonly included with this soil in mapping are spots of poorly drained or very poorly drained Canandaigua soils that have a higher silt and clay content than this Lamson soil, and also the somewhat poorly drained Cosad or poorly drained Cheektowaga soils that are underlain by clay deposits. Also included in some areas are shallow muck soils that have an organic surface layer 12 inches or more thick. In some places where this Lamson soil is near glacial till, the poorly drained Sun soils are included. Other common inclusions are soils that have a mucky surface layer and soils that have layers of gravel or a gravelly substratum.

Undrained areas of this soil are not suited to crops, but these areas can be used for unimproved pasture, native trees, or areas for wetland wildlife. If drainage is adequate, this soil is suited to vegetables and other crops grown in the county. (Capability unit IIIw-3; woodland suitability group 4w1)

Lamson fine sandy loam, gravelly substratum (Lg).--This soil has a profile similar to that described as representative for the series, except that a gravelly substratum occurs between depths of 3 1/2 and 6 feet. Slopes range from 0 to 2 percent. This soil is near glacial beaches, bars, and outwash areas. Areas normally are more than 30 acres in size, but in many places some areas are more than 100 acres. Areas are roughly rectangular in many places.

Most commonly included with this soil in mapping are areas where gravel is at a depth of less than 40 inches. Less commonly included are spots of poorly drained or very poorly drained Canandaigua soils. A few areas of somewhat poorly drained Cosad soils or poorly drained Cheektowaga soils are included where the sandy deposit is underlain by clay. Where this Lamson soil is near glacial till areas, the poorly drained Sun soils are included in some places. Other inclusions are a few areas where the surface layer is mucky and a few areas of Lamson silty clay loam.

Undrained areas of this soil are often ponded. This soil can be drained more readily than Lamson very fine sandy loam because of the underlying gravel layers, but obtaining suitable outlets is the major problem. The high content of organic matter, the fine sandy loam texture, and nearly level slopes are favorable characteristics for intensive use and management after drainage is installed. Permeability is moderately rapid, and runoff is slow. (Capability unit IIIw-3; woodland suitability group 4w1)

Lockport Series

The Lockport series consists of moderately deep, somewhat poorly drained soils that have a medium-textured surface layer and a moderately fine textured to fine textured subsoil. These soils formed principally in neutral or alkaline, reddish shale of the Queenston shale formation. In some places, rounded sandstone and granite rocks are strewn over the surface. These soils are level or nearly level and occur north of the Lockport limestone formation. They occupy a large continuous area near Hall Road in the southeastern part of Somerset and another large area north of the city of Lockport. Slopes are 0 to 3 percent.

In a representative profile of a Lockport soil that is idle, the surface layer is dark grayish-brown silt loam 6 inches thick. It is slightly acid and contains a few stones. The surface layer is underlain by a mottled brown, friable, heavy silt loam layer 2 inches thick. It is slightly acid. The subsoil is firm and is between depths of 8 inches and 23 inches. It is reddish-brown, faintly mottled heavy silty clay loam or silty clay. The subsoil is slightly acid in the upper part and neutral in the lower part. The substratum is at a depth of 23 inches. It consists of reddish-brown, partially weathered shale that is calcareous. The dusky-red, calcareous Queenston shale is at a depth of 36 inches.

The seasonal high water table rises to a few inches below the surface during spring and excessively wet periods. The water table is perched above the nearly impervious shale and slowly permeable subsoil. These soils may be droughty as the growing season progresses and as the water table drops.

Plant roots commonly are confined to a depth of 10 to 20 inches in the surface layer and subsoil.

The available moisture capacity is only moderate because rooting is shallow. Maintenance of good tilth is difficult. Most areas require surface drainage.

Representative profile of Lockport silt loam in town of Newfane on east side of Ewings Road, 3/10 mile south of McKee Road; idle area:

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine and medium, granular structure; slightly hard, friable; abundant fine roots; a few stones (sandstone and granite); slightly acid; abrupt, smooth boundary. 6 to 9 inches thick.

A2--6 to 8 inches, brown (7.5YR 5/4) heavy silt loam; common, medium, faint, strong-brown (7.5YR 5/6) and brown (7.5YR 5/2) mottles; moderate, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky; grayish-brown (10YR 5/2) peds; plentiful fine roots; slightly acid; clear, wavy boundary. 0 to 6 inches thick.

B2t--8 to 23 inches, reddish-brown (2.5YR 4/4) heavy silty clay loam to silty clay; common, fine, faint, red (2.5YR 4/6) mottles; moderate and strong, medium, prismatic structure breaking to moderate, medium, angular blocky structure; hard, firm, sticky; thin clay films on most of the ped faces; thicker films in pores; a few dusky-red (2.5YR 3/2) clay films along vertical channels; brown (7.5YR 5/2) coats on prism faces; few roots; less than 5 percent coarse fragments; slightly acid in upper part, to neutral in lower part; clear, wavy boundary. 11 to 22 inches thick.

C--23 to 36 inches, reddish-brown (2.5YR 4/4), partly weathered shale; some greenish-gray (5GY 5/1) shale; weak, medium, platy structure; extremely firm; no roots; calcareous; clear, smooth boundary. 0 to 15 inches thick.

R--36 inches +, dusky-red (2.5YR 3/2) shale bedrock; calcareous.

Thickness of the solum ranges from 18 to 35 inches, and depth to unweathered shale rock ranges from 20 to 40 inches. The solum ranges from medium acid to neutral. Coarse fragments may be present in any horizon, and many profiles commonly have glacial erratics in the surface layer or in the solum.

The Ap horizon has a hue of 10YR or 7.5YR, values of 3 to 5 when the horizon is moist, and chroma of 2 or 3. When the Ap horizon is dry, values are greater than 5.5. The A2 horizon is dominantly silt loam, but it ranges from silt loam to silty clay loam. The A2 horizon is absent in some profiles. Where present, the A2 horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value, and ranges from 2 to 4 in chroma.

The Bt horizon consists of more than one layer in some places and has a total thickness of 12 inches or more. The Bt horizon has ranges of 10YR to 5YR in hue, 4 or 5 in value, and ranges from 3 to 6 in chroma. It is clay loam and has a clay content of 35 to 55 percent. The upper part of the Bt horizon contains grayish or brownish silt coats on ped or prism surfaces. Clay films are present in the B horizon.

The C horizon is absent in some profiles. It has platy structure imparted by the underlying shale, contains greenish weathered shale in some places, and is neutral to moderately alkaline. The shale is neutral or calcareous. It ranges from easily penetrated soft shale to very hard, thinly bedded sandstone.

The Lockport soils formed in deposits similar to those of the Lairdsville soils. They have a finer textured B horizon and less depth to shale than Ovid soils. They are better drained, have a finer textured B horizon, and are shallower to shale than Cazenovia soils. The Lockport soils are similar to the Odessa soils and Lakemont soils in texture and color, but Lockport soils are moderately deep to shale.

Lockport silt loam (Lo).--This soil is level to nearly level and occurs in large flat areas that are influenced by the underlying bedrock. The average area is about 100 acres in size. Many areas are roughly oblong.

Most commonly included with this soil in mapping are better drained Claverack or Lairdsville soils that occur on small knolls. Also included are a few areas of Ovid, Hilton, Appleton, and other deep soils that formed in glacial till. In addition, a few areas of deep, clayey soils such as Churchville, Odessa, or Lakemont soils are included. A fairly large acreage of similar but poorly drained soil that is less than 40 inches to shale is included. These poorly drained areas are indicated by the symbol for wet spots.

Permeability is moderately slow in the surface layer and is very slow in the subsoil. Runoff is slow because of the nearly level topography. This soil has many limitations for farming. It dries out slowly in the spring and becomes baked during the hot weather. Because the soil is sticky when wet and hard when dry, it needs to be cultivated at a favorable moisture content. If the soil is cultivated when wet, hard clods or a crusty surface will form. If it is cultivated and planted when dry, seed germination and crop growth are poor.

This soil is well suited to hay, pasture, woods, or wildlife. If surface drainage is adequate, the soils are fairly suited to grain, some vegetables, and some fruit crops. Grapes do fairly well on this soil. Locally, stones in the surface layer are a problem. (Capability unit IIIw-2; woodland suitability group 3w1)

Madalin Series

The Madalin series consists of deep, poorly drained to very poorly drained soils that have a medium-textured surface layer and a moderately fine textured to fine textured subsoil. These soils developed in calcareous, lake-deposited clay and silt.

They are level to nearly level and occupy areas within the basins of old glacial lakes. In the southern part of Niagara County, Madalin soils are in areas that were occupied by glacial Lake Tonawanda. North of the limestone escarpment, they are in areas that were occupied by glacial Lake Iroquois. Most areas receive runoff from surrounding high areas and lack natural outlets. Slopes are less than 3 percent.

In a representative profile, a Madalin soil that has been cultivated has a very dark gray, slightly acid silt loam surface layer 6 inches thick. The upper part of the subsoil is light brownish-gray silty clay loam 4 inches thick. It is slightly acid and has distinct, yellowish-brown mottles. The middle part of the subsoil is light brownish-gray silty clay and is between depths of 10 inches and 17 inches. This layer is firm and plastic, and it has common, distinct, strong-brown mottles. The light olive-gray silty clay lower part of the subsoil extends to a depth of 26 inches. This layer is firm and plastic, and it has distinct, yellowish-brown mottles. Reaction is neutral. The substratum is calcareous, light olive-gray silty clay. It is firm when moist and plastic when wet.

These soils have a seasonal high water table that is on or just below the surface. Early in spring and in other excessively wet periods, these soils are often ponded. Because the subsoil and substratum are very slowly permeable, water may remain at or near the surface for long periods. The depth available for rooting depends on depth to the water table. If these soils are not drained, plant roots are confined mainly to a depth of less than 18 inches. The available moisture capacity is moderate.

Representative profile of Madalin silt loam in town of Cambria on west side of Budd Road, about one-fifth mile south of U.S. Highway No. 104 (Ridge Road) and 1 1/2 miles west of Warrens Corners; cultivated area:

Ap--0 to 6 inches, very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) when dry; moderate, fine, granular structure; friable; abundant fine roots; slightly acid; clear, irregular boundary. 6 to 8 inches thick.

B21tg--6 to 10 inches, light brownish-gray (10YR 6/2) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure that breaks to moderate, coarse, blocky structure; firm; plastic; plentiful fine roots; very thin, very dark gray (10YR 3/1) clay films on block faces; very dark gray (10YR 3/1) coats on prism faces; slightly acid; gradual, wavy boundary. 3 to 6 inches thick.

B22tg--10 to 17 inches, light brownish-gray (10YR 6/2) silty clay; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, prismatic structure breaking to moderate, medium, blocky structure; firm, plastic; plentiful fine roots on prism faces; few in ped interiors; very thin clay films on ped faces; slightly acid; gradual, wavy boundary. 6 to 12 inches thick.

B23tg--17 to 26 inches, light olive-gray (5Y 6/2) silty clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure breaking to moderate, medium, blocky structure; firm, plastic; thin clay films on ped faces; neutral; gradual, wavy boundary. 6 to 15 inches thick.

Cg--26 to 50 inches, light olive-gray; (5Y 6/2) silty clay; common, distinct, yellowish-brown (10YR 5/6) mottles; weak, thin, platy structure; firm, plastic; no roots; calcareous.

The solum ranges from 24 to 40 inches in thickness, and this thickness corresponds well with the depth to carbonates. Reaction generally ranges from medium acid to neutral, but it is mildly alkaline in the lower part of the solum in some places. Coarse fragments generally are absent, but in some places a few pebbles and stones are present in any horizon. Bedrock is at a depth of more than 40 inches.

The Ap horizon dominantly is 10YR in hue, 2 or 3 in value, and 1 or 2 in chroma. If this horizon is dry, value is 5 or less. The Ap horizon is less than 10 inches thick and less than one-third the thickness of the solum. An A2 horizon occurs in some places and ranges from 10YR to 5Y in hue and 5 to 7 in value; its chroma is less than 2. The A2 horizon may or may not be mottled. Where this horizon is mottled, the mottles are distinct or prominent. The A2 horizon ranges from silty loam to silty clay loam.

The Bt horizon has hues ranging from 10YR to 5Y and values ranging from 4 to 6. Chromas of 2 or less are dominant in 60 percent or more of the soil between the bottom of the Ap horizon and a depth of 30 inches. The Bt horizon ranges from silty clay loam to clay and has an average clay content of 35 to 55 percent. The lower part of the B horizon is mildly alkaline in some places.

The C horizon is similar to the B horizon in color. Below a depth of 30 inches, the C horizon has chroma of more than 2. Mottling is generally less and not so contrasting as in the B horizon. The C horizon generally is similar to the B horizon in texture, but it consists of varved silt and clay in some places. Glacial till occurs below a depth of 40 inches in some places. The C horizon is calcareous.

The Madalin soils formed in deposits similar to those of the moderately well drained to well drained Hudson, the somewhat poorly drained Rhinebeck, and the very poorly drained Fonda soils. They have a Bt horizon that is lacking in Fonda soils. Madalin soils are wetter than Churchville soils, and they lack the glacial till that occurs within a depth of 40 inches in the Churchville soils and the Madalin soils, loamy subsoil variant. The Madalin soils have a finer textured B horizon than Canandaigua soils.

Madalin silt loam (0 to 2 percent slopes) (Ma).--This soil occurs on broad flats or in narrow drainageways in the basins of old glacial lakes. Areas range from 5 to more than 100 acres in size. Most areas are roughly oblong.

Most commonly included with this soil in mapping are small areas of the better drained Rhinebeck soils at a slightly higher elevation and the similar Fonda soils in depressions or along drainageways. In the towns of Porter and Lewiston, there are common inclusions in which glacial till fragments are mixed into, or are present as thin layers in, the lacustrine silt and clay. Several areas are underlain by firm glacial till at a depth of 40 inches or more. Also included are areas of Churchville soils and the loamy subsoil variant of Madalin soils. Areas of Niagara or Canandaigua soils also are included in some places. In a few included areas, the surface layer is sandy, and in places there are inclusions of Cosad or Cheektowaga soils. Most areas where the surface layer is sandy or gravelly are shown on the soil map by the appropriate symbol.

Undrained areas of this soil are better suited to pasture, trees, or wetland wildlife than to cultivated crops. If the soil is adequately drained and well managed, cultivated crops can be grown. This soil should be cultivated at the proper moisture content. If it is cultivated when wet, hard clods or crusty surfaces generally form. If the soil is cultivated when too dry, germination and crop growth are poor. Cultivation at the wrong time damages soil structure and tilth. Runoff is slow, and drainage is commonly difficult because a suitable outlet is lacking. (Capability unit IVw-1; woodland suitability group 5w1)

Madalin Series, Loamy Subsoil Variant

The Madalin series, loamy subsoil variant, consists of deep, poorly drained to very poorly drained, medium-textured soils that are underlain by loamy glacial till. These soils formed in glacial lake sediments of silt and clay. The glacial till that underlies the lacustrine cap at a depth of 20 to 40 inches normally has not been altered by soil-forming processes.

These soils are level to nearly level and occur in or adjacent to areas that formerly were glacial lakes. They are mostly south of the limestone escarpment, where they are associated with Ovid, Odessa, Lakemont, and Fonda soils. A fairly large acreage is north of the escarpment in the town of Lewiston. Slopes are 2 percent or less.

A representative profile of a Madalin soil, loamy subsoil variant, has a very dark brown silt loam surface layer 8 inches thick. The upper part of the subsoil is gray to olive-gray, firm, neutral, plastic silty clay. It has strong-brown and gray mottles and extends to a depth of 16 inches. The lower part of the subsoil is grayish-brown, firm, plastic silty clay that has many strong-brown and gray mottles and is neutral. It grades into a grayish-brown mixture of silty clay lake sediments and reddish-brown silt loam glacial till. This mixed layer is firm, is about 10 percent stone fragments by volume, and is erratically calcareous. A substratum of reddish-brown silt loam glacial till occurs at a depth of 32 inches. It is calcareous, contains enough sand to give a gritty feel, and is 10 to 15 percent stone fragments.

The seasonal high water table is at or near the surface during spring and excessively wet periods. Some areas are ponded for short periods during the growing season. In spring the water table generally is perched above the fine-textured subsoil and the slowly permeable underlying glacial till. Because of slow permeability and the position of these soils, water is removed very slowly. Roots are confined mainly to the surface layer. Available moisture capacity is only moderate because depth of rooting is restricted.

Representative profile of Madalin silt loam, loamy subsoil variant, in the town of Lockport, three-fourths mile north of State Route 77 and 100 feet west of Richardson Road; cultivated area:

Ap--0 to 8 inches, very dark brown (10YR 2/2); heavy silt loam; gray (10YR 5/1) dry; weak, medium, granular structure; friable; abundant fine roots; neutral; abrupt, smooth boundary. 6 to 8 inches thick.

B21tg--8 to 16 inches, gray (5Y 5/1) to olive-gray (5Y 5/2) silty clay; many, medium, prominent strong-brown (7.5YR 5/6) mottles at center of aggregates occupy 30 percent of matrix; gray (5Y 5/1) ped and prism faces; moderate, medium, blocky structure; firm when moist, plastic when wet; distinct clay films on 5 to 10 percent of the ped faces and thicker films in most of the pores; few fine roots; neutral; clear, wavy boundary. 6 to 10 inches thick.

B22tg--16 to 26 inches, grayish-brown (2.5Y 5/2) silty clay; many, medium, distinct, strong-brown (7.5YR 5/6) mottles that occupy 25 to 30 percent of the matrix; strong, coarse, prismatic structure breaking to moderate, medium, blocky structure; firm when moist, plastic when wet; olive-gray (5Y 5/2) and light-gray (5Y 6/1) ped and prism faces; ped and prism faces have thin, nearly continuous clay films less than 1 millimeter thick; pores have clay films thicker than 1 millimeter; very few roots; neutral; no coarse fragments; clear, wavy boundary. 8 to 12 inches thick.

B3g--26 to 32 inches, grayish-brown (2.5Y 5/2) silty clay and reddish-brown (5YR 5/4) silt loam that have common, medium and coarse, distinct, yellowish-red (5YR 5/6) and red (2.5YR 4/6) mottles; some mixing of upper lake sediments and lower glacial till; moderate, medium, subangular blocky structure; firm; 10 percent coarse fragments; very few roots; erratically calcareous; abrupt, wavy boundary. 0 to 12 inches thick.

IIC--32 to 50 inches, reddish-brown (5YR 5/4) silt loam; numerous lime streaks; 10 to 15 percent coarse fragments; friable to firm; small sand pockets; weak, medium, platy structure; no roots; calcareous.

Thickness of the solum and depth to carbonates ranges from 20 to 34 inches. Bedrock is at a depth of more than 40 inches. The solum formed in fine-textured lake sediments, and the underlying contrasting material is glacial till deposits. Coarse fragments generally are absent in the solum, but in some profiles there may be up to 10 percent coarse fragments in any horizon. The underlying glacial till contains more than 5 percent but less than 35 percent coarse fragments.

The Ap horizon has a hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 2 or 1. It is less than 10 inches thick and less than one-third the thickness of the solum. Reaction is slightly acid to neutral. The Btg horizons have hues of 5Y to 2.5YR, values of 4 to 6, and a chroma of 1 or 2. These horizons normally contain mottles that have chroma greater than 2, but the percentage of chroma greater than 2 is less than 40 percent of the total area. The Btg horizons range from silt loam to clay and have an average clay content of more than 35 percent but less than 60 percent. The Btg horizons have moderate or strong, prismatic or blocky structure. They are slightly acid to moderately alkaline. The B3g horizon is absent in some places, but normally there is some mixing of the contrasting deposits, especially near the contact area.

The underlying IIC horizon ranges from 5Y to 2.5YR in hue, is 4 or 5 in value, and ranges from 2 to 4 in chroma. This horizon ranges from fine sandy loam to silt loam. The silt loam normally contains enough sand to give a gritty feel. It is gravelly or nongravelly and has a clay content of less than 18 percent. Coarse fragments make up 5 to 35 percent of this horizon and range from fine pebbles to large boulders. The IIC horizon is calcareous.

The Madalin soils, loamy subsoil variant, formed in deposits similar to those of the somewhat poorly drained Churchville soils. They are wetter and have a finer textured B horizon than Ovid soils. They are similar to normal Madalin soils except that they are moderately shallow over glacial till. The B horizon of these soils is finer textured than that of Canandaigua soils.

Madalin silt loam, loamy subsoil variant (Md).--This soil is level to nearly level. It occupies nearly level to slightly depressional areas at the margin of old glacial lakebeds. The individual areas range from less than 5 to more than 100 acres in size. They have no characteristic shape but, in most places, are fairly narrow strips that separate the deep, lake-laid sediments from surrounding glacial till.

Most commonly included with this soil in mapping are small areas of similar but better drained Churchville soils. Also included are coarser textured Ovid or Sun soils that formed in till, and deeper Odessa, Rhinebeck, Lakemont, and normal Madalin soils that formed in deeper clayey lacustrine deposits. A few areas have shale rock within 6 feet of the surface.

Unless drained, this soil is not suited to most cultivated crops. This soil is fairly well suited to well suited to pasture. It also is well suited to soft maple, white ash, and similar trees. With adequate drainage, this soil can be used for most hay and grain crops, but it is poorly suited to vegetables and most fruit crops.

Good tilth is difficult to maintain. Runoff is slow, and good outlets are difficult to locate in many places. If the soil is cultivated when wet, hard clods or a crusty surface forms. Germination and crop growth are poor if the soil is cultivated when it is too wet. (Capability unit IVw-1; woodland suitability group 5w1)

Made Land

Made land (Me) consists of areas that have been filled with stones, old masonry materials, brick, and other waste. These areas have been covered with a thin mantle of soil material. There is no profile development. These areas can be used for community development if they are filled, compacted, and leveled. Commonly, they are already leveled and have slopes of less than 3 percent. Most areas occur near the cities of Niagara Falls, Lockport, and North Tonawanda. Most of the acreage of Made land has little if any value for farming. Areas can be used for certain kinds of town and country planning, but the land varies so widely that onsite investigation is needed to determine its suitability for individual uses. (Capability unit and woodland suitability group not assigned)

Massena Series

The Massena series consists of deep, somewhat poorly drained to poorly drained, moderately coarse textured soils. These soils developed in calcareous glacial till deposits that have been capped by silty and sandy lacustrine material and disturbed by wave or other lake activity. These level or nearly level soils occupy wave-washed areas that are north of U.S. Highway No. 104 (Ridge Road). They occur in depressions or along drainageways, mainly in the towns of Wilson, Newfane, and Hartland. Slopes are less than 3 percent.

A representative profile of a Massena soil has a very dark gray fine sandy loam surface layer that is slightly acid and 8 inches thick. It is underlain by a very friable, pale-brown loamy fine sand layer that is slightly acid, distinctly mottled, and 9 inches thick. The upper part of the subsoil is at a depth of 23 inches. It is friable, brown gravelly fine sandy loam that is neutral, has many distinct mottles, and is 6 inches thick. The lower part of the subsoil is between depths of 25 to 29 inches. It consists of firm, grayish-brown silt loam that is prominently mottled, contains a few stone fragments, and is neutral in the upper part and weakly calcareous in the lower part. Between depths of 29 and

50 inches, there is a calcareous substratum. It consists of very firm, reddish-gray, mottled very fine sandy loam to silt loam glacial till that contains a few stone fragments.

The seasonal high water table rises to within 1 foot of the surface early in spring and in excessively wet periods. Some areas may be ponded for short periods. The water table is perched over the moderately slowly permeable subsoil and slowly permeable glacial till. Early in spring, roots are confined to the uppermost 12 inches of soil. As the growing season progresses and the water table drops, roots extend downward to the calcareous substratum. The available moisture capacity is low in the main rooting zone.

Representative profile of Massena fine sandy loam in the town of Hartland, 100 yards west of Checkered Tavern Road and two-fifths mile north of Gow Road; pasture:

Ap--0 to 8 inches, very dark gray (10YR 3/1) fine sandy loam; gray (10YR 6/1) when dry; weak, fine, granular structure; very friable; slightly acid; abundant roots; abrupt, smooth boundary. 6 to 10 inches thick.

A2--8 to 17 inches, pale-brown (10YR 6/3) loamy fine sand; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; very weak, thick, platy structure or single grain; very friable; slightly acid; plentiful fine roots; clear, smooth boundary. 6 to 10 inches thick.

IIB2--17 to 23 inches, brown (10YR 5/3) gravelly fine sandy loam; many (approximately 30 percent), medium, distinct, reddish-yellow (7.5YR 6/6) and brownish-yellow (10YR 6/6) mottles; weak, medium and coarse, subangular blocky structure; friable; dominantly grayish brown (10YR 5/2) on ped faces; about 20 percent gravel; slightly acid; few fine roots; abrupt, smooth boundary. 6 to 10 inches thick.

IIIB3--23 to 29 inches, grayish-brown (10YR 5/2) and light brownish-gray (10YR 6/2); silt loam; many (about 40 percent), coarse, prominent, brown (7.5YR 5/4) and strong-brown (7.5YR 5/6) mottles; moderate, very thick, platy structure; firm; neutral or weakly calcareous in lower part; very few fine roots; less than 5 percent coarse fragments; abrupt, smooth boundary. 0 to 10 inches thick.

IVC--29 to 50 inches, reddish-gray (5YR 5/2) very fine sandy loam to silt loam glacial till; many (about 40 percent), coarse, prominent, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6) mottles in upper part; moderate, thick, platy structure; very firm; between 5 and 10 percent coarse fragments; calcareous.

Thickness of the solum ranges from 20 to 36 inches and corresponds well with the depth to carbonates. The solum is slightly acid to mildly alkaline. Content of coarse fragments ranges from practically none to 35 percent in any horizon.

The Ap horizon has a hue of 10YR or 7.5YR and chroma of 2 or 1. It is 3 or 4 in value when moist and more than 5.5 when dry. The A2 horizon has a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. Texture ranges from loamy fine sand to silt loam.

The B2 horizon ranges from 10YR to 5YR in hue, is 4 to 6 in value, and is 2 or 3 in chroma. Chromas of 2 or less are dominant on ped faces or in the matrix. The B2 horizon is fine sandy loam to silt loam that is gravelly or nongravelly. Clay content is less than 18 percent, and fine sand and coarser sand total 15 percent or more. The B3 horizon has about the same range in texture as the B2 horizon. The B3 horizon is absent in some places.

The C horizon ranges from 10YR to 5YR in hue, is 4 or 5 in value, and is 2 to 4 in chroma. It is fine sandy loam to silt loam that is gravelly or nongravelly.

The Massena soils formed in deposits similar to those of the moderately well drained Bombay soils and the poorly drained to very poorly drained Sun soils. Massena soils are wetter and coarser textured than the Appleton soils. The Massena soil developed mainly in glacial till, but the Galen and Minoa soils formed mainly in sandy lake deposits.

Massena fine sandy loam (Mf).--This soil is nearly level and occupies areas where some runoff accumulates. Areas range from less than 5 to about 50 acres in size. The areas are oblong in many places and oriented in a northeast to southwest direction.

Most commonly included in mapping are areas of the better drained Hilton or Bombay soils and of the wetter Sun soils. The Hilton or Bombay soils occur on knolls or at a slightly higher elevation. The Sun soils occur in depressions or along drainageways. Included in a few places are the Galen, Elnora, Minoa, and other soils that are deep and sandy. A few included areas are of silty Niagara or Canandaigua soils.

Where this Massena soil is not drained, it is limited for cropping but is suited to pasture and woods. Where adequately drained, it is suited to most crops and, in places, to many kinds of vegetable crops. Most commonly, however, this soil is associated with stony or gravelly soils. Most areas are in hay, grain crops, or idle.

The major management needs are improving drainage, adding fertilizer, and regularly supplying organic matter. (Capability unit IIIw-1; woodland suitability group 3w2)

Minoa Series

The Minoa series consists of deep, somewhat poorly drained, medium-textured soils. These soils formed in calcareous lacustrine deposits of fine and very fine sand, silt, and a very small amount of clay. Most of the acreage is north of U.S. Highway No. 104 (Ridge Road). Slopes are less than 3 percent.

In a representative profile a Minoa soil that is cultivated has a very dark grayish brown, medium

acid very fine sandy loam plow layer 8 inches thick. The plow layer is underlain by a layer of friable, brown loamy fine sand that is mottled, medium acid, and 4 inches thick. The upper part of the subsoil is between depths of 12 and 20 inches. It consists of friable, brown very fine sandy loam that is neutral and contains many, brown and strong-brown mottles. The lower part of the subsoil consists of friable, brown, mottled loamy fine sand that contains a few, firm, reddish-brown, irregularly shaped bands of loam. This layer extends to a depth of 30 inches. The calcareous substratum consists of friable to firm, brown, stratified very fine sand and silt. It is mottled and is streaked with lime.

The seasonal high water table rises to within 1 foot of the surface early in spring and in other excessively wet periods. Some areas may be ponded for short periods. Early in spring, roots are confined to the uppermost 12 inches of the soil. As the growing season progresses and the water table drops, roots can extend downward to the calcareous substratum. The available moisture capacity is moderate. If the Minoa soils are adequately drained, they have a high potential for vegetable crops.

Representative profile of Minoa very fine sandy loam in the town of Lewiston, 20 feet south of Schoolhouse Road and about three-tenths mile west of Ransomville Road; cultivated area:

Ap--0 to 8 inches, very dark grayish brown (10YR 3/2) very fine sandy loam; dark grayish-brown (10YR 4/2) when rubbed; moderate, fine, granular structure; very friable; abundant fine roots; medium acid; abrupt, smooth boundary. 6 to 10 inches thick.

A2--8 to 12 inches, brown (10YR 5/3) loamy fine sand; many (about 40 percent), medium and fine, faint and distinct, brown (7.5YR 5/4) and strong-brown (7.5YR 5/6) mottles; weak, thin, platy structure; friable; plentiful fine roots; medium acid; clear, wavy boundary. 0 to 6 inches thick.

B21--12 to 20 inches, brown (7.5YR 5/4) very fine sandy loam; common, fine, faint, strong-brown (7.5YR 5/6) and brown (7.5YR 5/2) mottles; weak, medium, platy structure; friable and firm; no clay films; few fine roots; neutral; clear, wavy boundary. 8 to 15 inches thick.

B22--20 to 30 inches, brown (7.5YR 5/4) loamy very fine sand; common, fine, faint, strong-brown (7.5YR 5/6) and brown (7.5YR 5/2) mottles; weak, medium, platy structure; friable and firm; few reddish-brown (5YR 4/3), irregularly shaped bodies and thin layers that have a loam texture and are firm; very fine roots, neutral; clear, wavy boundary. 8 to 12 inches thick.

C--30 to 50 inches, brown (7.5YR 5/2), stratified very fine sand and silt; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; few, coarse, faint, pinkish-gray (7.5YR 6/2) lime streaks; very weak, thick, platy structure; friable and firm; calcareous.

Thickness of the solum ranges from 24 to 40 inches and corresponds well with the depth to carbonates. Coarse fragments generally are absent in the solum, but the content of coarse fragments may be as much as 15 percent in any horizon. The solum ranges from medium acid to neutral. Average clay content between depths of 10 and 40 inches is less than 15 percent. Between these depths, sand coarser than very fine sand makes up an average of between 15 and 40 percent of the soil mass. Bedrock is at a depth of more than 40 inches. The Ap horizon has a hue of 10YR or 7.5YR and a chroma of 2 or 1. The Ap horizon is 3 or 4 in value when moist and more than 5.5 when dry. The A2 horizon is 10YR or 7.5YR in hue, ranges from 4 to 6 in value, and is 3 or 4 in chroma. It ranges from loamy fine sand to very fine sandy loam.

A B1 horizon occurs in some places and has the same range in texture and in hue, value, and chroma as the A2 horizon. The B horizon ranges from 5YR to 2.5Y in hue, is 5 or 6 in value, and ranges from 2 to 6 in texture. Texture ranges from loamy fine sand to silt loam. Typically, the B horizon is loamy very fine sand that has lamellae or irregular-shaped bodies that are loam in texture. The C horizon has a hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 2 or 3. This horizon normally consists of stratified silt and sand but ranges from fine sand to silt loam. It is generally calcareous but is neutral in some places. Mottles having a chroma of 2 or less are present in at least one horizon at a depth below 20 inches.

The Minoa soils formed in deposits similar to those in well drained Arkport soils, the moderately well drained Galen soils, and the poorly to very poorly drained Lamson soils. The Minoa soils are wetter and finer textured than the Elnora soils. They are finer textured than the Stafford soils. They have a coarser textured B horizon than the Collamer and Niagara soils. The Minoa soils are similar to the Bombay and Massena soils in texture, but they lack the coarse fragments and the underlying glacial till of those soils.

Minoa very fine sandy loam (Mn).--This level to nearly level soil occupies the intermediate areas between the moderately well drained Galen or Elnora soils at a higher elevation and the poorly drained Lamson or Sun soils at a lower elevation. Individual areas range from 5 to more than 50 acres in size. They are commonly oblong or roughly rectangular.

Most commonly included with this soil in mapping are small areas of the Cosad, Massena, Galen, Elnora, and Lamson soils. The Cosad soils are included where the sand is moderately deep over a clay deposit. The Massena soils are included where the sand cap is thin over glacial till. Spots of Galen and Elnora soils occupy small knolls. The Lamson soils are included in drainageways or depressions. In silty areas, Niagara or Canandaigua soils may be included. In coarser textured areas, Stafford soils may be included. In some places there are inclusions of gravel or a gravel layer.

Where this Minoa soil is not drained, its use is limited to hay, pasture, woods or other low-intensity uses. Where the soil is adequately drained, most crops can be grown. It can be a highly desirable soil, especially for vegetable production. It is nonstony, generally is easily cultivated, does not crust or form clods, and responds well to management, including irrigation and fertilization. (Capability unit IIIw-1; woodland suitability group 3w2)

Muck, Shallow

Muck, shallow (Ms) consists of very poorly drained organic soils. These soils contain much organic matter that is decomposed to varying degrees. They occur in areas that once were ponds but have been gradually filled up with decaying plants. Large areas occur in the town of Hartland. Two very large areas are south of the Lockport limestone escarpment. One of these is northwest of Sanborn near Blackman Road, and the other is northeast of Royalton Center near Royalton Center Road. Other areas are scattered mostly north of U.S. Highway No. 104 (Ridge Road).

The surface layer is a black, granular, thoroughly decomposed organic material that normally is 10 to 15 inches thick. Under the decomposed surface layer in the deepest mucks, there is a spongy, brown, fibrous layer that is fairly variable in thickness. In some areas the substratum is sandy and contains gravel, but in other areas it is silt and clay. The substratum is mineral soil material and is at a depth ranging from 12 to 40 inches.

Muck, shallow, is of marginal suitability for farming. In many places it is difficult to drain because suitable outlets are lacking. In drained areas the organic layer subsides after artificial drainage and the mineral soil is exposed. Where the underlying material is sand or silt, drainage is less difficult than it is in areas underlain mostly by clay. The suitability for farming is better in areas underlain by sand or silt. Before estimating the farming potential, an onsite investigation is needed to determine the kind of mineral soil that underlies the organic materials.

Where this land type is unfarmed, it is better suited to woods or wildlife than to other uses. Some sites can be developed for wildlife that frequent marsh areas. (Capability unit IVw-2; woodland suitability group not assigned)

Niagara Series

The Niagara series consists of deep, somewhat poorly drained, medium-textured soils. These soils developed in neutral or calcareous glacial lake deposits that have a high silt content and moderate amounts of sand and clay. They typically are free of stones and other coarse fragments. Niagara soils are level to gently sloping and occur in basins of old glacial lakes. The main areas are north of the Lockport limestone escarpment. Slopes range from 0 to 6 percent.

A representative profile of a Niagara soil has a dark grayish-brown silt loam surface layer that is slightly acid and 8 inches thick. This layer is underlain by friable, light-brown very fine sandy loam to silt loam that contains distinct, yellowish-red mottles, is medium acid, and is 5 inches thick. Between depths of 13 inches and 30 inches, there is a firm, reddish-brown silt loam subsoil that is mottled. It is medium acid in the upper part and becomes slightly acid as depth increases. The substratum is at a depth of 30 inches. It consists of firm, reddish-brown, distinctly mottled silt loam that contains some thin strata of clay and is neutral to mildly alkaline.

The seasonal high water table rises to within a foot of the surface early in spring and in other excessively wet periods. Some areas are ponded. The water table generally is perched above the moderately slowly permeable subsoil and firm substratum. As the water table falls, roots can extend to the calcareous substratum. Most roots, however, are confined to the uppermost 20 inches of soil. The available moisture capacity is moderate to high.

Representative profile of Niagara silt loam, 0 to 2 percent slopes, in the town of Hartland, about two-fifths mile east of Checkered Tavern Road and 25 feet north of Wheeler Road; cultivated area:

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

A2--8 to 13 inches, light-brown (7.5YR 6/4) very fine sandy loam to silt loam; common, fine and medium, distinct, yellowish-red (5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; abundant fine roots and few medium roots; few large worm channels; some tonguing of Ap material into this horizon along vertical channels; medium acid; clear, irregular boundary. 0 to 7 inches thick.

B2t--13 to 30 inches, reddish-brown (5YR 5/3) silt loam; many (about 40 percent), large, faint, brown (5YR 5/4) and strong-brown (7.5YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; firm; thin, continuous, brown (7.5YR 5/2) clay films and coats on ped faces, thicker films in pores; dominantly brown (7.5YR 5/2) ped coats; abundant roots in upper part of horizon, few in lower part; few large worm channels; medium acid to slightly acid in lower part; clear, wavy boundary. 12 to 20 inches thick.

C--30 to 50 inches, reddish-brown (5YR 4/3) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, thick, platy structure or massive; firm; some light brownish-gray (2.5Y 6/2) clay strata that are 5 to 10 millimeters thick and that contain prominent strong-brown mottles; very few roots; neutral to mildly alkaline.

Thickness of the solum ranges from 20 to 36

inches and corresponds well with the depth to carbonates. These soils typically are free of stones, but any horizon may contain 15 percent or less coarse fragments by volume. Bedrock is at a depth of more than 40 inches and, in most places, is at a depth of more than 6 feet. The Ap horizon ranges in hue from 7.5YR to 2.5Y; its value is 3 or 4, and its chroma is 2 or 3. Dry values are greater than 5.5. The A2 horizon may be absent. Where it is present, the A2 horizon has hues ranging from 7.5YR to 2.5Y, value of 5 or 6, and chroma of 2 to 4. Texture ranges from fine sandy loam to silt loam.

The B2t horizon has hues ranging from 5YR to 2.5Y. Value ranges from 4 to 6, and chroma ranges from 2 to 4. Chroma of 2 or less dominates the ped faces or is dominant in the interior of the peds. Chroma of 2, however, makes up less than 60 percent by volume of the ped interiors. Texture ranges from silt loam to silty clay loam. Clay percentage averages between 18 and 35 percent. There is less than 15 percent fine sand or coarser in the B horizon. The C horizon has a hue ranging from 2.5Y to 5YR; value ranges from 3 to 5, and chroma from 2 to 4. This horizon commonly consists of varved silts, very fine sands, and clay. Silt, however, is the dominant particle size, at least to a depth of 40 inches. Glacial till, outwash, or bedrock may occur at depths between 40 inches and 6 feet. The C horizon is neutral to moderately alkaline.

Niagara soils formed in deposits similar to those in which the well drained Dunkirk, the moderately well drained Collamer, and the poorly drained Canandaigua soils formed. Niagara soils have a coarser textured Bt horizon than Rhinebeck or Odessa soils. They have a finer textured B horizon than Minoa soils. They are wetter and have a finer textured B horizon than Galen soils. Niagara soils lack the coarse fragments and underlying glacial till that are characteristic of Hilton and Appleton soils.

Niagara silt loam, 0 to 2 percent slopes (NaA).--This soil has the profile described as representative for the series. It is level or nearly level and occurs within old glacial lake basins. Individual areas range from about 5 to well over 100 acres in size. Their shapes are generally oblong.

Most commonly included are small areas of better drained Collamer soils on knolls or at a slightly higher elevation and wetter Canandaigua soils in depressions or along drainageways. In coarser textured areas, there are common inclusions of Galen and Minoa soils. In finer textured areas, there are inclusions of Rhinebeck or Odessa soils in some places. Areas associated with glacial till commonly are underlain by glacial till, and there are inclusions that are moderately deep to glacial till. In addition, some areas near glacial till include small areas of Hilton and Appleton soils. Most areas in which the surface layer is sandy or gravelly are indicated by the appropriate symbols.

Undrained, this soil is suited to small grain, hay, pasture, or woodland. If adequately drained and fertilized, it can be used for most crops grown in the county. Because of its generally nonstony nature, medium texture, and ease of cultivation, it is a desirable soil for vegetable crops. If surface drainage is installed, a protective cover of vegetation is needed to prevent erosion. Runoff is slow. (Capability unit IIIw-1; woodland suitability group 3w2)

Niagara silt loam, 2 to 6 percent slopes (NaB).--This gently sloping soil has a profile that is similar to the one described as representative for the series, but the surface layer is likely to be thinner or finer textured. This soil is located along drainageways where the landscape is undergoing some dissection by erosion. Individual areas are generally less than 20 acres in size. Many of them are roughly rectangular in shape.

Most commonly included in mapping are small areas of the better drained Collamer soils on knolls or at the highest elevations. Canandaigua soils are included in the drainageways in some places. Some areas have inclusions of soils that are moderately deep to glacial till, and there are small included areas of Hilton and Appleton soils. In places where a sand cap occurs there are inclusions of Claverack or Galen soils. In some places the surface layer is sandy or gravelly, and these are generally indicated on the soil map by the appropriate symbols.

This soil is suited to about the same crops as the nearly level Niagara soil. Drainage, however, is normally easier to establish. Runoff is medium to rapid. Erosion is a serious hazard if the soil is intensively cultivated. (Capability unit IIIw-5; woodland suitability group 3w2)

Odessa Series

The Odessa series consists of deep, somewhat poorly drained, moderately fine textured soils. These soils formed in lacustrine deposits in which calcareous clay is dominant. They are level to gently sloping and occur in basins of old glacial lakes. Most areas of the Odessa soils occur south of the Lockport limestone formation. Slopes range from 0 to 6 percent.

A representative profile of an Odessa soil has a slightly acid, dark grayish-brown silty clay loam surface layer 8 inches thick. This layer is underlain by slightly acid, firm, brown silty clay 8 inches thick. The subsoil is slightly acid, firm, brown and light reddish-brown silty clay that is mottled. It is slightly acid in the upper part and mildly alkaline in the lower part. The substratum is calcareous and is at a depth of 33 inches. It consists of very firm, reddish-brown, mottled layers of clay and silt.

The seasonal high water table is 6 to 12 inches below the surface early in spring and in excessively wet periods. The water table usually is perched above the slowly permeable subsoil and substratum. Rooting depth is related to the water table and the

calcareous substratum. As the water table falls, roots can penetrate to the calcareous substratum. Most roots are confined to the uppermost 20 inches of soil. The available moisture capacity is moderate. Permeability is moderately slow in the surface layer and slow in the subsoil.

Representative profile of Odessa silty clay loam, 0 to 2 percent slopes, in the town of Cambria, 800 feet east of junction of Thrall Road and Upper Mountain Road and 1,300 feet south of Upper Mountain Road; cultivated area:

Ap--0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam; strong, medium to coarse, granular structure; friable; abundant fine roots; slightly acid; clear, wavy boundary. 6 to 9 inches thick.

B&A--8 to 16 inches, brown (10YR 5/3) silty clay; many (50 percent), medium, faint, brownish-yellow (10YR 6/8) and light brownish-gray (10YR 6/2) mottles; strong, fine to medium, subangular blocky structure; firm; ped faces have thick, gray (10YR 6/2, silty coats; abundant fine roots; slightly acid; clear, wavy boundary. 0 to 9 inches thick.

B21t--16 to 19 inches, brown (7.5YR 5/4) silty clay; common, fine, faint, reddish-yellow (7.5YR 6/6) and light brownish-gray (10YR 6/2) mottles; strong, coarse, prismatic structure breaking to strong, medium, angular blocky structure; firm; dark-gray (10YR 4/1), thin, continuous clay films on ped faces and in all pores; abundant fine roots; slightly acid; gradual, wavy boundary. 2 to 4 inches thick.

B22t--19 to 33 inches, light reddish-brown (5YR 6/4) silty clay; common, fine, faint, light-brown (7.5YR 6/4) and reddish brown (2.5YR 5/4) mottles; strong, coarse, prismatic structure breaking to strong, medium, angular blocky structure; firm; no coarse fragments; brown (7.5YR 5/2) ped coats; gray (10YR 5/1) clay films on ped faces and in pores; few roots; mildly alkaline in lower part of horizon; clear, wavy boundary. 12 to 18 inches thick.

C--33 to 56 inches, reddish-brown (2.5YR 4/4) silty clay; common, medium, distinct, brown (10YR 5/3) mottles; weak, thin and medium, platy structure; very firm; gray (5Y 5/1) clay coats less than 1 millimeter thick in upper part; some clay flows in old root channels; few coarse fragments in lower part of horizon; no roots; calcareous.

Thickness of the solum ranges from 20 to 40 inches and corresponds closely with depth to carbonates. The solum ranges from medium acid to mildly alkaline.

The Ap horizon typically has a hue of 10YR and is 2 or 3 in chroma. It ranges from 3 to 5 in value when moist and is more than 5.5 when wet. A thin, mottled A2 horizon occurs in some places. The B&A horizon is absent in some areas. If the B&A horizon is absent, silt coatings are on the ped faces of the upper B21t horizon. The B21t and B22t horizons range from 7.5YR to 2.5YR in hue, are 4 to 6 in value, and generally are 3 or 4 in chroma. Ped faces have chroma of 2 or less. Mottles of low and high chroma range from common to many. The B21t and B22t horizons range from silty clay loam to clay and have an average clay content of 35 to 55 percent. Clay films occur on both horizontal and vertical faces of peds and in pores. The B21t and B22t horizons have moderate or strong and prismatic or blocky structure.

The C horizon to a depth of 40 inches ranges from weak, platy or massive silty clay or silty clay loam to stratified or varved silt and clay. The color range is the same as for the B21t and B22t horizon.

The Odessa soils formed in deposits similar to those of the moderately well drained to well drained Schoharie soils and the poorly drained to very poorly drained Lakemont soils. Odessa soils are similar to Cayuga and Churchville in texture but lack the underlying glacial till. Color is redder in the Odessa soils than in the Rhinebeck and Madalin soils. Odessa soils have finer textured Bt horizons than the Niagara soils.

Odessa silty clay loam, 0 to 2 percent slopes (OdA).--This soil has the profile described as representative for the series. It is south of the limestone escarpment in areas that were occupied by glacial lakes. Areas normally are fairly large, and they are roughly oblong. The average-sized area is about 50 acres.

Most commonly included with this soil in mapping are areas of Lakemont soils in depressions or along drainageways, of Schoharie and Cayuga soils on ridges or knolls, and of Churchville soils where the lake deposits are moderately deep over glacial till. In many areas glacial till is within 8 feet of the surface. South of the city of Lockport, near Robinson and Donner Roads, inclusions are moderately deep to silt. Here, the reddish-colored silt is between depths of about 2 and 4 feet. Reddish, silty glacial till occurs at a depth of 4 feet. North of the limestone escarpment, included soils contain less clay than is normal for Odessa soils, and browner Rhinebeck soils also are included. Other inclusions are areas with a silt loam surface layer. In a few included areas, there is a cap of silt 12 to 20 inches thick.

This soil is well suited to hay, grain, pasture, and trees. Drainage is needed to obtain good crop growth. This soil is poorly suited to vegetables and fruits because of the soil texture and surface wetness. Grapes are successfully grown in some places. This soil is sticky when wet and hard when dry, and good tilth is difficult to maintain. If this soil is worked when wet, hard clods and crusty surfaces are formed. If this soil is planted when dry, poor germination of seeds can be expected. (Capability unit IIIw-2; woodland suitability group 3w1)

Odessa silty clay loam, 2 to 6 percent slopes (OdB).--This soil occurs with the nearly level Odessa soil in most places. In many places this soil is along small streams or drainageways where

erosion has dissected the landscape. A few areas are on foot slopes below glacial till ridges. Areas range from about 5 to 50 acres in size and are oblong in many places. The average-sized area is about 20 acres.

Commonly included are small areas of poorly drained Lakemont soils in depressions or along drainageways and of better drained Schoharie or Cayuga soils on knolls. Also included are areas of Churchville soils where the lake deposits are moderately deep to glacial till. South of the city of Lockport near Robinson and Donner Roads, included areas are moderately deep to silt. In these areas reddish silt is between depths of about 2 to 4 feet, and at 4 feet there is reddish, silty glacial till. In areas north of the limestone escarpment, areas of Niagara and Rhinebeck soils are included.

This soil is best suited to hay, grain, pasture, or trees. In most places random drainage of wet spots is needed. This soil is poorly suited to vegetables and fruits because of texture and surface wetness. Grapes grow fairly well on this soil. Drainage normally is easier on this soil than on Odessa silty clay loam, 0 to 2 percent slopes.

Because this soil is sticky when wet and hard when dry, it needs to be cultivated at a favorable moisture content. If this soil is worked when wet, hard clods and crusty surfaces are formed. If this soil is planted when dry, poor germination of seeds can be expected. In cultivated but unprotected areas of this soil, the erosion hazard is moderate. (Capability unit IIIw-5; woodland suitability group 3w1)

Ontario Series

The Ontario series consists of deep, well-drained, medium-textured soils that formed in calcareous, loamy glacial till deposits. The glacial material contains semirounded and angular rock fragments that are mostly sandstone and limestone. These soils are mainly in the central part of Niagara County. They parallel the Lockport limestone escarpment and generally occupy the sloping areas that are associated with the limestone formation. Another fairly large part occupies the higher till ridges, such as Chestnut Ridge in the southern part of the county. Slopes range from 0 to 30 percent.

In a representative profile, a cultivated Ontario soil has a brown to dark-brown loam surface layer 8 inches thick. This layer is slightly acid and contains between 5 and 10 percent stone fragments. It is underlain by very friable, brown loam that is neutral and 6 inches thick. This layer contains about the same amount of stone fragments as the surface layer. The subsoil is between depths of 14 and 32 inches. It consists of friable, reddish-brown heavy gravelly loam. The substratum is at a depth of 32 inches and consists of firm, dark reddish-brown gravelly loam that is calcareous.

In nearly level or gently sloping Ontario soils, the water table may be perched above the slowly permeable glacial till or the moderately slowly permeable subsoil for short periods. These periods are mostly early in spring and in excessively wet periods. Rooting depth is generally unrestricted above the calcareous substratum, which is at a depth of 30 to 42 inches. Very few roots penetrate into the substratum. The available moisture capacity is high. Permeability is moderate in the surface layer and is moderately slow in the subsoil. These soils respond well to fertilization and other good practices of management.

Representative profile of Ontario loam, 2 to 8 percent slopes, 300 yards north of Mountain Road and 250 yards west of Peet Road; cultivated area:

Ap--0 to 8 inches, brown to dark-brown (10YR 4/3) loam; moderate, fine, granular structure; very friable; 5 to 10 percent coarse fragments; abundant roots; slightly acid; abrupt, smooth boundary. 7 to 10 inches thick.

B&A--8 to 14 inches, brown (7.5YR 5/4) loam; weak, fine, subangular blocky structure; friable; ped coats of light brown (7.5YR 6/4) are one-half inch thick at top of the horizon but are thinner as depth increases; 5 to 10 percent coarse fragments; plentiful roots; neutral; gradual, discontinuous boundary. 3 to 16 inches thick.

B2t--14 to 32 inches, reddish-brown (5YR 4/3) heavy gravelly loam; moderate, medium, subangular blocky structure; firm; clay films on ped faces and in pores; 20 percent gravel and some cobblestones up to 8 inches in diameter; plentiful fine roots; neutral; clear, wavy boundary. 12 to 24 inches thick.

C--32 to 54 inches, dark reddish-brown (5YR 3/4) gravelly loam; moderate, thick, platy structure; firm; few, grayish-brown (10YR 5/2) and yellowish brown (10YR 5/4), weathered shale fragments; 20 to 30 percent gravel and some cobblestones and stones up to 12 inches in diameter; calcareous; very few roots.

Thickness of the solum ranges from 30 to 42 inches and corresponds well with the depth to calcareous glacial till. Depth to bedrock is more than 40 inches. Depth to rock in the limestone substratum phases is mainly between 40 inches and 6 feet. Content of coarse fragments ranges from about 5 to 30 percent in the solum and from 10 to 35 percent in the substratum.

The Ap horizon is 10YR or 7.5YR in hue and ranges from 3 to 5 in chroma. Value is 2 or 3 when the Ap horizon is moist and is more than 5.5 when this horizon is dry.

The A2 horizon is destroyed by cultivation in some areas. Where present, the A2 horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value, and is 3 or 4 in chroma. Texture ranges from fine sandy loam to loam.

The B&A horizon is very thin or is in the upper few inches of the Bt horizon as interfingering. The B part has the same range in texture as the B2t horizon, and the A part has the same range as the A2

horizon. The B2t horizon has hues ranging from 10YR to 5YR, value of 4 or 5, and chroma of 3 or 4. The overall texture is loam or gravelly loam that has an average clay content ranging from 18 to 28 percent. Reaction ranges from medium acid to neutral. Clay films cover 5 to 30 percent of ped faces in the B2t horizon, but they are continuous in only a few places.

The C horizon has the same color range as the B2t horizon. Consistence is firm or extremely firm, and structure is strong and platy. The C horizon ranges from fine sandy loam to loam in the gravelly soils.

The Ontario soils formed in deposits similar to those of the moderately well drained Hilton soils and the somewhat poorly drained Appleton soils. The Bt horizon is coarser textured in the Ontario soils than in the Cazenovia or Cayuga soils. The Ontario soils have a Bt horizon but Farmington soils do not, and Ontario soils are more than 3 1/2 feet to rock.

Ontario loam, 2 to 8 percent slopes (OnB).--This soil has the profile described as representative for the series. It normally is on the top of glacial till ridges south of the limestone escarpment. Some of these ridges are used for highways, such as Chestnut Ridge Road, Bear Ridge Road, and Beach Ridge Road. Many areas are cigar shaped or roughly circular. Areas range from about 5 to 50 acres in size. The average-sized area is about 15 acres.

Most commonly included with this soil in mapping are small areas of the finer textured Cazenovia soils and the moderately well drained Hilton soils. Also included are a few areas of coarser textured Bombay soils. In a few areas near Chestnut Ridge and near the village of Gasport, there are inclusions of gravelly Howard soils, silty Dunkirk soils, and sandy Arkport soils. Other inclusions are of Ontario soils that have a silt loam surface layer. Areas that have a sandy, gravelly, or stony surface layer are normally indicated on the soil map by the appropriate symbols.

This is one of the better soils in the county for farming. Most crops can be successfully grown, and alfalfa, corn, and small grains grow especially well. This soil is not used much for fruits and vegetables, partly because of the climate and partly because of the underlying, firm glacial till. Runoff is generally moderate, and there is a hazard of erosion if this soil is cultivated and not protected. This soil responds well to fertilization. Irrigation is needed for best crop growth, especially in dry years or during dry periods.

This soil is easily cultivated and can be plowed fairly early in the spring. Locally, stones may interfere with cultivation. (Capability unit IIe-1; woodland suitability group 2o1)

Ontario loam, 8 to 15 percent slopes (OnC).--The profile of this soil is similar to that described as representative, except that the surface layer is thinner in some places. In many places this soil is on the side slopes of glacial till ridges. In many places it is near the limestone escarpment and slopes to the north. Most areas are roughly oblong and are less than 20 acres in size.

Most commonly included with this soil in mapping are areas of the finer textured Cazenovia or Cayuga soils. Included in a few areas are coarser textured Bombay soils. Inclusions of Hilton or Appleton soils are in drainageways or depressional areas. Commonly included are areas where the surface layer has a texture other than loam and areas that are less than 6 feet to limestone rock. Stony and gravelly soils and bedrock outcrops are normally indicated on the soil map by symbols.

This soil is not so desirable for farming as the gently sloping Ontario soil. Crops are more difficult to plant and to harvest because of slope. Runoff is moderate to rapid, and erosion is a constant hazard. This soil is suited to alfalfa, pasture, some kinds of grain, and trees. Locally, stones or bedrock may be a problem. (Capability unit IIIe-1; woodland suitability group 2o1)

Ontario loam, 8 to 15 percent slopes, eroded (OnC3).--This soil has a profile that differs from that described as representative for the series in that the surface layer is thinner and contains less organic matter. Also, the content of coarse fragments in the surface layer normally is greater. Part of the subsoil is mixed with the original surface layer in many places. Gullies occur, and there are other indications of past erosion. This soil is generally in the same areas as Ontario loam, 8 to 15 percent slopes, and in many places it is closely associated with it. Areas generally are roughly oblong and less than 20 acres in size.

Most commonly included with this soil in mapping are areas of finer textured Cazenovia or Cayuga soils. A few areas have inclusions of Bombay soils. Included areas of Hilton or Appleton soils are in drainageways or depressional areas. Common inclusions are of Ontario soils that have a surface layer other than loam, noneroded areas, and small areas that are less than 6 feet deep to limestone. Stony and gravelly areas and bedrock outcrops are indicated on the soil map by symbols.

This soil has serious limitations for cultivated crops. It is eroded and is susceptible to continuing erosion. Runoff is moderate to rapid. In its present condition, this soil is best suited to hay, pasture, trees, or wildlife. (Capability unit IVe-1; woodland suitability group 2o1)

Ontario loam, 15 to 30 percent slopes, eroded (OnD3).--This soil has a profile that differs from the one described as representative for the series in that the surface layer normally is thinner and contains less organic matter. Also, the content of coarse fragments in the surface layer is generally greater. Gullies or other indications of past erosion can be seen in most places. This soil is located near the limestone escarpment or near areas of glacial till dissected by streams. Most areas are less than 10 acres in size. In many places near dissected areas, this soil occurs in roughly oblong

strips. The dissected areas normally contain one or more drainageways or gullies.

Most commonly included with this soil in mapping are areas of Cayuga and Cazenovia soils. Alluvial land is included in some of the drainageways. The major inclusions are slightly eroded areas, areas that are less than 6 feet deep to rock, and slopes that are less than 15 percent or more than 30 percent. Gravel, stones, bedrock outcrops, and springs are generally indicated on the soil map by symbols.

This soil is not suited to cultivated crops, because of slope and the erosion hazard. It is suited to some hay crops, pasture, trees, or wildlife. It is best to keep this soil in some kind of permanent vegetation. Permeability is somewhat slower than in other Ontario soils. Runoff is generally rapid or very rapid. (Capability unit VIe-1; woodland suitability group 2r2)

Ontario loam, limestone substratum, 0 to 3 percent slopes (OoA).--This soil has a profile similar to that described as representative for the Ontario series but is underlain by limestone bedrock at a depth ranging from 3 1/2 to 6 feet. It is near limestone rock outcrops. Areas range from less than 5 to more than 50 acres in size. They commonly are roughly rectangular, and they parallel the bedrock formation.

Most commonly included with this soil in mapping are areas that are 20 to 40 inches deep to rock. Also included are a few areas of shallow Farmington soils and of Ontario soils that are deeper than 6 feet to rock. Minor inclusions are of the moderately well drained Hilton soils and finer textured Cazenovia or Cayuga soils. Stony or rock outcrop inclusions are indicated on the soil map by symbols.

This soil is suited to most crops grown in the county. It is well suited to hay, grain, and other forage crops, but these crops do not grow as well as on the deeper Ontario soils. This soil is droughty during extended dry periods, especially in areas that have shallower spots included. Stones or bedrock interfere with cultivation of some crops in some areas. For these reasons, vegetables are not frequently grown on this soil. Some fruit, especially cherries and grapes, are grown. Freeze damage to trees may occur because this soil is too far south of Lake Ontario to get the full effect of the lake-moderating temperatures. This soil responds well to fertilization and other good practices of management. Crop response to irrigation is good. (Capability unit I-1; woodland suitability group 2o1)

Ontario loam, limestone substratum, 3 to 8 percent slopes (OoB).--This soil has a profile that differs from that described as representative for the series, mainly by being underlain by bedrock at a depth of 3 1/2 to 6 feet. Also, the surface layer contains a higher percentage of coarse fragments than that in the representative profile. This soil is near limestone areas. The topography is somewhat controlled by the underlying rock. Areas range from less than 5 to more than 50 acres in size. They have no characteristic shape, but many of them are roughly oblong.

Most commonly included with this soil in mapping are areas that are 20 to 40 inches deep to rock. Included in a few places are shallow Farmington soils and a few areas of Ontario soils that are deeper than 6 feet to rock. Minor inclusions are of the moderately well drained Hilton soils and the finer textured Cazenovia or Cayuga soils. Stony or rock outcrop inclusions are generally indicated on the soil map by symbols.

This soil is suited to most crops grown in the county. Hay, grain, and other forage crops grow well. This soil is droughty, especially during extended dry periods and in areas where the underlying limestone rock varies in depth. Locally, stones and bedrock interfere with the cultivation of crops. Because of stones and droughtiness, this soil is generally not used for vegetables. Some fruits, especially cherries, peaches, and grapes, are grown. Freeze damage to trees often occurs, because this soil is too far south of Lake Ontario to get the full benefit of the lake-tempered climate. The hazard of erosion is moderate if this soil is cultivated and not protected.

This soil responds well to fertilization and other good practices of management. Crop response to irrigation is good. (Capability unit IIe-1; woodland suitability group 2o1)

Otisville Series

The Otisville series consists of deep, excessively drained, moderately coarse textured soils. These soils formed in glacial beach deposits that are mainly sand and gravel. They are confined mainly to the former glacial Lake Iroquois beach ridge (U.S. Highway No. 104) and to some offshore bars adjacent to the former beach. They are level to gently sloping.

A representative profile of an Otisville soil has a dark grayish-brown gravelly sandy loam surface layer. It is slightly acid and is 9 inches thick. The subsoil is very friable, brown and reddish-brown gravelly loamy sand. It is medium acid and extends to a depth of 28 inches. The substratum consists of stratified sand and gravel that is loose and slightly acid.

In these rapidly permeable soils, the seasonal high water table seldom rises to within 4 feet of the surface and is usually at a depth of more than 5 feet. The depth of soil available to roots is related to the depth to calcareous material or to the water table, whichever is less. Most roots, however, are in the surface layer where the major sources of plant nutrients are located. The available moisture capacity is low.

These excessively drained, gravelly soils are some of the first soils to be ready for cultivation in the spring, and they respond well to fertilization and irrigation. For these reasons, they are well suited to early truck crops or early fruit. They are well suited to cherries, peaches, and other specialty crops. Unless these soils are irrigated, most crops are damaged by drought during extended dry periods.

Representative profile of Otisville gravelly sandy loam, 0 to 3 percent slopes, in the town of Newfane, about one-half mile east of Ridgewood and 30 feet south of U.S. Highway No. 104 (Ridge Road); cultivated area:

Ap--0 to 9 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam; weak, medium and coarse, granular structure; very friable; abundant fine roots; 20 percent gravel; slightly acid; abrupt, smooth boundary. 6 to 10 inches thick.

B21--9 to 16 inches, brown (7.5YR 5/4) gravelly loamy sand; very weak, fine and medium, subangular blocky structure or single grain; very friable; few fine roots; 25 percent gravel; medium acid; gradual, smooth boundary. 5 to 10 inches thick.

B22--16 to 28 inches, reddish-brown (5YR 4/4) gravelly loamy sand; very weak, fine and medium, subangular blocky structure or single grain; very friable; few fine roots; 30 percent gravel; medium acid; abrupt, wavy boundary. 8 to 24 inches thick.

C--28 to 50 inches, dark-brown (7.5YR 4/2) black (10YR 2/1), yellow (10YR 7/6), and white (10YR 8/2) stratified sand and gravel; structureless; loose; very few roots; approximate average content of gravel 30 percent; slightly acid.

Thickness of the solum ranges from 20 to 40 inches. Calcareous material is at a depth of more than 30 inches. Bedrock is at a depth of more than 40 inches. Content of coarse fragments ranges from 20 to 35 percent between depths of 10 to 40 inches. The principal evidence of alteration in horizons below the surface horizon is the apparent removal of bases.

The Ap horizon ranges from 10YR to 7.5YR in hue and is 2 or 3 in chroma. The Ap horizon ranges from 3 to 5 in value when moist and is more than 5.5 in value when dry. Reaction ranges from strongly acid to neutral.

The B horizon ranges from 5YR to 10YR in hue, is 4 or 5 in value, and is 3 or 4 in chroma. Texture ranges from loamy fine sand to sand, and dominantly the gravelly or nongravelly soils have less than 5 percent clay.

The C horizon generally consists of stratified sand and gravel. Its color is inherited from the minerals in the sand and gravel and ranges from black to white. Content of coarse fragments to a depth of 40 inches is less than 35 percent by volume.

The Otisville soils formed in deposits similar to those of the moderately well drained to somewhat poorly drained Altmar soils. Otisville soils are coarser textured than Howard soils and lack the Bt horizon. They are texturally similar to Colonie soils but contain gravel in the profile and are underlain by gravel.

The Otisville soils in this county are higher in reaction and contain less gravel than Otisville soils that are within the defined range for the series. These characteristics provide a more favorable moisture content and reaction than are normal for the series.

Otisville gravelly sandy loam, 0 to 3 percent slopes (OsA).--This soil has the profile described as representative for the series. It occupies the tops of beach ridges and offshore beach bars. Areas range from less than 5 to more than 50 acres in size. In most places this soil is in long thin strips on beach ridges, where it occurs with the more sloping Otisville soils.

Most commonly included with this soil in mapping are small areas of the moderately well drained Altmar soil of similar material and the sandy Colonie soils. Included in some places are areas of a similar soil that has a gravelly sandy loam subsoil. A few areas of finer textured Howard soils also are included. Other inclusions are of gravelly soils that are less than 40 inches to silt, clay, or glacial till.

This soil is suited to most cultivated and noncultivated crops. It is a droughty soil and has low natural fertility, but it is an especially good soil for early fruit and vegetable crops. Irrigation is needed during dry periods and response is good. Soil blowing may be a problem during dry periods in unprotected areas. Locally, gravel or stones interfere with the cultivation of some crops and are hard on machinery. (Capability unit IIIs-1; woodland suitability group 4s1)

Otisville gravelly sandy loam, 3 to 8 percent slopes (OsB).--This soil has a profile similar to the one described as representative for the series, except that the surface layer contains a higher percentage of gravel and is thinner.

This soil occupies the side slopes of beach ridges and offshore beach bars. In a few places it occupies the whole ridge or bar. Areas range from about 5 to more than 100 acres in size. The areas on the offshore beach bars are roughly oblong or long and thin, and those along a large beach ridge are cigar shaped.

Most commonly included with this soil in mapping are areas of sandy Colonie soils. Also included is a soil that is similar to this Otisville soil, except that the surface layer is gravelly sandy loam. Other inclusions are areas of finer textured, gravelly Howard soils. Some areas, especially those on offshore bars, have inclusions of soils that are less than 40 inches to silt, clay, or glacial till.

This soil is suited to most cultivated and noncultivated crops. It is droughty and has low natural fertility, but it is especially well suited to early fruit and vegetables. Response to irrigation is good.

Runoff is slow to moderate. Erosion by wind or water may be a problem in areas unprotected by vegetation. Locally, gravel or stones interfere with the cultivation and growth of some crops and are hard on machinery. (Capability unit IIIs-1; woodland suitability group 4s1)

Ovid Series

The Ovid series consists of deep, somewhat poorly drained soils. These soils formed in calcareous glacial till. The glacial till is generally modified somewhat by glacial lake sediments of silt and clay. Ovid soils are level to gently sloping. Slopes range from 0 to 8 percent.

A representative profile of an Ovid soil has a dark grayish-brown silt loam surface layer. The surface layer contains less than 5 percent stone fragments, is neutral, and is 6 inches thick. It is underlain by friable, pale-brown silt loam that is distinctly mottled and contains less than 5 percent stone fragments. This layer is neutral and 5 inches thick. The subsoil is between depths of 11 and 24 inches. It consists of firm, mottled, reddish-brown silty clay loam. The subsoil contains between 5 and 10 percent stone fragments and is neutral. The substratum is at a depth of 24 inches. It consists of very firm, reddish-brown heavy loam. It contains about 15 percent stone fragments and is calcareous.

These soils have a seasonal high water table that rises to just below the surface layer early in spring and in excessively wet periods. The water table is usually perched above the moderately slowly permeable to slowly permeable subsoil and the slowly permeable glacial till. Roots are confined mainly to the surface layer early in spring. As the water table falls, some roots extend downward to the very firm, calcareous glacial till, but most roots are confined to the uppermost 20 inches of soil. Because of the fairly shallow rooting depth, the available moisture capacity is only moderate.

Representative profile of Ovid silt loam, 0 to 2 percent slopes, 300 yards east of Miller Road and about one-half mile south of State Route 31; idle area:

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, light brownish-gray (10YR 6/2) to light-gray (10YR 7/2) when dry; moderate, fine, subangular blocky structure; friable; less than 5 percent coarse fragments; abundant roots; neutral; abrupt, smooth boundary. 5 to 8 inches thick.

A2--6 to 11 inches, pale-brown (10YR 6/3) silt loam; few, medium, distinct, strong-brown (7.5YR 5/6) to yellowish-brown (10YR 5/6) mottles; weak, fine to very fine, subangular blocky structure; friable; less than 5 percent coarse fragments; plentiful roots; neutral; clear, wavy boundary. 4 to 6 inches thick.

B2t--11 to 20 inches, reddish-brown (5YR 4/3) silty clay loam; few, fine, faint, reddish-brown (5YR 4/4) mottles and distinct, yellowish-red (5YR 4/6) mottles, and few, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, angular blocky structure in weak medium prisms; firm; dark reddish-gray (5YR 4/2) ped coats; clay films evident in pores; some greenish-gray (5GY 5/1) ped coats in lower part; few roots; between 5 and 10 percent coarse fragments; neutral; clear, wavy boundary. 6 to 20 inches thick.

B3--20 to 24 inches, reddish-brown silty clay loam, similar to B2t horizon but weakly calcareous; clear, wavy boundary. 0 to 5 inches thick.

C--24 to 50 inches, reddish brown (5YR 4/3) heavy loam; moderate, medium, platy structure; very firm; approximately 15 percent coarse fragments; calcareous.

Thickness of the solum ranges from 20 to 36 inches. Depth to carbonates ranges from 18 to 36 inches. Bedrock is at a depth of more than 40 inches. The solum is medium acid to mildy alkaline. Content of coarse fragments ranges from 1 to 25 percent and typically increases with depth. A chroma of 2 or less is dominant on ped faces, but chroma of more than 2 is dominant on the matrix from top of the A2 horizon to a depth of 30 inches.

The Ap horizon is 10YR or 7.5YR in hue and 2 or 3 in chroma. The Ap horizon is 3 or 4 in value when moist and more than 5.5 when dry. The A2 horizon is absent in some profiles. Where present, the A2 horizon is 10YR or 7.5YR in hue, ranges from 4 to 6 in value, and is 2 or 3 in chroma. Mottles are distinct or prominent. The Bt horizon has hues ranging from 7.5YR to 2.5YR, value of 4 or 5, and chroma of 3 or 4. Ped faces have a dominant chroma of 2 or less. The clay content of the Bt horizon averages between 28 and 35 percent. The Bt horizon is generally clay loam or silty clay loam. Carbonates are present in the lower part of some, but not all, profiles.

The C horizon above a depth of 40 inches is comparable in color to the Bt horizon, but its texture is generally slightly coarser. Structure is typically platy.

Ovid soils formed in deposits similar to those of the moderately well drained to well drained Cazenovia soils. Ovid soils are wetter than Hilton soils and have a finer textured Bt horizon. They have a coarser textured Bt horizon than Churchville soils. Ovid soils have a coarser textured Bt horizon than Lockport soils and are more than 3 1/2 feet to rock. Ovid soils are better drained than Sun soils.

Ovid silt loam, 0 to 2 percent slopes (OvA).--This soil has the profile described as representative for the series. It is in large, nearly level areas that normally are near the beds of old postglacial lakes. These areas are at a slightly higher elevation than the lakebed proper. Areas range from about 5 to more than 100 acres in size. The average-sized area is 20 acres or more. The areas normally are roughly oblong.

Most commonly included with this soil in mapping are areas of Churchville, Cazenovia, Cayuga, and Appleton soils. Churchville and Cayuga soils are included in areas where clay caps the underlying glacial till. Cazenovia soils are similar to this Ovid soil but are better drained. Appleton soils are similar to this Ovid soil in drainage but are

coarser textured. Brown inclusions of similarly textured soils are common north of the limestone escarpment. Some areas near the limestone escarpment have inclusions of soils that are moderately deep to limestone. Gravelly or stony areas are generally indicated on the soil map by the appropriate symbols.

This soil is suited to grain, hay, pasture, and trees. Under good management, it can be used for other crops such as vegetables and fruit. Dominant management needs on this soil are adequate systems of surface and subsurface drainage. The maintenance of tilth may be difficult if this soil is cropped intensively. Locally, gravel or stones hinder cultivation and the growth of certain crops. (Capability unit IIIw-1; woodland suitability group 3w2)

Ovid silt loam, 2 to 6 percent slopes (OvB).--This soil has a profile similar to that described as representative for the series, except that the surface layer is thinner in some places, more coarse fragments are in the surface layer in many places, and the subsoil is generally directly under the plow layer. This soil occupies undulating areas near beds of old glacial lakes. In many places it occurs along drainageways where the landscape is dissected. Areas range from about 5 to 50 acres in size. The average-sized area is about 10 acres. In many places the areas are roughly oblong.

Most commonly included with this soil in mapping are areas of Cazenovia, Cayuga, and Churchville soils. The Cazenovia soil is similar to this Ovid soil but better drained. The Cayuga soil is finer textured in the upper part and better drained, and the Churchville is finer textured. Coarser textured Hilton and Appleton soils are minor inclusions. Brown inclusions of similarly textured soils are common north of the limestone escarpment. Some areas near the limestone escarpment have inclusions of soils that are moderately deep to limestone. Gravelly or stony areas are generally indicated on the soil map by the appropriate symbols.

This soil is suited to grain, hay, pasture, and trees. Under good management, it can be used for vegetables, fruit, and other crops. Dominant management needs are surface and subsurface drainage. Some erosion control measures are necessary if this soil is used intensively. In intensively cultivated areas the maintenance of good tilth is difficult. Locally, gravel or stones hinder the growth and cultivation of certain crops. (Capability unit IIIw-5; woodland suitability group 3w2)

Ovid silt loam, limestone substratum, 0 to 3 percent slopes (OwA).--This soil differs from Ovid silt loam, 0 to 2 percent slopes, because it is underlain by limestone bedrock at a depth ranging from 3 1/2 to 6 feet. In most places this soil contains larger coarse fragments than Ovid silt loam, 0 to 2 percent slopes. This soil occupies areas near the limestone escarpment or other areas where limestone bedrock is at a depth of 3 1/2 to 6 feet. Areas range from about 5 to 50 acres in size. They are roughly oblong in most places.

Commonly included with this soil in mapping are areas of Churchville soils that occur where lake-laid clay caps the glacial till. Commonly included are small areas of a soil that is less than 3 1/2 feet to bedrock. In other included areas bedrock is at a depth of more than 6 feet. In a few places areas of the coarser textured Appleton soils are included. In some included areas south of the villages of Gasport and Middleport, the soil is underlain by gray shale rather than hard dolomitic limestone.

This soil is not so well suited to crops as Ovid silt loam, 0 to 2 percent slopes. In many places it has slightly finer texture, more stones, and bedrock within 6 feet of the surface. It can be used for most crops grown in the area, but it is not so well suited as the deeper Ovid soils. Vegetables or fruit generally are not suited. Drainage is needed but is difficult to establish in many places because of the stones and bedrock. (Capability unit IIIw-1; woodland suitability group 3w2)

Ovid silt loam, limestone substratum, 3 to 8 percent slopes (OwB).--This soil has a profile that differs from the one described as representative for the series mainly because bedrock is at a depth ranging from 3 1/2 to 6 feet. In most places this soil contains larger coarse fragments than the soil with the profile described as representative. It occupies areas near the limestone escarpment or other areas where the limestone bedrock is at a depth of 3 1/2 to 6 feet. Areas range from about 5 to 50 acres in size. They generally are roughly oblong and are parallel to the escarpment areas.

Included with this soil in mapping are some fairly large areas of Churchville soils where lake-laid clay caps the glacial till. Commonly included are small areas that are less than 3 1/2 feet to bedrock. In some places soils that are more than 6 feet to rock are included. The better drained Cazenovia, Hilton, and Cayuga soils are minor inclusions. Some areas of this soil south of the villages of Gasport and Middleport are underlain by gray shale rather than hard dolomitic limestone.

This soil is not so well suited to crops as Ovid silt loam, 0 to 2 percent slopes. In many places, texture is slightly finer, the soil contains more stones, and bedrock is within 6 feet of the surface. This soil can be used for most crops grown in the area but is not so well suited as the deeper Ovid soils. Vegetables or fruits generally are not suited. Drainage is needed but, in many places, is difficult to establish because of stones and bedrock Also, there is a moderate hazard of erosion if this soil is cultivated and not protected. (Capability unit IIIw-5; woodland suitability group 3w2)

Phelps Series

The Phelps series consists of deep, moderately well drained, medium-textured, gravelly soils. These soils formed in neutral to mildly alkaline glacial outwash and glacial beach deposits of sand and

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gravel. The major areas in Niagara County are north of U.S. Highway No. 104 (Ridge Road) in the towns of Wilson, Newfane, Hartland, and Somerset. Slopes range from 0 to 5 percent.

A representative profile of a Phelps soil has a very dark grayish-brown, neutral gravelly loam surface layer 8 inches thick. This layer is underlain by a friable, brown gravelly fine sandy loam layer that is neutral and extends to a depth of 17 inches. The subsoil is a firm, sticky, brown to dark-brown heavy gravelly loam that is distinctly mottled with olive and olive gray. It is neutral and extends to a depth of 30 inches. The substratum is at a depth of 30 inches and is neutral to mildly alkaline. It consists of loose, brown, stratified fine sand and gravel.

The seasonal high water table rises to within 18 inches of the surface early in spring and in other excessively wet periods. The water table in this soil generally fluctuates and usually remains within 4 feet of the surface throughout the year. As the water table falls, roots can extend downward to the calcareous substratum or to the water table, whichever is nearer the surface. These soils have a moderate available moisture capacity. Locally, gravel may hinder the cultivation of certain crops and may be hard on machinery.

Representative profile of Phelps gravelly loam, 0 to 5 percent slopes, in the town of Hartland, 3 miles north of Johnson Creek on east side of Johnson Creek Road; cultivated area:

Ap--0 to 8 inches, very dark grayish brown (10YR 3/2) gravelly loam, dark grayish-brown (10YR 4/2) when rubbed; moderate to strong, fine, granular structure; friable; abundant roots; neutral; abrupt, smooth boundary. 8 to 10 inches thick.

A2--8 to 17 inches, brown (10YR 5/3) gravelly fine sandy loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, fine to very fine, subangular blocky structure; friable; 20 to 25 percent gravel; plentiful roots; neutral; abrupt, wavy boundary. 0 to 9 inches thick.

B2t--17 to 30 inches, brown to dark-brown (10YR 4/3) heavy gravelly loam; common, medium, distinct, olive (5Y 5/4) and olive-gray (5Y 5/2) mottles; weak, fine, subangular blocky structure or massive; sticky; interfingering of yellowish-brown (10YR 5/4) A2 material in upper 3 to 4 inches; 25 percent gravel; clay films and clay bridges prominent; few roosts; neutral; clear, wavy boundary. 10 to 20 inches thick.

C--30 to 50 inches, brown (7.5YR 5/4), stratified fine sand and gravel; loose; neutral to mildly alkaline.

Thickness of the solum ranges from 24 to 36 inches and corresponds well with depth to carbonates. Bedrock is more than 40 inches from the surface.

The Ap horizon is 10YR or 7.5YR in hue and 2 or 3 in chroma. Value is 3 or 4 when this horizon is moist and is more than 5.5 when it is dry. When material is rubbed, value is more than 3. The solum ranges from neutral to medium acid. The A2 horizon is absent in some places. The A2 horizon is 10YR or 7.5YR in hue, 5 or 6 in value, and 2 to 4 in chroma. The A2 horizon ranges from fine sandy loam to silt loam in gravelly and nongravelly soils. Reaction ranges from neutral to medium acid.

The Bt horizon has hues ranging from 7.5YR to 2.5YR, value of 4 or 5, and chroma of 3 or 4. Mottles in the Bt horizon are mostly of higher chroma, but some mottles have a chroma of 2. The A horizon interfingers into the upper part of the Bt horizon. The Bt horizon ranges from gravelly loam to gravelly silt loam. Gravel content is less than 35 percent, and average clay content ranges from 18 to 27 percent. The Bt horizon contains clay films and typically has some clay bridging between sand grains or pebbles. A B3 horizon occurs in some places.

The C horizon typically consists of stratified sand and gravel, but it includes strata of gravelly loam or gravelly silt loam in some places. Color has about the same range as for the Bt horizon to a depth of 40 inches, but the minerals in the sand and gravel may impart varying colors. The C horizon is calcareous in many places. It ranges from neutral to moderately alkaline.

The Phelps soils formed in deposits similar to those of the well-drained to somewhat excessively drained Howard soils and the somewhat poorly drained Fredon soils. Texture is finer in the Phelps soils than in the Altmar soils. Phelps soils are similar to gravelly Hilton and Cazenovia soils in the upper part but are underlain by gravel instead of glacial till.

Phelps gravelly loam, 0 to 5 percent slopes (PsA).--This soil occupies intermediate areas between the better drained Howard soils at a slightly higher elevation and the slightly lower, wetter Fredon soils. Areas range from about 5 to 50 acres in size and are mostly irregular in shape.

Most commonly included with this soil in mapping are areas of Howard and Fredon soils that formed in deposits similar to those of this Phelps soil. In some areas coarser textured Otisville or Altmar soils are included. Other commonly included soils are similar to this Phelps soil in the upper part but are underlain by glacial till or silt and clay at a depth of less than 40 inches. Some included areas underlain by silt and clay are near the Niagara River in the towns of Lewiston and Porter, near Phillips Road in northern part of Newfane, and near Seaman Road in northern part of Hartland. Inclusions that have a sandy surface layer, as well as wet spots, are normally indicated on the soil map by the appropriate symbols.

This soil can be used for crops, pasture, or trees. It is suited to most crops grown in the county. Unless this soil is drained, planting is briefly delayed. In local areas gravel may interfere with cultivation and be hard on machinery. Areas that do not contain an excess amount of gravel in the surface layer are excellent for growing vegetables. Both drainage and irrigation may be needed

for best crop growth. (Capability unit IIw-2; woodland suitability group 2o1)

Raynham Series

The Raynham series consists of deep, somewhat poorly drained, medium-textured soils. These soils formed in dominantly calcareous, silty sediments that were deposited in glacial Lake Tonawanda. They are level to gently sloping and occur within the glacial lake area. In Niagara County these soils are within 3 miles of Tonawanda Creek, mainly near the city of North Tonawanda. Slopes range from 0 to 6 percent.

A representative profile of a Raynham soil has a dark grayish-brown silt loam surface layer. It is medium acid and 8 inches thick. The upper part of the subsoil is friable, light olive-brown silt loam that is distinctly mottled. It contains pockets of heavy silt loam, is slightly acid, and extends to a depth of 25 inches. The lower part of the subsoil consists of very friable, light olive-brown loamy very fine sand to very fine sandy loam. It contains many distinct mottles, is neutral, and extends to a depth of 38 inches. The calcareous substratum consists of friable, light olive-brown very fine sandy loam that has discontinuous pockets of light-gray and light brownish-gray silt and very fine sand.

The seasonal high water table rises to within 1 foot of the surface early in spring and in other excessively wet periods. A few areas are ponded for short periods. Roots are confined to the surface layer early in spring. As the growing season progresses and the water table falls, roots extend to the water table or calcareous substratum, whichever is shallower. Most roots, however, are confined to the upper 20 inches. The available moisture capacity is moderate.

If drainage is adequate, these soils are suited to most crops grown in the county. They are well suited to some vegetables.

Representative profile of Raynham silt loam, 0 to 2 percent slopes, in the town of Wheatfield, about one-fourth mile west of Tonawanda Creek Road and 50 feet north of Walck Road; idle field:

Ap--0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine and medium, granular structure; friable; abundant fine roots; medium acid; abrupt, smooth boundary. 6 to 9 inches thick.

B2--8 to 25 inches, light olive-brown (2.5Y 5/4) silt loam that has a few pockets of heavy silt loam; many (about 30 percent), fine, distinct, grayish-brown (2.5Y 5/2) mottles and coarse, distinct, yellowish-brown (10YR 5/6) mottles; moderate, thin, platy structure within weak, medium, subangular blocky structure; friable; grayish-brown (10YR 5/2) ped faces; abundant fine roots in upper part, plentiful fine roots in lower part; slightly acid; abrupt, smooth boundary. 12 to 20 inches thick.

B3--25 to 38 inches, light olive-brown (2.5Y 5/4) loamy very fine sand to very sandy loam; many (about 30 percent), coarse, distinct, yellowish-brown (10YR 5/6) and faint, grayish-brown (2.5Y 5/2) mottles; very weak, thin, platy structure; very friable; grayish brown (2.5Y 5/2) ped coats; few fine roots; neutral; clear, wavy boundary. 6 to 18 inches thick.

C--38 to 50 inches, light olive-brown (2.5Y 5/4) very fine sandy loam and light-gray (10YR 6/1) and light brownish-gray (10YR 6/2) discontinuous layers of silt and fine sand; many (about 35 percent), coarse, prominent, reddish-yellow (7.5YR 6/6) and faint, grayish-brown (2.5Y 5/2) mottles; very weak, medium, platy structure; friable; very few roots; calcareous.

Thickness of the solum ranges from 25 to 40 inches and corresponds to the depth to carbonates. The profile is generally free of coarse fragments, but in a few places a few pebbles are on the surface or in the profile. Texture ranges from loamy very fine sand to silt loam in the solum and from very fine sand to silt loam in the C horizon. Between depths of 10 to 40 inches, the soil material is less than 18 percent clay and less than 15 percent sand coarser than very fine sand. The solum ranges from medium acid to mildly alkaline.

The Ap horizon is 10YR in hue and 2 in chroma. Value is 4 or 3 when the Ap horizon is moist and is more than 5.5 when this horizon is dry.

The matrix of the B horizon is mainly 10YR and 2.5Y in hue, but the range is from 5Y to 7.5YR. Value of the matrix is 4 or 5, and chromas range from 2 to 4. The mottles in ped interiors normally have both high and low chromas. Not more than 60 percent of the B horizon has a chroma of 2. Ped faces have dominant chromas of 2 or less and are generally free of mottles. The B horizon ranges from loamy very fine sand to heavy silt loam. The finest texture generally is directly below the Ap horizon, and texture is coarser as depth increases.

The C horizon is stratified silt and very fine sand in many places. It normally contains less clay than the B horizon. Colors are in the same range as for the B horizon, except that the C horizon has pockets or centers in which mottles have a chroma of 1.

The Raynham soils in this county are calcareous nearer the surface than the defined range for the series. This difference does not alter the usefulness and behavior of the Raynham soils in this county.

The Raynham soils are better drained than the Canandaigua soils. The B horizon in the Raynham soils is coarser textured than that in the Rhinebeck soils. Raynham soils are similar to Minoa soils in drainage but have a higher proportion of silt and very fine sand. They lack the Bt horizon of Niagara soils.

Raynham silt loam, 0 to 2 percent slopes (RaA).--This soil has the profile described as representative

for the series. It is in areas that were occupied by glacial Lake Tonawanda. It occurs on slightly higher landscapes in close association with poorly drained Canandaigua soils. Areas are generally more than 10 acres in size, but some are more than 100 acres. Areas generally are irregular in shape, but some are oblong and parallel Tonawanda Creek.

Most commonly included with this soil in mapping are areas of poorly drained Canandaigua soils. Also included are areas of coarser textured Minoa soils and finer textured Rhinebeck soils. Other inclusions, near the southern boundary of the Raynham soils, are areas where the silty sediments are underlain by reddish clay. In these areas there are inclusions of Rhinebeck soils, thick surface variant, in many places.

If undrained, this soil is suited to hay, pasture, trees, or other uses of low intensity. If adequately drained and fertilized, the soil can be used for most of the cultivated crops grown in the county. It is excellent for growing some kinds of vegetables. Suitability for fruit is questionable because of the geographic location of this soil. Drainage outlets may be difficult to establish. Also, maintaining good tilth is difficult if this soil is used intensively. (Capability unit IIIw-1; woodland suitability group 3w2)

Raynham silt loam, 2 to 6 percent slopes (RaB).--This soil has a profile similar to that described as representative for the series, except that the surface layer is thinner or finer textured in some places. This soil is in the same general areas as Raynham silt loam, 0 to 2 percent slopes. It normally is near drainageways where erosion is starting to dissect the landscape. Areas range from about 5 to 25 acres in size. They are in fairly narrow strips along drainageways.

Commonly included with this soil in mapping are Canandaigua or Wayland soils in the lowest part of drainageways. At higher elevations areas of Galen or Collamer soils are included in some places. Other inclusions are areas of Niagara soils. The largest inclusion is of the nearly level Raynham soil.

This gently sloping soil has about the same uses and needs about the same management as the nearly level Raynham soil, though in most places this gently sloping soil is more difficult to manage because of slope and drainageways. Some erosion control measures are needed in intensively cultivated areas. Drainage may be easier on this soil because most areas have adequate outlets. (Capability unit IIIw-5; woodland suitability group 3w2)

Rhinebeck Series

The Rhinebeck series consists of deep, somewhat poorly drained, moderately fine textured and medium-textured soils. These soils formed in calcareous lacustrine deposits of silt and clay. They are nearly level to gently sloping and occur in the basins of old glacial lakes. Slopes range from 0 to 6 percent.

A representative profile of a Rhinebeck soil has a very dark grayish brown silt loam surface layer that is neutral and 8 inches thick. This layer is underlain by friable, grayish-brown silt loam 2 inches thick. It is neutral and contains many, prominent mottles. The subsoil is between depths of 10 and 23 inches. It consists of firm, plastic, dark grayish-brown heavy silty clay loam that is mottled and neutral. Next is a very firm, calcareous substratum that consists of brown silty clay loam and thin lenses of silt. It has many mottles and some thin, pinkish-white streaks of lime.

The seasonal high water table rises to within 1 foot of the surface early in spring and in excessively wet periods. Some areas are ponded for short periods. The water table is generally perched above the slowly permeable subsoil and substratum.

Roots are restricted to the dark plow layer early in spring. As the season progresses and the water table drops, roots can extend downward to the calcareous substratum. Most roots, however, are confined to the uppermost 20 inches of soil. The available moisture capacity is moderate.

Representative profile of Rhinebeck silt loam, 0 to 2 percent slopes, in the town of Porter, 1 mile west of Ransomville Road and 800 yards south of State Route 18 (Lake Road); cultivated area:

Ap--0 to 8 inches, very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when rubbed; weak, medium and fine, granular structure; very friable; abundant, fine roots; neutral; abrupt, smooth boundary. 7 to 10 inches thick.

A2--8 to 10 inches, grayish-brown (2.5Y 5/2) silt loam; many (about 50 percent), fine and medium, prominent, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; abundant fine roots; neutral; clear, broken boundary. 0 to 4 inches thick.

B2t--10 to 23 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam; many (about 50 percent), fine, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, subangular blocky structure within moderate, coarse, prismatic structure; firm, plastic; dark-gray (10YR 4/1) coats on prism faces; clay films are nearly continuous on ped faces and fairly thick in pores; material from A2 horizon interfingers around peds in the upper part of B2t horizon; neutral; plentiful fine roots; clear, wavy boundary. 4 to 26 inches thick.

C--23 to 60 inches, brown (7.5YR 5/2) silty clay loam and thin lenses of silt; many (about 50 percent), fine, distinct, strong-brown (7.5YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; moderate, medium and thick, platy structure; strong, coarse, prismatic structure in the upper part; very firm; gray (5YR 5/1) and greenish-gray (5GY 5/1) coats on prism faces; thin, pinkish-white (7.5YR 8/2) streaks and patches of lime;

roots few in upper part and decrease to none with depth; calcareous.

Thickness of the solum ranges from 20 to 40 inches and corresponds well with depth to carbonates. The solum is neutral to slightly acid. Coarse fragments are typically absent, but up to 5 percent may occur in any horizon. Bedrock is at a depth of more than 40 inches and typically is deeper than 6 feet.

The Ap horizon is 10YR or 2.5Y in hue and 3 or 2 in chroma. Value is 4 or 3 when the Ap horizon is moist, but is more than 5.5 when the horizon is dry and is 4 or more when the material is rubbed. Texture ranges from silt loam to silty clay loam. The A2 horizon is absent in some places. If present, the A2 horizon ranges from 10YR to 5Y in hue, is 5 or 6 in value, and is 2 or 3 in chroma. Texture ranges from silt loam to silty clay loam.

The Bt horizon has hues ranging from 10YR to 5Y, value of 4 or 5, and chroma ranging from 2 to 4. A chroma of 2 does not dominate more than 59 percent of the Bt horizon. Ped coats and prism faces have a dominant chroma of 2 or less. Texture ranges from silty clay loam to clay. The average clay content is between 34 and 55 percent. Interfingering of A2 material into the upper part of the Bt horizon is interpreted as degradation.

The C horizon ranges from 7.5YR to 5Y in hue, is 4 or 5 in value, and ranges from 1 to 3 in chroma. This horizon ranges from silt loam to silty clay, but it contains strata of sand, silt, or clay in some places. The C horizon typically has thick, platy structure that was imparted by the varved lake deposits.

The Rhinebeck soils formed in deposits similar to those of the moderately well drained to well drained Hudson soils and the poorly drained to very poorly drained Madalin soils. Rhinebeck soils are similar to Churchville soils in texture and drainage but lack the underlying glacial till that is characteristic of Churchville soils. Rhinebeck soils are wetter than Cayuga soils and do not have glacial till within a depth of 3 1/2 feet. The Bt horizon of Rhinebeck soils is finer textured than that of the Niagara soils. Rhinebeck soils have a Bt horizon, but Raynham soils do not. They are better drained than Canandaigua soils, which do not have a Bt horizon.

Rhinebeck silt loam, 0 to 2 percent slopes (RbA).--This soil has the profile described as representative for the series. It occupies broad, nearly level areas within glacial lake plains. Areas are fairly large in most places and are more than 100 acres in size. The areas are roughly oblong in many places. Most of the acreage of this soil is north of the limestone escarpment. Much of it is in the towns of Porter, Wilson, and Somerset within 5 miles of Lake Ontario.

Most commonly included with this soil in mapping are areas of Niagara soils that contain less clay in the subsoil than this Rhinebeck soil. Also included are areas of Hudson or Collamer soils on knolls and at higher elevations and of poorly drained Madalin or Canandaigua soils in depressions and along drainageways. Cayuga or Churchville soils are included in areas where the lacustrine deposits are moderately deep over glacial till. The Ovid soils are included where the lacustrine deposits have been mixed with glacial till or glacial beach deposits. Other inclusions are sand or gravel smears, which are normally indicated on the soil map by the appropriate symbol.

This soil is suited to most crops grown in the county if drainage is adequate. Undrained areas are better suited to some grains, hay, pasture, trees, or wildlife than to row crops. Because the soil is only a short distance from Lake Ontario, this soil is used intensively for fruit, especially for apples, pears, and grapes. Alfalfa generally does well because of the high lime content of the soils.

Because this soil is plastic when wet and is cloddy, hard, or crusty when dry, cultivation at the proper moisture content is needed. Machinery bogs down if used when this soil is wet. Seed germination is generally poor if this soil is cultivated and planted when dry. Maintenance of good tilth is difficult in intensively cultivated areas. Runoff is slow because this soil is nearly level. (Capability unit IIIw-2; woodland suitability group 3w1)

Rhinebeck silt loam, 2 to 6 percent slopes (RbB).--This soil has a profile similar to that described as representative for the series, except that the surface layer is likely to be thinner or finer textured. This soil is in the same general areas as the nearly level Rhinebeck silt loam. It occupies the slope breaks and, in many places, is along drainageways. Areas are generally small but in some places are as much as 50 acres or more in size. They are roughly oblong in many places.

Most commonly included with this soil in mapping are areas of Hudson or Collamer soils on knolls. Madaline or Canandaigua soils are included in depressions or in the lowest parts of the drainageways. Also included, in some places, are silty Niagara soils. Other inclusions are of Cayuga, Churchville, and other soils that are underlain by glacial till. In a few included areas of Cazenovia or Ovid soils, material has been mixed with glacial till or glacial beach deposits. Some included areas are severely eroded. Areas of sand or gravel smears are normally indicated on the soil map by the appropriate symbols.

This soil is suited to about the same use and requires about the same management as the nearly level Rhinebeck silt loam, but drainage is normally easier to establish on this soil because it is more sloping. Erosion is a hazard in some places, especially if this soil is intensively cultivated. Runoff is moderate to moderately rapid. (Capability unit IIIw-5; woodland suitability group 3w1)

Rhinebeck silty clay loam, sandy substratum, 0 to 2 percent slopes (RhA).--This soil has a profile

similar to that described as representative for the series, but it has a finer textured surface layer and a coarser textured substratum. Most profiles of this soil are free of coarse fragments, but the profile described as representative has some fragment in the surface layer or in layers under it.

This soil occurs in the southern part of Niagara County, generally within 3 miles of Tonawanda Creek. It is in broad, flat areas that were occupied by glacial Lake Tonawanda. Areas are generally large, some more than 500 acres in size. They are normally roughly oblong and parallel to Tonawanda Creek.

Most commonly included with this soil in mapping are areas of silty Raynham soils and wetter Canandaigua soils. A few areas have inclusions of Rhinebeck soils, thick surface variant. Included areas of Madalin or Canandaigua soils are in wet spots or along drainageways. In some included areas, the fine-textured surface deposit is less than 20 inches thick. Other inclusions have sand layers above a depth of 40 inches. Many included areas have a silt loam surface layer rather than one of silty clay loam.

Undrained areas of this soil are suited to some grains, hay, pasture, trees, or wildlife. If drainage is adequate, most cultivated crops can be grown, but this soil is not suited to most fruit crops, because of its geographic location. Because of the moderately fine textured surface layer, this soil is not suited to most vegetable crops. It needs to be cultivated at the proper moisture content. If this soil is plowed and cultivated when wet, hard clods or crusty surfaces form. Seed germination is generally poor if seeds are planted when this soil is too dry. Some areas are ponded early in spring and in excessively wet periods. Permeability is moderately slow in the surface layer and slow in the subsoil. Runoff is slow because this soil is nearly level. (Capability unit IIIw-2; woodland suitability group 3w1)

Rhinebeck silty clay loam, sandy substratum, 2 to 6 percent slopes (RhB).--This soil has a profile similar to that described as representative for the series, except that the surface layer is finer textured and a coarser textured substratum is below a depth of 40 inches. This soil is in the southern part of Niagara County, normally within 2 miles of Tonawanda Creek. It occurs along drainageways and other areas that were occupied by glacial Lake Tonawanda. Areas are generally less than 20 acres in size. They normally are long narrow strips bordering drainageways.

Most commonly included with this soil in mapping are poorly drained Wayland, Madalin, or Canandaigua soils in the lowest part of the drainageways. Other large inclusions are of the nearly level Rhinebeck soil.

In undrained areas this gently sloping soil is suited to some grains, hay, pasture, trees, or wildlife. If drainage is adequate, most cultivated crops can be grown. Because of its geographic location, this soil is not well suited to most fruit crops. Because the surface layer is moderately fine textured, vegetable crops do not grow well. If this soil is plowed and cultivated when wet, hard clods or crusty surfaces form. Seed germination is generally poor if this soil is planted when too dry. The hazard of erosion is serious if the soil is cultivated and not protected. (Capability unit IIIw-5; woodland suitability group 3w1)

Rhinebeck Series, Thick Surface Variant

The Rhinebeck series, thick surface variant, consists of deep, somewhat poorly drained, medium-textured soils. These soils formed in lake deposits in which the dominant material is silt to a depth of 26 to 40 inches. The upper part of these soils is similar to that of Raynham soils, but the lower part has a high clay content similar to that of the Rhinebeck soils.

Soils of the Rhinebeck series, thick surface variant, are nearly level and occur in areas that were occupied by postglacial lakes. In Niagara County, there are two major areas. One is just south of the village of Bergholtz, and the other is near Dunnigan Road, south of the city of Lockport. Slopes are less than 3 percent.

A representative profile of a Rhinebeck soil, thick surface variant, has a very dark grayish-brown silt loam surface layer 9 inches thick. The upper part of the subsoil is friable, mottled, light olive-brown silt loam that is neutral. The lower part of the subsoil begins at a depth of 17 inches. It consists of very friable, light olive-brown very fine sandy loam to light silt loam that has many mottles and is neutral. The calcareous substratum is at a depth of 24 inches. It consists of firm, reddish-brown, silty clay streaked with pinkish-gray lime.

The seasonal high water table rises to within a foot of the surface early in spring and in other excessively wet periods. Some areas are ponded for short periods. The water table is generally perched above the slowly permeable, fine-textured lower part of the subsoil. Early in the growing season, roots are confined to the surface layer. As the growing season progresses and the water table is lowered, roots extend downward to the water table or to the calcareous substratum, whichever is deeper. Most roots are confined to the uppermost 20 inches of soil. The available moisture capacity is moderate.

Representative profile of Rhinebeck silt loam, thick surface variant, in the town of Wheatfield, about 350 yards southwest of sharp bend in Sy Road and 1 1/2 miles south of the village of Bergholtz; idle field:

Ap--0 to 9 inches, very dark grayish brown (10YR 3/2) silt loam, light brownish gray (2.5Y 6/2) when dry; moderate, fine and very fine, subangular blocky structure; friable; abundant fine roots; neutral; abrupt, smooth boundary.

B21--9 to 17 inches, light olive-brown (2.5Y 5/4) silt loam; many (about 35 percent), faint, grayish-brown (2.5Y 5/2) and distinct, yellowish-brown (10YR 5/6) mottles; moderate, thin, platy structure within weak, prismatic structure; friable; grayish-brown (2.5Y 5/2) ped

faces; some tonguing of Ap material along root and worm channels; abundant fine roots; neutral; gradual, wavy boundary. 6 to 12 inches thick.

B22--17 to 24 inches, light olive-brown (2.5Y 5/4) very fine sandy loam to light silt loam; many (about 50 percent), coarse, faint, grayish-brown (2.5Y 5/2) mottles and coarse, distinct, yellowish-brown (10YR 5/6) mottles; very weak, medium, subangular blocky structure within weak, prismatic structure; very friable; grayish-brown (2.5Y 5/2) ped faces; plentiful fine roots; neutral or calcareous; abrupt, smooth boundary. 5 to 10 inches thick.

IIB23t--24 to 32 inches, reddish-brown (5YR 4/3) silty clay; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, blocky structure; firm; many, pinkish-gray (5YR 7/2) lime streaks; greenish-gray (5GY 5/1) ped faces in upper part; few roots; calcareous. 8 to 12 inches thick.

Thickness of the solum ranges from 26 to 40 inches and corresponds well with depth to the underlying calcareous, red clay. Coarse fragments are generally absent to a depth of 40 inches. The solum ranges from medium acid to mildly alkaline. Bedrock is at a depth of more than 40 inches and, in most places, is below 6 feet.

The Ap horizon is 10YR or 2.5Y in hue and 1 or 2 in chroma. Value is 3 or 4 when the Ap horizon is moist and is more than 5.5 when it is dry. The Ap horizon is dominantly silt loam, but it ranges from fine sandy loam to light silty clay loam.

The B horizon has hues ranging from 10YR to 5Y, value of 5 or 6, and chroma ranging from 2 to 4. Chroma of 2 or less is not dominant in the matrix but is on the ped faces. The B horizon ranges from loamy very fine sand to heavy silt loam. The clay content is between 5 and 18 percent. The total content of silt and very fine sand is more than 70 percent, and typically is more than 80 percent.

The IIB and IIC horizons range from 10YR to 2.5Y in hue, are 3 to 5 in value, and are 3 or 4 in chroma. Texture ranges from silty clay loam to clay. The average clay content is more than 35 percent.

The Rhinebeck soils, thick surface variant, are similar to the Raynham soils in the upper part but are moderately deep to clayey lake sediments. These soils have a higher silt content in the upper part than normal Rhinebeck soils or Odessa soils. They are better drained and have a higher silt content in the upper part than Lakemont or Madalin soils.

Rhinebeck silt loam, thick surface variant (Rk).--This nearly level soil occurs in the flat intergrade zone between large areas of deep, silty Raynham soils to the south and of deep, clayey soils to the north. Between these large areas, they are in narrow strips in many places. They also occur in small, slightly higher areas surrounded by the poorly drained Lakemont or Madalin soils. Areas range from about 10 to 50 acres in size.

Most commonly included with this soil in mapping are areas of finer textured Odessa, Lakemont, and Madalin soils. These included areas occur where the silty cap is less than 20 inches thick. In a few places there are inclusions of deep, silty Raynham or Canandaigua soils. Inclusions of Rhinebeck or Cosad soils also are in a few areas.

If undrained, this soil is suited to hay, pasture, or trees, or to other uses of low intensity. If adequately drained and fertilized, this soil can be used for most cultivated crops grown in the county. Because of its geographic location, fruit growing is questionable.

Drainage is the most important management need. Suitable outlets are difficult to establish in some places. This soil should be plowed and cultivated at a favorable moisture content. If it is plowed and cultivated when wet, hard clods or crusty surfaces form. Permeability is moderate in the surface layer and moderately slow to slow in the subsoil. Runoff is slow. (Capability unit IIIw-2; woodland suitability group 3w1)

Rock Land, Nearly Level

Rock land, nearly level (RoA) consists of areas that have rock outcrops and very shallow soils over rock. The general rockiness affects areas of this land type more than all other soil characteristics. Exposed stones or rock outcrops generally cover 70 to 80 percent of the surface of this mapping unit. Vegetation is sparse and stunted.

This mapping unit occurs in areas of the limestone escarpment, or it is closely associated with these areas. One fairly large area is just east of the county jail near Sunset Road and Jackson Street. Some areas of deeper soils are covered by stones in most places. A few of these stony areas occur between the villages of Sanborn and Pekin. In these stony areas, the fields have had stones moved and dumped in areas where there was a large boulder or rock outcrops. Small islands of very stony soils are made by this dumping.

Some areas of Rock land, nearly level, can be used for light grazing, but better uses are for recreation and wildlife. The larger areas, such as those near the county jail, could be used for nature trails. Permeability normally is rapid because of the cracks and fractures in the underlying limestone, but in some areas small depressions are ponded early in spring and in excessively wet periods. Runoff is mostly slow.

This mapping unit generally has slopes of less than 5 percent. Most slopes in the larger areas are less than 3 percent. (Capability unit VIIIs-1; woodland suitability group not assigned)

Rock Land, Steep

Rock land, steep (RoF) is similar to Rock land, nearly level, but has slopes of more than 15 percent.

In this steep mapping unit, the area of rock outcrops is not so large as in the nearly level unit, but the amount of boulders and rock rubble is generally more. Rock land, steep, is on the north face of the limestone escarpment. It is in a narrow strip that passes through the center of the county, beginning just south of the village of Middleport and ending at the Niagara River near the village of Lewiston. In some areas it consists of nearly vertical cliffs.

Most commonly included with this land in mapping are areas of a deep, stony soil that was created by falling rocks and the downward creep of soil material.

This mapping unit is suited to recreation, wildlife, and esthetic purposes. Tree growth is generally better than on Rock land, nearly level, because of the deeper pockets of stony soil material. This unit also receives more moisture from springs. It has a potential for recreation. Nature trails can be established, and the escarpment area is one of the most scenic areas in the county.

In some places, areas are favorable for large homes of the estate type. Permeability is moderately rapid in parts of this unit. Runoff is generally rapid to very rapid, especially near the cliff areas. (Capability unit VIIIs-1; woodland suitability group not assigned)

Schoharie Series

The Schoharie series consists of deep, moderately well drained to well drained, moderately fine textured soils. These soils formed in calcareous lacustrine deposits of silt and clay. They occupy the higher elevations and knolls within glacial lake areas, mainly south of the limestone escarpment. A few areas are between the limestone escarpment and U.S. Highway No. 104 (Ridge Road). Slopes range from 2 to 6 percent.

A representative profile of a Schoharie soil has a dark grayish-brown silty clay loam surface layer 6 inches thick. This layer is underlain by friable, brown silt loam that has many, faint mottles and also is 6 inches thick. Between depths of 12 and 30 inches, there is a reddish-brown silty clay subsoil that has many, faint mottles. It is slightly acid in the upper part and neutral in the lower part. The calcareous substratum consists of reddish-brown layers of clay and silt.

These soils have a seasonal high water table at depths between 18 and 24 inches. It is perched above the slowly permeable subsoil and underlying substratum. Most roots are confined to the uppermost 25 inches of soil. The available moisture capacity is high. Maintenance of good tilth is difficult on these soils.

Representative profile of Schoharie silty clay loam, 2 to 6 percent slopes, in the town of Wheatfield, five-sixteenths of a mile north of Lockport Road and three-eighths of a mile east of Walmore Road near power lines; idle areas:

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) silty clay loam; moderate, medium and fine, granular structure; friable; abundant roots; slightly acid; abrupt, smooth boundary. 6 to 9 inches thick.

A2--6 to 12 inches, brown (7.5YR 5/4) silt loam; many, fine, faint, strong-brown (7.5YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; friable; abundant fine roots; slightly acid; clear, wavy boundary. 0 to 8 inches thick.

B2t--12 to 30 inches, reddish-brown (5YR 4/4) silty clay; few, fine, faint, reddish-brown (5YR 5/3) mottles; moderate, medium and coarse, angular blocky structure; firm; brown (7.5YR 5/4) silt coats interfinger around soil peds in upper 3 to 4 inches of horizon; nearly continuous, reddish-brown (6YR 5/3) clay films on ped faces and thicker films in pores; slightly acid in upper part, neutral in lower; plentiful fine roots; clear, wavy boundary. 10 to 25 inches thick.

C--30 to 50 inches, reddish-brown (5YR 5/3), varved silt and clay; weak, thick, platy structure; firm; very few fine roots; calcareous.

Thickness of the solum ranges from 20 to 40 inches and corresponds well with the depth to carbonates. Bedrock is at a depth of more than 40 inches and typically is more than 6 feet from the surface. Below the Ap horizon, hue is 7.5YR or redder. The dominant hue in the B2t horizon is 5YR or redder. Coarse fragments are typically absent, but up to 5 percent is present in any horizon in some places. In many places glacial till occurs between a depth of 40 inches and 6 feet.

The Ap horizon is 7.5YR or 10YR in hue and 2 or 3 in chroma. Value of the Ap horizon is 3 or 4 when the horizon is moist, is 4 or more when rubbed, and is more than 5.5 when dry. The A2 horizon is absent in some places. Where present, the A2 horizon ranges from 7.5YR to 2.5YR in hue, is 5 or 6 in value, and is 3 or 4 in chroma. Mottles occur in some places. Texture ranges from silt loam to silty clay loam.

The B2t horizon has a hue of 5YR or redder, value of 4 or 5, and chroma of 3 or 4. The B horizon normally contains faint or distinct mottles, but no mottles that have a chroma of 2 occur in the upper 10 inches of this horizon. Texture ranges from heavy silty clay loam to clay. The average clay content ranges from 35 to 55 percent. Clay films are obvious, and there is some evidence of degradation in the upper part of the B horizon. The B horizon ranges from slightly acid to neutral.

The Schoharie soils formed in deposits similar to those of the somewhat poorly drained Odessa soils and the poorly drained to very poorly drained Lakemont soils. Schoharie soils are similar to Cayuga soils in texture and drainage but lack the moderate depth to glacial till that is characteristic of Cayuga soils. Schoharie soils have a finer textured Bt horizon than Dunkirk or Collamer soils. They are redder than Hudson soils.

Schoharie silty clay loam, 2 to 6 percent slopes (ShB).--This soil occupies knolls and other areas at higher elevations within old glacial lakebeds. The areas are generally less than 20 acres in size. In most places they are roughly circular or are in narrow strips that border drainways.

Most commonly included with this soil in mapping are areas of the Cayuga soils. Also included are areas of soils underlain by glacial till, much of it within 40 inches of the surface. In some places the somewhat poorly drained Odessa or Churchville soils are in depressions or drainways. In coarser textured areas, Cazenovia soils are included in some places. In about one-third of the mapped areas, there are Schoharie soils that have a silt loam surface layer.

This soil is suited to corn, small grain, hay, pasture, and other crops commonly grown in the county. Because of its geographic position and moderately fine texture, this soil is not well suited to fruits or vegetables. If this soil is cropped intensively, maintaining good tilth is difficult. It is important to plow and cultivate at the right moisture content. Maintaining or increasing the content of organic matter is a good management practice. Erosion is a hazard in intensively cultivated areas. Runoff is medium. (Capability unit IIe-4; woodland suitability group 2o1)

Stafford Series

The Stafford series consists of deep, somewhat poorly drained, sandy soils. These soils formed in sandy deposits that generally are close to U.S. Highway No. 104 (Ridge Road). Below a depth of 40 inches, Stafford soils normally have strata that restrict internal drainage. Slopes are less than 3 percent.

A representative profile of a Stafford soil has a very dark gray loamy fine sand surface layer that is 9 inches thick and slightly acid. This layer is underlain by a layer of very friable, grayish-brown loamy fine sand that is slightly acid and contains many, faint and distinct, brown and yellowish-brown mottles. Between depths of 13 and 30 inches, a brown loamy fine sand subsoil occurs. It contains grayish-brown and yellowish-brown mottles. It is slightly acid in the upper part and neutral in the lower part. The substratum consists of loose, stratified fine sand, loamy fine sand, and medium sand. It is grayish brown and neutral to mildly alkaline.

The seasonal high water table rises to within 1 foot of the surface early in spring and in other wet periods. Some areas are ponded for short periods except in drained areas. The water table remains at a depth of about 40 inches throughout much of the year unless the soils are artificially drained. Roots are restricted to the surface layer early in the growing season. As the growing season progresses and the water table drops, roots can extend downward to the water table. The available moisture capacity is low.

Representative profile of Stafford loamy fine sand in the town of Hartland, about 100 yards south of Ellicott Road and 100 feet west of Checkered Tavern Road; hay meadow:

Ap--0 to 9 inches, very dark gray (10YR 3/1) loamy fine sand, gray (10YR 6/1) when dry; weak, fine, granular structure; very friable; abundant fine roots; slightly acid; abrupt, smooth boundary. 8 to 10 inches thick.

A2g--9 to 13 inches, grayish-brown (10YR 5/2) loamy fine sand; many (about 35 percent), medium, faint mottles and distinct, brown (10YR 5/3) and yellowish-brown (10YR 5/4) mottles; very weak, thick, platy structure or single grain; very friable; plentiful roots; slightly acid; clear, wavy boundary. 0 to 6 inches thick.

B21--13 to 24 inches, brown (10YR 5/3) loamy fine sand; many (about 40 percent), medium, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4 and 5/6) mottles; very weak, thick, platy structure or single grain; very friable; few roots; no coarse fragments; slightly acid to neutral; clear, wavy boundary. 10 to 15 inches thick.

B22--24 to 30 inches, brown (10YR 5/3); loamy fine sand; few, fine, faint, yellowish-brown (10YR 5/4) mottles; very weak, granular structure or single grain; very friable; very few roots; no coarse fragments; neutral; clear, wavy boundary. 6 to 10 inches thick.

C--30 to 50 inches, grayish-brown (10YR 5/2), stratified fine sand, loamy fine sand, and medium sand; single grain; loose; no roots; no coarse fragments; neutral to mildly alkaline at a depth of 40 inches.

Thickness of the solum ranges from 25 to 40 inches. Depth to calcareous material is more than 30 inches but is less than 5 feet. Chroma of 2 or less is dominant in some horizons above a depth of 20 inches. Coarse fragments are absent in most places, but to a depth of 40 inches, any horizon may contain up to 10 percent coarse fragments, particularly fine pebbles. Bedrock is at a depth of more than 40 inches and typically is deeper than 6 feet. The solum ranges from medium acid to neutral, and the C horizon is neutral to mildy alkaline.

The Ap horizon is 10YR in hue and 1 or 2 in chroma. It is 3 or 4 in value when moist and more than 5.5 when dry. Where present, the A2g horizon is 10YR or 7.5YR in hue, 5 or 6 in value, and 2 or 3 in chroma. It is loamy fine sand or fine sand.

The B horizon has a hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 or 3. It is loamy fine sand to fine sand.

The C horizon is 10YR or 7.5YR in hue, 5 or 6 in value, and from 1 to 3 in chroma. The dominant texture to a depth of 40 inches is fine sand or medium sand that generally is layered.

The Stafford soils formed in deposits similar to those of the well-drained to excessively drained Colonie soils and the moderately well drained

Elnora soils. The A and B horizons of the Stafford soils are similar to corresponding layers in the Cosad soils, but Stafford soils are not moderately deep to clayey lake sediments. Stafford soils are better drained than Lamson soils and are coarser textured than Minoa soils.

Stafford loamy fine sand (St).--This soil has the profile described as representative for the series. Slopes are less than 3 percent. This soil is near offshore beaches or sand bars that are near U.S. Highway No. 104 (Ridge Road). Areas are generally less than 20 acres in size. They have no characteristic shape, but a few areas are in narrow strips that parallel and lie just north of the highway.

Most commonly included with this soil in mapping are Elnora, Lamson, and Cosad soils. The Elnora soils occupy knolls or the higher elevations. The Lamson soils occupy depressions. The Cosad soils are included in areas that are underlain by fine-textured material. Stafford soils that have a gravelly substratum occur in many places. Other inclusions are a few areas of gravelly Altmar soils.

This soil, unless it is drained, is suited to limited cultivation and to pasture, woods, or wildlife. Where drained and adequately managed, it is suited to most crops grown in the county. It can be used for vegetables. Drainage is a management need, but drainage is difficult to establish in most places because suitable outlets are lacking. This soil normally receives water from surrounding higher soils and acts as an underground water reservoir. Because this soil is sandy, it requires frequent additions of lime and fertilizer for best crop growth. (Capability unit IIIw-4; woodland suitability group 4w1)

Stafford loamy fine sand, gravelly substratum (Su).--This soil has a profile similar to that described as representative for the series, except that it is underlain by gravel at a depth of 40 inches or more. It occupies larger areas than Stafford loamy fine sand but is in the same general location. Areas range from about 5 to more than 50 acres in size. The largest areas are near Hess Road in the town of Newfane and near German Road in the town of Wilson.

Commonly included with this soil in mapping are areas of soil having gravel at a depth of 20 to 40 inches. Also included are areas of about the same soils as those included with Stafford loamy fine sand.

Use and management needs are about the same as for Stafford loamy fine sand, though this soil that has a gravelly substratum is generally easier to drain. Because areas are fairly large, it is economical to drain this soil in many places. (Capability unit IIIw-4; woodland suitability group 4w1)

Sun Series

The Sun series consists of deep, poorly drained and very poorly drained, medium-textured soils. These soils formed in calcareous glacial till that has received some overwash and has been reworked by waves. They occupy nearly level to depressional areas in glacial till moraines. Slopes are less than 4 percent.

A representative profile of a Sun soil has a black, neutral silt loam surface layer 8 inches thick. The upper part of the subsoil is greenish-gray fine sandy loam that is distinctly mottled. It contains 5 percent coarse fragments and is neutral. The lower part of the subsoil is between depths of 11 and 22 inches and consists of a reddish-brown, firm silt loam. It is distinctly mottled, contains 5 to 10 percent stone fragments, and is neutral. At a depth of 22 inches, a calcareous substratum occurs. It consists of firm, brown gravelly loam that contains mottles and about 20 percent stone fragments.

The seasonal high water table is at or near the surface early in spring and in other excessively wet periods. Many areas are ponded during wet periods. The water table is generally perched over a moderately slowly permeable to slowly permeable subsoil and substratum. Roots are confined to the surface layer early in spring. As the water table falls, roots extend downward to the calcareous substratum. The available moisture capacity is moderate.

Representative profile of Sun silt loam in the town of Wilson, 1 1/4 miles east of Maple Road and 350 yards north of Ide Road; idle area:

Ap--0 to 8 inches, black (10YR 2/1) silt loam, dark gray (10YR 4/1) when dry; moderate, medium, granular structure; very friable; abundant fine roots; neutral; abrupt, smooth boundary. 7 to 9 inches thick.

B21g--8 to 11 inches, greenish-gray (5GY 5/1) fine sandy loam; common, medium, distinct, light olive-brown (2.5Y 5/6) and reddish-brown (5YR 5/3) mottles; moderate, medium, platy structure; friable; plentiful fine roots; 5 percent coarse fragments; neutral; clear, wavy boundary. 2 to 5 inches thick.

B22--11 to 22 inches, reddish-brown (5YR 4/3) silt loam; common, coarse, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, platy structure; firm; greenish-gray (5GY 5/1) ped faces; few roots; 5 to 10 percent coarse fragments; neutral; clear, smooth boundary. 7 to 20 inches thick.

C--22 to 50 inches, brown (7.5YR 5/4) gravelly loam; common, medium, faint, strong-brown (7.5YR 5/6 and 7.5YR 5/8) mottles; moderate, medium, platy structure; firm; few, greenish-gray (5GY 5/1), weathered sandstone fragments; few roots; 20 percent coarse fragments; calcareous.

Thickness of the solum ranges from 20 to 30 inches and corresponds well with the depth to carbonates. To a depth of 20 inches, the content of coarse fragments ranges from none to 25 percent. Between depths of 20 and 40 inches, coarse fragments range from 5 to 30 percent. The solum ranges from medium acid to neutral. The substratum is neutral to moderately alkaline. From the base of the Ap

horizon to a depth of 40 inches, the content of clay generally ranges from 5 to 18 percent. The average silt content is less than 40 percent.

The Ap horizon has a hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. Chroma is 2 or less in more than 60 percent of the matrix in the A2 horizon, but chroma is more than 2 in more than 40 percent of the matrix of some horizons between the A2 horizon and a depth of 30 inches.

The B21g horizon ranges mainly from 10YR to 5YR in hue but includes GY gray hues; value is 5 or 6 and chroma is 0 or 1. Texture ranges from fine sandy loam to silt loam. The B22 horizon ranges from 10YR to 5YR in hue, from 4 to 6 in value, and from 2 to 4 in chroma. Texture ranges from fine sandy loam to silt loam.

The C horizon ranges from 10YR to 5YR in hue, from 4 to 6 in value, and from 2 to 4 in chroma. Texture ranges from sandy loam to loam.

The Sun soils formed in deposits similar to those of the moderately well drained Bombay soils, the moderately well drained Hilton soils, the somewhat poorly drained Appleton soils, and the somewhat poorly drained to poorly drained Massena soils. Sun soils are similar to Lamson soils in texture and drainage but formed mainly in glacial till. Less clay is in the B horizon of Sun soils than is in that of the Canandaigua soils.

Sun silt loam (Sw).--This nearly level soil occurs in low areas in the glacial till plain. Slopes are less than 4 percent. The soil also occurs in drainageways surrounded by better drained soils. Areas range from less than 5 to more than 100 acres in size. They are roughly oblong and in many places extend in a northeast-southwest direction. In a few places they are in narrow strips along drainageways.

Permeability is moderate in the surface layer and moderately slow or slow in the substratum. Runoff is very slow, and this soil is ponded at times.

Most commonly included with this soil in mapping are areas of Appleton, Hilton, Massena, Canandaigua, and Lamson soils. Because areas of Sun silt loam south of the limestone escarpment are slightly finer textured than areas in the northern part of the county, the Hilton, Appleton, and Canandaigua are the most commonly included soils in the southern part of the county. Massena and Lamson soils are the most common inclusions in the northern parts of the county. In some included areas, the surface layer is mucky. Inclusions that have a sandy and gravelly surface layer are generally indicated on the soil map by the appropriate symbols.

Undrained areas of this soil can be used for pasture and trees and for wetland wildlife. If adequately drained, this soil can be used for most cultivated crops. The growing of fruit is questionable. Locating a suitable outlet for drainage is difficult in many places. Locally, stones are a limitation to use. (Capability unit IVw-1; woodland suitability group 4w1)

Wayland Series

The Wayland series consists of deep, poorly drained to very poorly drained, medium-textured soils. These level to nearly level soils formed in recent alluvial deposits. They are of limited extent in the county and generally occur mainly along the major creeks. They occupy positions that are farthest from the main flow of water but are yet within the flood plain. Slopes are less than 3 percent.

A representative profile of a Wayland soil has a very dark grayish brown silt loam surface layer 8 inches thick. The upper part of the subsoil is friable, dark-gray silt loam. It contains many yellowish-red mottles, is neutral, and extends to a depth of 18 inches. The lower part of the subsoil is between depths of 18 inches and 30 inches and consists of firm, brown silt loam. It is neutral and contains many strong-brown and reddish-yellow mottles. The substratum is between depths of 30 and 50 inches. It is firm, mottled, reddish-brown silty clay loam that is neutral to moderately alkaline.

The Wayland soils have a seasonal high water table and are usually flooded at least once each year. The water table is at the surface early in spring and in other excessively wet periods. Many areas are subject to frequent flooding. Roots are limited by the depth to the water table. Most roots are confined to the dark surface layer. The available moisture capacity is moderate.

Representative profile of Wayland silt loam in the town of Lockport, 350 yards east of State Route 78 and two-fifths mile south of Wicks Road; woodland:

Ap--0 to 8 inches, very dark grayish brown (10YR 3/2) silt loam; dark gray (10YR 4/1) when dry; moderate, medium, granular structure; very friable; neutral; clear, wavy boundary. 6 to 9 inches thick.

B21g--8 to 18 inches, dark-gray (10YR 4/1) silt loam; many (about 35 percent), medium, distinct, yellowish-red (5YR 5/6) mottles; weak, coarse, granular structure; friable; neutral; clear, wavy boundary. 8 to 20 inches thick.

B22g--18 to 30 inches, brown (7.5YR 5/2) silt loam; many (about 35 percent), medium, distinct, strong-brown (7.5YR 5/8) and reddish-yellow (7.5YR 6/8) mottles; very weak, coarse, subangular blocky structure; firm; neutral; clear, wavy boundary. 6 to 18 inches thick.

IIC--30 to 50 inches, reddish-brown (5YR 4/3) silty clay loam; many, fine and medium, distinct, yellowish-red (5YR 4/6) mottles; weak, thick, platy structure; firm; neutral to moderately alkaline.

Thickness of the silty deposit over variable material ranges from 20 to 40 inches. The dominant range is 24 to 36 inches. Reaction is neutral to a depth of 20 inches and is neutral to moderately alkaline below 20 inches.

The Ap horizon ranges from 7.5YR to 2.5 in hue and is 2 or less in chroma. Value is 2 or 3 when the Ap horizon is moist and is less than 6 when it is dry. Thickness of the Ap horizon is less than one-third the depth to carbonates.

The C horizon ranges from 2.5Y to 4YR in hue and from 4 to 6 in value. Chroma is 1 or 2 to a depth of 30 inches and ranges from 1 to 4 below 30 inches. Mottles are generally higher chroma but are less than 35 percent of the matrix to a depth of 30 inches. The C horizon ranges from silt loam to silty clay loam. Average clay content between the Ap horizon and a depth of 40 inches ranges from 18 to 35 percent. Below a depth of 40 inches, the material is variable. Many profiles are underlain by red shale.

The Wayland soils formed in deposits similar to those of the well-drained Hamlin soils. The Wayland soils are more uniform in texture than Alluvial land and have a more developed profile.

Wayland silt loam (Wa).--This soil is in the lower areas of the flood plains and is normally in slack-water areas at the outer edge of these plains. Areas range from about 5 to 25 acres in size. In many places these areas are long, narrow strips in the flood plains.

Included with this soil in mapping are areas of drier soils that formed in similar materials. Also included are small spots of Hamlin soils. Alluvial land is included in many areas. In some included areas, red shale bedrock is at a depth of less than 40 inches. In a few areas south of the limestone escarpment, included soils are moderately deep to limestone bedrock.

Where this soil is undrained, it is suited to pasture and trees or to wildlife. Most areas are too small to be profitably drained. These areas are difficult to drain because of their position in the landscape. Drained areas should be protected from flooding. (Capability unit IIIw-6; woodland suitability group 4w1)

FORMATION, MORPHOLOGY, AND CLASSIFICATION OF SOILS

Soils are formed through the interaction of five major factors--climate, plant and animal life, parent material, relief, and time. The relative influence of each factor generally varies from place to place. Local variations in soils are the result of differences in kind of parent material and in relief and drainage. In places one factor may dominate the formation of a soil and determine most of its properties.

Factors of Soil Formation

The five factors of soil formation, as they relate to the formation of soils in Niagara County, are discussed in the following pages.

Climate

Climate, particularly temperature and precipitation, is one of the most influential soil-forming factors. To a large degree, climate determines the weathering of mineral materials. It also affects the growth of vegetation and the leaching and translocation of weathered materials. In Niagara County the climate was cool and humid during the period of soil formation in which organic matter has accumulated in the surface layer of the soils. For more detailed information on present climate, see the section "General Nature of the County."

Plant and Animal Life

All living organisms, including plants, animals, bacteria, and fungi, are important in the formation of soils. The kinds and amounts of vegetation are generally responsible for the content of organic matter and the color of the surface layer and for the amount of plant nutrients in the soils. Animals, such as earthworms, cicada, and burrowing animals, help keep the soil open and porous. Bacteria and fungi decompose the vegetation, and decomposition releases nutrients for plant food. In Niagara County the native forests have had more influence on soil formation than any other living organism.

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.

Parent Material

Parent material is the unconsolidated masses in which the soils formed. It determines the mineralogical and chemical composition of the soils and, to a large extent, the rate that soils form.

In Niagara County soils have formed in glacial till, glacial outwash, glaciolacustrine materials, recent stream alluvium, and organic materials. Most of the materials in which the soils formed were left after the glaciers melted 10,000 to 15,000 years ago. Alluvial and organic materials are of recent origin and are being deposited at the present time. Soils formed in glacial till are the most extensive in the county and have a wide range of characteristics. The Ontario, Hilton, Appleton, and Sun soils are examples of soils derived from glacial till. Soils formed in glacial outwash are generally loamy and commonly are underlain by stratified sand and gravel. Examples of soils of this kind are in the Howard and Phelps series.

The soils that formed in lacustrine materials have a surface layer ranging from loamy fine sand to silty clay loam. Examples of soils formed in coarse-textured lacustrine material are in the Colonie, Elnora, and Claverack series. Examples of soils

formed in fine-textured lacustrine materials are in the Schoharie, Odessa, and Lakemont series. Soils on the stream bottoms formed in water-laid materials called recent alluvium. They are medium textured and have little or no soil development. Examples of these soils are in the Hamlin and Wayland series. In this county the soils that formed in organic materials are called Muck, shallow.

Relief

The shape of the land surface, or lay of the land, the slope, and the position of the parent material in relation to the water table have had much influence on the formation of soils in the county. Soils that formed in sloping areas where runoff is moderate to rapid generally are well drained and have a bright-colored, unmottled subsoil. In most places, these soils are leached to greater depths than wetter soils in the same general area. In more gently sloping areas where runoff is slower, the soils generally show some evidence of wetness, such as mottling in the subsoil. In level areas or in slight depressions where the water table is at or near the surface for long periods, the soils show evidence of wetness to a marked degree. These soils have a dark-colored, thick, organic surface layer and a strongly mottled or grayish subsoil. Some soils are wet because of a high water table or because of their position in the landscape. Also, the permeability of the soil material, as well as the length, steepness, and configuration of the slopes, influence the drainage of soils from place to place. Local differences in the soils of Niagara County are largely the results of differences in parent material and relief.

Time

The formation of soils requires time for changes to take place in the parent materials. The time is usually long if measured in years. The soils of Niagara County have formed since glaciation. Evidence of this relatively limited time can be seen in the soils. Soils formed on low bottoms, subject to varying degrees of overflow, may receive new sediments with each flooding. These soils have only weak soil structure and weak differences in color between horizons. Hamlin soils are an example. Soils that have well-developed soil horizons, such as the Ontario soils, have been forming for longer periods than the Hamlin soils.

Morphology of Soils

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 the soil-forming processes.

Most soils contain three major horizons, called the A, B, and C horizons (13). These major horizons can be further subdivided by the use of letters and numbers to indicate changes within the major horizon. An example is the B2t horizon. It represents a layer within the B horizon that contains translocated clay moved from the A horizon.

The A horizon is the surface layer. This is the layer that has the largest accumulation of organic matter, and it is called an A1 or Ap horizon. It is also the layer of maximum leaching or eluviation of clay and iron. Where considerable leaching has taken place, an A2 horizon is formed. The A2 horizon of some soils in Niagara County shows brownish colors that result from 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 substances that have been leached from the A horizon. In some soils the B horizon is formed by alteration in place rather than from illuviation. The alteration may be caused by oxidation and reduction of iron or to the weathering to clay minerals. The B horizon has blocky or prismatic structure. It is generally firmer and lighter colored than the A horizon, but it is darker than the C horizon.

The C horizon is below the A or B horizon. It consists of material that is little altered by the soil-forming processes, but it is modified by weathering in some places.

Several processes are involved in the formation of soil horizons in the soils of Niagara County. These include 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 at the same time throughout the profile. The processes are very slow and have been going on for thousands of years.

The accumulation of organic matter takes place with the decomposition of plant residue. This process darkens the surface layer and helps to form the A1 horizon. After organic matter has been lost, a long time is required to replace it. The surface layer of the soils in Niagara County has an average organic-matter content of about 3.5 percent.

For soils to have distinct 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.

The most important process in the formation of horizons in the soils of Niagara County is the formation and translocation of silicate clay minerals. The amount of clay minerals in a soil profile depends on the parent materials, but amounts of clay vary from one soil horizon to another. Clay minerals are generally eluviated from the A horizon and illuviated in the B horizon as clay films on the ped faces and in the pores and root channels. In some soils

an A2 horizon forms when considerable clay minerals are eluviated to the B horizon. The A2 horizon is light colored and has platy structure in some profiles. In the Ontario soils clay minerals have been translocated from the A horizon to the B.

The reduction and transfer of iron occurs mainly in the wetter, more poorly drained soils. This process is called gleying. Moderately well drained to somewhat poorly drained soils have yellowish-brown and reddish-brown mottles that indicate the segregation of iron. The Canandaigua, Lakemont, Sun, and similar poorly drained and very poorly drained soils have a grayish-colored subsoil that indicates reduction and transfer of iron.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us in understanding their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (3) and later revised (11). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (9, 12). In table 11, the soil series of Niagara County are placed in some categories of the current system and in the great soil groups and orders of the older system. Placement of some series in the current system of classification may change as more precise information becomes available.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode or origin, are grouped together. The classes that make up the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridosols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Table 11 shows the four soil orders in Niagara County--Alfisols, Inceptisols, Entisols, Mollisols.

Alfisols are soils that have clay-enriched B horizons that are high in base saturation. In Niagara County this order includes all of the soils that formerly were called Gray-Brown Podzolic soils and many of the soils that were called Low-Humic Gley soils.

Inceptisols most often are found on young but not recent land surfaces. In Niagara County this order includes soils formerly called Alluvial soils, Humic Gley soils, Sols Bruns Acides, and Low-Humic Gley soils.

Entisols are recent soils. They do not have genetic horizons or have only the beginnings of such horizons. In Niagara County this order includes some sandy soils previously classified Sols Bruns Acides.

Mollisols generally formed under grass vegetation. They have a thick, dark-colored surface layer. In Niagara County this order includes soils that formerly were called Alluvial soils intergrading to Low-Humic Gley soils and Humic Gley soils.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The suborder is not shown in table 11.

GREAT GROUP: Soil orders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that have pans interfering with growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 11, because the name of the great group is the last work in the name of the subgroup.

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

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils where used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature,

permeability, thickness of horizons, and consistence.

SERIES: The series consists of a group of soils that formed from a particular kind of parent material and have genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile. Among these characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

New soil series must be established, and concepts of some established series, especially older ones that have been used little in recent years, must be revised in the coarse of the soil survey program across the county. A proposed new series has tentative status until review of the series at the State, regional, and national levels of responsibility for soil classification results in a judgement that the new series should be established.

TABLE 11.--SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT SYSTEM OF CLASSIFICATION AND THE 1938 SYSTEM WITH ITS LATER REVISIONS

Series	Current Classification			1938 classification	
	Family	Subgroup	Order	Great soil group	Order
Altmar--------	Mixed, mesic-------	Aquic Udipsamments----	Entisols-----	Sols Bruns Acides-----	Zonal.
Appleton------	Fine-loamy, mixed, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Arkport-------	Coarse-loamy, mixed, mesic.	Psammentic Hapludalfs-	Alfisols-----	Sols Bruns Acides over Gray-Brown Podzolic soils.	Zonal.
Bombay 1/-----	Coarse-loamy, mixed, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Brockport-----	Fine, illitic, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Canandaigua---	Fine-silty, mixed, nonacid, mesic.	Mollic Haplaquepts----	Inceptisols--	Low-Humic Gley soils or Humic Gley soils.	Intrazonal.
Cayuga--------	Fine, illitic, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Cazenovia-----	Fine-loamy, mixed, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Cheektowaga---	Sandy over clayey, mixed, noncalcareous, mesic.	Typic Haplaquolls-----	Mollisols----	Low-Humic Gley soils or Humic Gley soils.	Intrazonal.
Churchville---	Fine, illitic, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Claverack-----	Sandy over clayey, mixed, mesic.	Aquic Udorthents------	Entisols-----	Sols Bruns Acides-----	Zonal.
Collamer------	Fine-silty, mixed, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Colonie-------	Mixed, mesic-------	Alfic Udipsamments----	Entisols-----	Sols Bruns Acides-----	Zonal.
Cosad---------	Sandy over clayey, mixed, nonacid, mesic.	Aquic Udorthents------	Entisols-----	Sols Bruns Acides-----	Zonal.
Dunkirk-------	Fine-silty, mixed, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Elnora--------	Mixed, mesic-------	Aquic Udipsamments----	Entisols-----	Sols Bruns Acides-----	Zonal.
Farmington----	Loamy, mixed, mesic.	Lithic Eutrochrepts---	Inceptisols--	Brown Forest soils----	Intrazonal.
Fonda---------	Fine, illitic, nonacid, mesic.	Mollic Haplaquepts----	Inceptisols--	Humic Gley soils------	Intrazonal.
Fredon--------	Coarse-loamy over sandy or sandy-skeletal, mixed, nonacid, mesic.	Aeric Haplaquepts-----	Inceptisols--	Low-Humic Gley soils--	Intrazonal.
Galen---------	Coarse-loamy, mixed, mesic.	Psammentic Hapludalfs-	Alfisols-----	Gray-Brown Podzolic soils intergrading toward Sols Bruns Acides.	Zonal.

TABLE 11.--SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT SYSTEM OF CLASSIFICATION AND THE 1938 SYSTEM WITH ITS LATER REVISIONS--Continued

Series	Current Classification			1938 classification	
	Family	Subgroup	Order	Great soil group	Order
Hamlin--------	Coarse-loamy, mixed, mesic.	Dystric Fluventic Eutrochrepts.	Inceptisols--	Alluvial soils--------	Azonal.
Hilton--------	Fine-loamy, mixed, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Howard--------	Loamy-skeletal, mixed, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Hudson--------	Fine, illitic, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Lairdsville---	Fine, illitic, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Lakemont------	Fine, illitic, mesic.	Udollic Ochraqualfs---	Alfisols-----	Low-Humic Gley soils--	Intrazonal.
Lamson--------	Coarse-loamy, mixed, nonacid, mesic.	Aeric Haplaquepts-----	Inceptisols--	Low-Humic Gley soils or Humic Gley soils.	Intrazonal.
Lockport------	Fine, illitic, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Madalin-------	Fine, illitic, mesic.	Mollic Ochraqualfs----	Alfisols-----	Low-Humic Gley soils--	Intrazonal.
Massena-------	Coarse-loamy, mixed, nonacid, mesic.	Aeric Haplaquepts-----	Inceptisols--	Brown Forest soils intergrading toward Gray-Brown Podzolic soils.	Intrazonal.
Minoa 2/------	Coarse-loamy, mixed, mesic.	Aquic Dystric Eutrochrepts.	Inceptisols--	Brown Forest soils intergrading toward Gray-Brown Podzolic soils.	Intrazonal.
Niagara-------	Fine-silty, mixed, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Odessa--------	Fine, illitic, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Ontario-------	Fine-loamy, mixed, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Otisville 3/--	Sandy-skeletal, mixed, mesic.	Typic Udorthents------	Entisols-----	Sols Bruns Acides-----	Zonal.
Ovid----------	Fine-loamy, mixed, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Phelps--------	Fine-loamy over sandy or sandy skeletal, mixed, mesic.	Glossaquic Hapludalfs-	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Raynham 4/----	Coarse-silty, mixed, nonacid mesic.	Aeric Haplaquepts-----	Inceptisols--	Low-Humic Gley soils--	Intrazonal.
Rhinebeck-----	Fine, illitic, mesic.	Aeric Ochraqualfs-----	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Schoharie-----	Fine, illitic, mesic.	Glossoboric Hapludalfs.	Alfisols-----	Gray-Brown Podzolic soils.	Zonal.
Stafford------	Mixed, mesic-------	Typic Psammaquents----	Entisols-----	Low-Humic Gley soils--	Intrazonal.
Sun-----------	Coarse-loamy, mixed, nonacid, mesic.	Aeric Haplaquepts-----	Inceptisols--	Low-Humic Gley soils or Humic Gley soils.	Intrazonal.

TABLE 11.--SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT SYSTEM OF CLASSIFICATION AND THE 1938 SYSTEM WITH ITS LATER REVISIONS--Continued

Series	Current Classification			1938 classification	
	Family	Subgroup	Order	Great soil group	Order
Wayland-------	Fine-silty, mixed, nonacid mesic.	Fluventic Haplaquepts-	Inceptisols--	Alluvial soils--------	Azonal.

1/ Some of these soils are taxadjuncts to the Bombay series because they are calcareous at a shallower depth than is typical for the series.

2/ These soils are taxadjuncts to the Minoa series because they are calcareous at a shallower depth than is typical for the series.

3/ These soils are taxadjuncts to the Otisville series because they are higher in reaction and contain less gravel than is typical for the series.

4/ These soils are taxadjuncts to the Raynham series because they are calcareous at a shallower depth than is typical for the series.

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This section provides general information about Niagara County. It discusses geology, physiography, drainage, climate, farming, and other subjects of general interest.

Geology

The soils of Niagara County formed in glacial material that was deposited during and shortly after the ice age. During the Pleistocene epoch, or ice age, the advancing ice sheet moved slowly southward and picked up rocks and soil material. This material was transported farther south and was later dumped to form hills, ridges, and plains. This dumped material is called glacial till.

When the ice halted or started to melt back, great streams and rivers carrying soil material poured out from the ice mass. The coarser material was dropped out to form eskers, kames, terraces, and large outwash plains. This material is called outwash. The finer material, such as silt and clay, settled out in small and large bodies of water. This finer material is called lacustrine deposits.

Where a lake, such as postglacial Lake Tonawanda, overflowed into another large lake, such as Lake Iroquois, a delta was formed. A delta is formed when a large stream carrying soil material flows into a large body of water such as a lake. Occasionally, a lake remained for a long period and built up a distinctive shoreline. Postglacial Lake Iroquois shows a good example of an old shoreline. The gravel along U.S. Highway No 104 (Ridge Road) was deposited by the waves at the edge of the lake. The area north of Ridge Road was occupied by glacial Lake Iroquois. A discontinuous beach, called the Newfane Beach, is thought to be a remnant of a lower lake level.

The many cobbly areas located near the Lake Iroquois beach were formed by the incessant movement of the waves near the shoreline. During one of the earlier glacial periods, the entire county was covered by glacial Lake Lundy. This lake is responsible for a large amount of the reddish-colored lake sediments. The Odessa, Lakemont, and Schoharie soils are among those that formed principally in these lake sediments. A large part of the reddish-colored glacial till areas was modified by these lake sediments.

Somewhat later the area adjacent to Tonawanda Creek was covered by glacial Lake Tonawanda. This lake received olive and brownish sediments that were deposited over the red clay. The Raynham, Rhinebeck, Canandaigua, and other soils formed in these sediments. The thick-surface variant of Rhinebeck soils is in an area that nearly marks the shoreline of Lake Tonawanda and the beginning of the reddish sediments of postglacial Lake Lundy.

The last large lake to disappear was glacial Lake Iroquois. The water that covered the area north of U. S. Highway No. 104 (Ridge Road) was relatively shallow. In this area are the Lockport, Lairdsville, Hilton, Appleton, Cazenovia, Ovid, and similar soils. The deepest water of Lake Iroquois that covered the present land surface was near the present shoreline of Lake Ontario. Consequently, the soil areas near Lake Ontario have thicker lake sediments. Some of these thicker sediments contain lacustrine soils such as the Collamer, Niagara, Hudson, and Rhinebeck.

The principal bedrock formations are Queenston shale, Lockport dolomitic limestone, and Rochester shale. Soils of four series are strongly influenced by these bedrock formations. The Lairdsville and Lockport soils are nearly residual soils that developed in material weathered from Queenston shale. The Brockport soils are nearly residual soils that developed in material weathered from Rochester shale. The Farmington soils have only a thin glacial deposit over the Lockport dolomitic limestone. Queenston shale is well exposed in the Niagara River Gorge and near the banks of the many smaller streams. The Rochester shale is well exposed in a road cut south of the village of Gasport. The Lockport dolomitic limestone is exposed along the Niagara Escarpment and Barge Canal and in the large limestone quarries. As the glacier crossed the Niagara Escarpment, it plucked large boulders and rock fragments from it. Many of these large fragments were deposited a short distance south of the escarpment. Some of the soils, especially the rock substratum phases of the Ontario, Hilton, Cayuga, and Ovid series, contain these large fragments in the soil or on the surface.

Glacial till occupies a large part of the surface area in the county. It also underlies most areas of lake sediments. Four types of glacial till deposits occur in the county. These are ground moraines, drumlins, elongated till ridges, and terminal moraines.

The ground moraine is by far the largest till deposit. It occupies most of the Appleton-Hilton-Sun and the Hilton-Ontario-Ovid soil associations, which are the largest in the county. A ground moraine occupies a low undulating till plain. The least modified ground moraine is in a belt 3 to 5 miles wide that extends from Lockport to the Niagara River. This ground moraine has been modified in most areas, especially where it was covered by glacial Lake Iroquois. The average thickness of the ground moraine in Niagara County is 10 to 15 feet.

Drumlins and drumloid forms are smoothly rounded hills that were molded beneath the ice. A few of them have rock cores, but many have cores of very compact glacial till. Most of the drumlins in Niagara County are very subdued or modified by lakes. The best examples of drumlins are south of Pendleton Center near the Tonawanda Game Club.

Elongated till ridges are very thin ridges that extend in a northeast-southwest direction. They are located in the Ontario Plain north of Ridge Road. These ridges have some characteristics of drumlins, but they are believed to be related to giant flutings in the underlying Queenston shale (5). The ridges consist of pebbly till containing generally more coarse fragments than the surrounding ground moraine.

Terminal moraines have a general east-west trend and were formed when the ice stagnated for a long period. They are more likely to contain gravel than other glacial till deposits. The two principal terminal moraines in Niagara County are the Barre Moraine and the Rochester-Albion Moraine. The Barre Moraine parallels the escarpment and is dominantly water-worked glacial till. The Rochester-Albion Moraine is between the Barge Canal and the escarpment. It contains much sand, silt, and gravel.

The largest outwash deposit is located in a 1- to 2-mile belt that extends 3 miles westward and 5 miles eastward from the village of Olcott. This deposit is 1 to 10 feet thick. The coarser gravel is in the southern part of the belt. Another small outwash area is in the city of North Tonawanda near the Niagara River.

The principal beach deposit is the Iroquois beach ridge. This ridge stretches nearly all the way across the county and provides the road base for the Ridge Road. Some lesser beaches are located north of Ridge Road. The most recognizable of these are in the Newfane beach area. Outwash and beach deposits provide the best source of gravel in the county. They also contain the best soils for crops grown for an early market.

Physiography and Drainage

Niagara County lies in the eastern lake section of the Central Lowland physiographic province (8). This section is divided into the Erie, Huron, and Ontario Plains. The county occupies part of the Huron and Ontario Plains. The Ontario Plain extends from the shore of Lake Ontario to the foot of the Niagara Escarpment, and the Huron Plain from the crest of the escarpment southward beyond the county line.

The Niagara Escarpment consists of a steep northward slope, along which perpendicular bluffs are exposed in places. The crest has an elevation of slightly more than 600 feet. It is steeper and narrower in the western part. Its width ranges from only a few rods at Lewiston to nearly 2 miles in the eastern part. North of the 400-foot contour line, the nearly level lake plain slopes at the rate of 20 feet a mile toward the lake, which is 8 miles from the escarpment. The surface of the lake is 246 feet above sea level, and the lakeshore is nearly everywhere bordered by low bluffs 15 to 60 feet high. The land surface is fairly uniform, but it is dissected in a few places by shallow valleys of minor streams. The minor irregularities of relief have a northeast-southwest trend. This is chiefly indicated by the courses of the streams, most of which flow northeastward.

A low but well-marked, fairly sinuous ridge runs along the inner margin of the Ontario Plain. In some places this ridge is close to the base of the escarpment, and in others it is more than 4 miles north of it. The ridge rises 10 to 30 feet above the level of the surrounding land. It extends in a general westerly direction from Johnson Creek and the eastern part of the county to Ridge Road, where it turns south-westward and continues to Wrights Corners. The ridge is not well developed across the valley of Eighteenmile Creek, but it reappears near Warrens Corners and extends westward to the base of the escarpment east of Lewiston. Although low and in places inconspicuous, the ridge is an important topographic feature, as it is traversed by a main highway, United States Highway No. 104, or the Ridge Road, and is everywhere thickly settled. It represents an old beach ridge formed by a predecessor of Lake Ontario (5), and a well-worn Indian trail followed it before the arrival of white men.

For the last few miles of their courses, the larger streams flowing into Lake Ontario descend through narrow gorges 10 to 30 feet deep. About 4 miles above its mouth, Eighteenmile Creek flows through a gorge that is 70 feet deep and one-eighth mile wide and has precipitous walls in places. The broad, shallow valley of the Niagara River crosses the Ontario Plain on the west.

About half the area of the county is occupied by the Huron Plain. The central part of this plain extends from Wolcottsville westward past North Tonawanda. It is nearly level and slopes gently westward from an altitude of 600 feet or more on the east to 570 feet along the Niagara River. The evenness of most of the surface is broken in places by low, narrow, irregular ridges that have a northeast-southwest direction. These irregular ridges range from 1.4 to nearly 2 miles in length and rise 20 to 50 feet above the general land surface. West of Lockport a long, narrow ridge that is roughly parallel to the Niagara Escarpment lies along the northern margin of the plain. This ridge rises 20 to 40 feet above the plain and reaches an altitude of 660 feet at one or two points near Pekin and of 680 feet about 2 miles east of Dysinger. East of Lockport the surface is more or less irregular, and there are several low ridges that have a general east-west trend.

The general elevation of the Huron Plain is 600 feet. Elevation ranges from 575 feet at the mouth of Tonawanda Creek to a maximum of 680 feet near Dysinger. The elevation at Lockport is 600 feet, which also is the elevation at Niagara Falls. The elevation of the Ontario Plain at the base of the escarpment ranges from 400 feet at Lewiston to 500 feet at the point where the escarpment leaves the county on the east.

Drainage of the Ontario Plain is northward into Lake Ontario. The streams have crooked channels, which meander through comparatively narrow flood plains that are not deeply cut. Within the plain there are several broad, level or slightly depressed, basinlike areas that have poorly developed outlets. The drainage of these and of numerous other level areas has been attempted by ditching, but most of the ditches are too small for efficient drainage, and many are choked with weeds and shrubs. Many of the soils of the lake plain are somewhat poorly drained to poorly drained.

Drainage of the Huron Plain is southward into Tonawanda Creek, which flows westward and empties into the Niagara River. As on the Ontario Plain, drainage here is not well developed. The almost level surface makes artificial drainage a problem because runoff is slow.

Water Supply

Niagara County has an abundant water supply. The county is surrounded on three sides by fresh water. Tonawanda Creek is on the south, the Niagara River is on the west, and Lake Ontario is on the north. Most residents obtain their water from municipal water systems. The county has a public water district that was the first of its kind in New York State. This district obtains water from the Niagara River and is connected with the municipal water systems for emergency service.

Many rural residents depend on deep and shallow wells for their water. Most deep wells that are north of the Niagara Escarpment are dug into the red Queenston shale. The quantity and quality of the available water is erratic. In many places deep wells dug or drilled into the red shale produce water that has a high salt or sulfide content. The yield of water is often inadequate during extended dry periods.

Deep wells south of the escarpment that are drilled into the Lockport limestone formation yield water that is generally high in bases, especially calcium. This high content of bases makes the water hard. Water softeners are generally needed for the most efficient use of this water. The yield of water is generally much better from limestone than from shale.

The best areas for springs and shallow wells are in three of the 11 soil associations. The three associations are the Otisville-Altmar-Fredon-Stafford association, the Howard-Arkport-Phelps association, and the Hilton-Ovid-Ontario association. Because population and septic tank disposal are increasing, shallow wells and springs are in danger of contamination.

Climate[9/]

Niagara County has a humid, continental type of climate. The North American continent is the primary source for air masses and weather systems that affect the county. Air flow from the south or southwest brings moisture to the region from the Atlantic Ocean and Gulf of Mexico.

The county has pleasantly warm summers. The winters are fairly long and cold, and they have frequent spells of cloudy, unsettled weather. Precipitation generally is evenly distributed during the year, though minimum monthly precipitation is slightly less during winter than during other seasons. The county does not have distinct seasonal differences in maximum precipitation. Tables 12 and 13 give climatic data taken from the records at Lockport.

Most atmospheric pressure systems affect Niagara County as they move across the continent or up the Atlantic Coast. The result is a variety of weather. Temperatures and other atmospheric elements usually undergo noticeable change within an interval of a few days. On the average, the weather during a given week is often quite different from that during the preceding or following week. Seasonal weather differs from year to year.

The climate is greatly influenced by the close proximity of Lakes Ontario and Erie. In spring the cold lake waters function as a heat sink that retards the normal warming of the air temperature. Plant growth is delayed, and tender crops are aided in passing more safely through critical periods of freezing temperatures. The lakes tend to restrict the occurrence of extreme high temperatures in summer. Niagara County is therefore less subject to severe thunderstorms caused by strong summer heating than are other counties farther inland. In fall the lake waters are a source of heat that reduces cooling at night and increases the length of freeze-free growing season. Lake Ontario, and Lake Erie to a lesser extent, remains largely unfrozen in the winter, and this modifies the occurrence of extreme cold temperatures in comparison with more inland areas of similar elevation and latitude.

Nearness to the Great Lakes is an important factor in the amount of snow that falls in the county. Air flow from the southwest is heated and moistened as it moves across the open, relatively warm waters of Lake Erie. Moving inland, the air masses release moisture in the form of heavy snowfall. These lake-affected storms are most common in November and December. They are characterized by substantial snow over a wide area and very heavy amounts in narrow bands or local areas. The frequency and intensity of these storms decrease later in winter as more of the lake surface becomes covered with ice. Niagara County is less affected by such storms arising over Lake Ontario.

Elevation is of minor influence on the climate because of the relatively small differences in the county. The climate is comparatively uniform, except as it may be affected by distance from the Great Lakes. Thus, with slight adjustment the temperature data for Lockport contained in tables 12 and 13 are reasonably applicable to other sections of Niagara County.

The county has much cloudiness in the winter. High winds often accompany the lake-affected snowstorms and hamper travel. Otherwise, severe and damaging storms of various types are not a serious weather hazard to the inhabitants and economy of this area.

9/ By A. BOYD PACK, climatologist for New York, National Weather Service, U.S. Department of Commerce.

TABLE 12.--TEMPERATURE AND PRECIPITATION AT LOCKPORT, N.Y.

[Based on a 30-year period of record]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	7 years in 10 will have--		Average total	3 years in 10 will have--		Snow	
			Maximum temperature equal to or higher than--	Minimum temperature equal to or lower than--		More than--	Less than--	Average total	7 years in 10 will have more than--
	° F.	° F.	° F.	° F.	In.	In.	In.	In.	In.
January------	32	17	46	1	2.5	2.7	1.7	15	10
February-----	34	18	47	3	2.5	2.8	2.0	13	9
March--------	41	24	57	14	2.4	3.0	1.9	10	4
April--------	55	35	72	24	3.0	3.5	2.4	2	(1/)
May----------	67	45	80	32	3.1	3.7	2.2	(1/)	(2/)
June---------	77	55	88	44	2.4	3.1	1.5	--	--
July---------	82	60	90	50	2.9	3.4	2.2	--	--
August-------	80	59	88	48	3.2	4.4	2.4	--	--
September----	73	51	85	37	2.7	3.5	2.2	--	--
October------	62	42	78	30	2.7	3.4	1.2	(1/)	(2/)
November-----	48	33	65	20	2.8	3.4	2.1	5	2
December-----	36	22	51	6	2.4	2.0	1.9	11	6
Year-------	57	38	91	-2	32.6	35.0	30.4	56	46

1/ Trace.

2/ One year in 10 will have more than a trace.

TABLE 13.--PROBABILITY OF LAST FREEZING TEMPERATURE IN SPRING AND FIRST IN FALL AT LOCKPORT, N.Y.[1/]

[Elevation 520 feet]

Probability	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
Spring:					
1 year in 10 later than--------	April 4	April 11	April 19	May 7	May 21
2 years in 10 later than-------	March 29	April 6	April 15	May 2	May 17
5 years in 10 later than-------	March 16	March 27	April 7	April 23	May 9
Fall:					
1 year in 10 earlier than------	November 17	November 7	November 2	October 11	September 30
2 years in 10 earlier than-----	November 22	November 12	November 6	October 18	October 4
5 years in 10 earlier than-----	December 2	November 22	November 15	October 31	October 12

1/ The following example illustrates how to use and interpret the data in this table. Take a temperature of 32° F. or lower. In 1 year out of 10 (10 percent probability), a temperature of 32° or lower can be expected to occur later than May 21; in 5 years out of 10 (50 percent probability), a temperature of 32° or below can be expected to occur later than May 9. The fall dates are interpreted similarly for a given temperature, but the occurrence is earlier than the given date.

Vegetation

The early settlers in Niagara County found most of the area covered with thick forest (8). The clearings consisted mainly of Indian villages and marshy areas along the larger streams.

The higher, drier land bore a heavy growth of sugar maple (hard maple), red maple (soft maple), black walnut, white oak, red oak, basswood, hickory, beech, black birch, wild cherry, and chestnut. On the lower, wetter areas, there was a tangle of vegetation. Large elm, red maple, and black ash trees grew, and there were bushes of alder, huckleberry, and cranberry. Much of the low, level land was swampy and covered with water during several months of the year.

Very few of the original trees are left. Most areas have been cut over at least once, and some areas have been cut over several times. By 1958, according to the Conservation Needs Inventory, 54 percent of the land was used for cropland, 6 percent was pastured, 13 percent was in woods, 11 percent was idle or other land, and 16 percent was urban or built-up areas (6). According to preliminary forest statistics in 1967, the forested areas covered about 17 percent of the county (7).

Settlement

The area of which Niagara County is a part was one of the first areas of the Great Lakes country to be visited by white men. The waterways of the St. Lawrence River and the Great Lakes brought adventurers into the area during the seventeenth century.

In 1679, under the leadership of La Salle, a log fort was built near the outlet of the Niagara River (8). At the time, this fort was the most important French post west of Montreal. It was taken by the British in 1759 and held until 1796. During the Revolutionary War, it was the headquarters for marauding parties of Indians and English against settlers in the eastern part of New York State and northern Pennsylvania.

All of Niagara County, except a strip 1 mile wide along the Niagara River and the Indian Reservations, was included in the Holland Land Purchase. After 1799, the whole county except for the Indian Reservations was opened up for settlement. The first settlements were along the Niagara River and better drained parts of the county such as the escarpment, Lake Iroquois beach ridge (U.S. Highway No. 104), and along the shores of Lake Ontario.

In December 1813, Fort Niagara was again taken by the British and held until the close of the War of 1812. During the period of British occupation, all the settlements and villages were burned. After the war and with the completion of the Erie Canal in 1825, rapid development of the county began. The Erie Canal is now known as the Barge Canal.

Niagara County was set up as a distinct unit in 1808. It has maintained its present boundaries since 1821, when part of it was taken to form Erie County.

According to the Federal census the population of Niagara County doubled from 31,132 in 1840 to 62,491 in 1890. By 1960, the population had increased to 242,269. In 1960, the rural population was 78,675, or about 32 percent of the total.

Most of the rural people are descendants of the original settlers. The people in the southern part of the county are largely of German descent. Bergholtz and Wolcottsville were settled by German immigrants, for whom the land was obtained in advance of their coming. The industry and thrift of these people were factors in the cultivation of the heavy wet soils in that area.

Three cities make up about two-thirds of the county population. In 1960, Niagara Falls had a population of 102,394, North Tonawanda 34,757, and Lockport 26,443. Barker, Lewiston, Middleport, Wilson, and Youngstown are smaller incorporated villages.

Transportation, Industry, and Markets

By water, air, and railways, Niagara County has access to the nation, the continent, and the world. Four major railroads serve the area, and there are bridge connections to Canada. The St. Lawrence Seaway, the Niagara River Channel, and the Barge Canal provide water routes for economical transportation of such bulk commodities as lumber, ore, petroleum products, and grain. The Niagara Falls Airport, which has facilities to handle the largest intercontinental jets, makes Niagara a jetport for international service.

A network of modern highways services all of Niagara County. County roads that are either macadam or concrete total 281 miles. There are 214 miles of State and Federal highways and 508 miles of roads maintained by towns. The Robert Moses Parkway and the Niagara Expressway are limited access, high-speed roads that tie into the New York State Thruway and connect the United States with Canada. Three highway bridges provide direct connections with Canada. Scenic parkways along the Niagara River offer spectacular views of the falls and gorge.

About 170 industries in Niagara County supply worldwide markets. The products include abrasives, chemicals, carbon, graphite, iron and steel castings, pig iron, gears, plastics, cereals, flour, paper, building materials, paints, boats, musical instruments, automotive parts, and office equipment. Low-cost electric power from Niagara Falls first attracted the industries that made the city of Niagara Falls the largest electrochemical and electrometallurgical center in the world. As these industries expanded, new ones developed and grew. Today, Niagara County has excellent diversification. Of the 500 largest manufacturing companies in the United States, 22 have plants in Niagara County. The demand by companies for skilled and semiskilled workers commonly exceeds the local supply.

The market for consumer goods produced in Niagara County is extensive. Manufactured goods such as automotive radiators, musical instruments, and

graphite products have worldwide distribution. A large part of the agricultural products are consumed within a 75-mile radius, but such products as fruits and vegetables are distributed nationally.

Farming

The favorable climate, fairly large acreage of good soils, and excellent markets contribute to a diversified and prosperous agriculture. The moderation of temperature by air currents passing over Lakes Erie and Ontario make the northern part of the county ideal for growing peaches, cherries, and other fruits. The area is markedly free of hurricanes and excessive storms. Moderate temperatures, long frost-free periods, and good soils help make the county an outstanding fruit-growing region.

The first crops grown were those needed to meet the basic needs of people in a wilderness (8). Few articles were brought in, and none were shipped out. While the land was being cleared for cultivation, the production of potash salts from wood ashes was an important industry and gave the settlers a source of cash income. The completion of the Erie Canal in 1825 gave a great impetus to settlement and farm development. The completion of this waterway provided an outlet to eastern markets, and it stimulated consumption of products because of the large influx of people during the construction period.

Farming, immediately following the completion of the canal, was based mainly on grain and livestock. Wheat has continued as an important crop, but livestock raising in general and sheep raising in particular have declined. The decline started after the Civil War, when competition from the West became severe.

The 1964 Census of Agriculture shows that 53 percent of Niagara County is in farms. This includes 152,713 acres of cropland, 4,988 acres of pasture, and 10,806 acres of woodland. There were 13,353 acres in other land that consisted of buildings, farm lanes, and idle nonwooded areas.

The number of farms has been declining, especially the smaller family-type farms. The average size of individual farms has been increasing steadily since 1954. The increase in size has been in the 100- to 500-acre range, whereas farms of less than 100 acres have been decreasing in size.

In types of farming from 1954 to 1964, dairying has increased 7 percent, fruit growing has decreased 19 percent, and vegetable farms have increased 100 percent (4). Of the 1,800 farms listed in the county in 1964, the 1964 census classes 1,028 as commercial farms.

Community Facilities

Niagara County has many community facilities available to the public. Colleges and universities are within easy driving distance for any resident. For more than 100 years, Niagara University has been the cultural center of the county. It offers both on-campus and part-time programs in many subjects. The Niagara County Community College is a 2-year coeducational institution supervised by the State University of New York. It offers courses in liberal arts and career programs that lead to Associate in Art or Associate in Applied Science degrees.

Electricity and telephone services are available throughout the county. Sewer and water facilities are available in all cities and villages and in some suburban areas. The cities of Niagara Falls and Lockport have daily newspapers and radio stations. Churches of all denominations serve the people of Niagara County. Cultural activities are many.

Recreation facilities are numerous and include eight county parks, seven State parks, and municipal parks in the cities and most of the villages. One park has a zoo, another contains historical Fort Niagara, and the greatest attraction is the park that contains Niagara Falls. The major recreational activities consist of boating, swimming, sailing, golfing, camping, hunting, athletic games, sightseeing, and picnicking. Many recreational activities are privately operated. The State of New York operates the Tonawanda Reservation and the Barge Canal.

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GLOSSARY

Acidity. See Reaction.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

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 of soils, or "chain" of soils on a landscape, that developed from one kind of parent material but having different characteristics because of differences in relief and drainage.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Chroma. One of three variables of color. The relative purity or strength of the spectral color.

Clay. As a soil separates, 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.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are--

Loose.--Noncoherent when dry or moist; does not hold together in a mass.

Friable.--When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.--When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.--When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.--When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.--When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.--When dry, breaks into powder or individual grains under very slight pressure.

Cemented.--Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

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.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Esker (geology). A narrow, winding ridge or mound of stratified gravelly and sandy drift that was deposited by a subglacial stream.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

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.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from glaciers.

Gleization. The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the lower horizons, as a result of waterlogging with poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil.

Graded stripcropping. Growing crops in strips that are slightly graded to drain into a protected waterway.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4)

by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.--Consolidated rock beneath the soil. The rock normally underlies a C horizon but may be immediately beneath an A or B horizon.

Illuviation. The process of deposition of soil material removed from one horizon to another horizon of the soil.

Intergrade. Soils that possess moderately well developed distinguishing characteristics of two or more soil groups.

Internal 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.

Leaching, soil. The removal of soluble materials from soils or other material by percolating water.

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.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in 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.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are--

platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

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

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Variant, soil. A soil having properties sufficiently different from those of 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.

Varves. Distinctly marked annual deposits of sediment, regardless of their origin.

GUIDE TO MAPPING UNITS

To obtain a complete description of a mapping unit, it is necessary to read the description of the mapping unit and the description of the soil series to which it belongs. In referring to a capability unit or a woodland group, read the introduction to the section it is in for general information about its management. Other information in this soil survey is in tables as follows:

Estimated yields, tables 1, 2, and 3 pp. 27 through 36.
Woodland, table 4, page 38.
Wildlife, table 5, page 43.

Engineering uses of soils, tables 6, 7, and 8, pp. 48 through 97.
Nonfarm uses of soils, table 9, page 100.

Map symbol	Mapping units	Described on page	Capability unit		Woodland group	
			Symbol	Page	Symbol	Page
Ad	Alluvial land	122	Vw-1	25	---	---
Af	Altmar loamy fine sand	123	IIw-1	19	4s1	40
Am	Altmar gravelly fine sandy loam	123	IIw-1	19	4s1	40
AnA	Appleton gravelly loam, 0 to 3 percent slopes	124	IIIw-1	21	3w2	40
ApA	Appleton silt loam, 0 to 3 percent slopes	124	IIIw-1	21	3w2	40
ArB	Arkport very fine sandy loam, 0 to 6 percent slopes	125	IIs-2	18	2o1	38
ArC	Arkport very fine sandy loam, 6 to 12 percent slopes	126	IIIe-3	20	2o1	38
AsA	Arkport fine sandy loam, gravelly substratum, 0 to 2 percent slopes	126	IIs-1	18	2o1	38
AsB	Arkport fine sandy loam, gravelly substratum, 2 to 6 percent slopes	126	IIs-2	18	2o1	38
BoA	Bombay fine sandy loam, 0 to 2 percent slopes	127	IIw-2	19	3o1	38
BoB	Bombay fine sandy loam, 2 to 6 percent slopes	127	IIe-3	17	3o1	38
BrA	Brockport silt loam, 0 to 4 percent slopes	129	IIIw-2	22	3w1	40
Ca	Canandaigua silt loam	129	IIIw-3	22	4w1	40
Cb	Canandaigua silty clay loam	130	IIIw-3	22	4w1	40
CcA	Cayuga and Cazenovia silt loams, 0 to 2 percent slopes	131	IIw-2	19	2o1	38
CcB	Cayuga and Cazenovia silt loams, 2 to 6 percent slopes	131	IIe-3	17	2o1	38
CcC	Cayuga and Cazenovia silt loams, 6 to 12 percent slopes	131	IIIe-1	20	2o1	38
CeA	Cazenovia gravelly silt loam, 0 to 3 percent slopes	132	IIw-2	19	2o1	38
CeB	Cazenovia gravelly silt loam, 3 to 8 percent slopes	132	IIe-3	17	2o1	38
CgA	Cazenovia gravelly silt loam, shale substratum, 0 to 3 percent slopes	133	IIw-2	19	2o1	38
CgB	Cazenovia gravelly silt loam, shale substratum, 3 to 8 percent slopes	133	IIe-3	17	2o1	38
Ch	Cheektowaga fine sandy loam	134	IIIw-3	22	5w1	40
ClA	Churchville silt loam, 0 to 2 percent slopes	135	IIIw-2	22	3w1	40
ClB	Churchville silt loam, 2 to 6 percent slopes	135	IIIw-5	23	3w1	40
CmA	Claverack loamy fine sand, 0 to 2 percent slopes	136	IIw-1	19	3s1	40
CmB	Claverack loamy fine sand, 2 to 6 percent slopes	136	IIw-1	19	3s1	40
CnA	Collamer silt loam, 0 to 2 percent slopes	138	IIw-2	19	2o1	38
CnB	Collamer silt loam, 2 to 6 percent slopes	138	IIe-2	17	2o1	38
CoB	Colonie loamy fine sand, 0 to 6 percent slopes	139	IIIs-1	21	4s1	40
Cs	Cosad fine sandy loam	140	IIIw-4	23	4w1	40
Cu	Cut and fill land	140	------	---	---	---
DuB	Dunkirk silt loam, 2 to 6 percent slopes	141	IIe-2	17	2o1	38
DuC3	Dunkirk silt loam, 6 to 12 percent slopes, eroded	141	IVe-2	24	2r1	38
DvD3	Dunkirk and Arkport soils, 12 to 20 percent slopes, eroded	142	VIe-1	25	2r3	38
ElA	Elnora loamy fine sand, 0 to 2 percent slopes	143	IIw-1	19	4s1	40
ElB	Elnora loamy fine sand, 2 to 6 percent slopes	143	IIw-1	19	4s1	40
FaA	Farmington silt loam, 0 to 8 percent slopes	144	IIIs-2	21	5d1	40
Fo	Fonda mucky silt loam	145	IVw-1	24	5w1	40
Fr	Fredon gravelly loam	146	IIIw-1	21	3w2	40
GnA	Galen very fine sandy loam, 0 to 2 percent slopes	147	IIw-1	19	2o1	38
GnB	Galen very fine sandy loam, 2 to 6 percent slopes	147	IIw-1	19	2o1	38
Ha	Hamlin silt loam	148	IIw-3	19	2o2	38
HgA	Hilton gravelly loam, 0 to 3 percent slopes	150	IIw-2	19	2o1	38
HgB	Hilton gravelly loam, 3 to 8 percent slopes	150	IIe-3	17	2o1	38

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GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group	
			Symbol	Page	Symbol	Page
HlA	Hilton silt loam, 0 to 3 percent slopes	150	IIw-2	19	2o1	38
HlB	Hilton silt loam, 3 to 8 percent slopes	150	IIe-3	17	2o1	38
HmA	Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes	151	IIw-2	19	2o1	38
HmB	Hilton and Cayuga silt loams, limestone substratum, 3 to 8 percent slopes	151	IIe-3	17	2o1	38
HoA	Howard gravelly loam, 0 to 3 percent slopes	152	IIs-1	18	2o1	38
HoB	Howard gravelly loam, 3 to 8 percent slopes	152	IIs-2	18	2o1	38
HoC	Howard gravelly loam, 8 to 15 percent slopes	153	IIIe-2	20	2o1	38
HsB	Hudson silt loam, 2 to 6 percent slopes	154	IIe-2	17	2o1	38
HtC3	Hudson silty clay loam, 6 to 12 percent slopes, eroded	154	IVe-2	24	2r1	38
HuF3	Hudson soils, 20 to 45 percent slopes, eroded	154	VIe-1	25	2r3	38
LaB	Lairdsville silt loam, 0 to 6 percent slopes	155	IIe-4	17	3o1	38
Lc	Lakemont silty clay loam	156	IVw-1	24	5w1	40
Ld	Lamson very fine sandy loam	158	IIIw-3	22	4w1	40
Lg	Lamson fine sandy loam, gravelly substratum	158	IIIw-3	22	4w1	40
Lo	Lockport silt loam	159	IIIw-2	22	3w1	40
Ma	Madalin silt loam	161	IVw-1	24	5w1	40
Md	Madalin silt loam, loamy subsoil variant	162	IVw-1	24	5w1	40
Me	Made land	162	-----	--	---	---
Mf	Massena fine sandy loam	163	IIIw-1	21	3w2	40
Mn	Minoa very fine sandy loam	164	IIIw-1	21	3w2	40
Ms	Muck, shallow	165	IVw-2	24	---	---
NaA	Niagara silt loam, 0 to 2 percent slopes	166	IIIw-1	21	3w2	40
NaB	Niagara silt loam, 2 to 6 percent slopes	166	IIIw-5	23	3w2	40
OdA	Odessa silty clay loam, 0 to 2 percent slopes	167	IIIw-2	22	3w1	40
OdB	Odessa silty clay loam, 2 to 6 percent slopes	167	IIIw-5	23	3w1	40
OnB	Ontario loam, 2 to 8 percent slopes	169	IIe-1	16	2o1	38
OnC	Ontario loam, 8 to 15 percent slopes	169	IIIe-1	20	2o1	38
OnC3	Ontario loam, 8 to 15 percent slopes, eroded	169	IVe-1	23	2o1	38
OnD3	Ontario loam, 15 to 30 percent slopes, eroded	169	VIe-1	25	2r2	38
OoA	Ontario loam, limestone substratum, 0 to 3 percent slopes	170	I-1	16	2o1	38
OoB	Ontario loam, limestone substratum, 3 to 8 percent slopes	170	IIe-1	16	2o1	38
OsA	Otisville gravelly sandy loam, 0 to 3 percent slopes	171	IIIs-1	21	4s1	40
OsB	Otisville gravelly sandy loam, 3 to 8 percent slopes	171	IIIs-1	21	4s1	40
OvA	Ovid silt loam, 0 to 2 percent slopes	172	IIIw-1	21	3w2	40
OvB	Ovid silt loam, 2 to 6 percent slopes	173	IIIw-5	23	3w2	40
OwA	Ovid silt loam, limestone substratum, 0 to 3 percent slopes	173	IIIw-1	21	3w2	40
OwB	Ovid silt loam, limestone substratum, 3 to 8 percent slopes	173	IIIw-5	23	3w2	40
PsA	Phelps gravelly loam, 0 to 5 percent slopes	174	IIw-2	19	2o1	38
RaA	Raynham silt loam, 0 to 2 percent slopes	175	IIIw-1	21	3w2	40
RaB	Raynham silt loam, 2 to 6 percent slopes	176	IIIw-5	23	3w2	40
RbA	Rhinebeck silt loam, 0 to 2 percent slopes	177	IIIw-2	22	3w1	40
RbB	Rhinebeck silt loam, 2 to 6 percent slopes	177	IIIw-5	23	3w1	40
RhA	Rhinebeck silty clay loam, sandy substratum, 0 to 2 percent slopes	177	IIIw-2	22	3w1	40
RhB	Rhinebeck silty clay loam, sandy substratum, 2 to 6 percent slopes	178	IIIw-5	23	3w1	40
Rk	Rhinebeck silt loam, thick surface variant	179	IIIw-2	22	3w1	40
RoA	Rock land, nearly level	179	VIIIs-1	25	---	---
RoF	Rockland, steep	179	VIIIs-1	25	---	---
ShB	Schoharie silty clay loam, 2 to 6 percent slopes	181	IIe-4	17	2o1	38
St	Stafford loamy fine sand	182	IIIw-4	23	4w1	40
Su	Stafford loamy fine sand, gravelly substratum	182	IIIw-4	23	4w1	40
Sw	Sun silt loam	183	IVw-1	24	4w1	40
Wa	Wayland silt loam	184	IIIw-6	23	4w1	40

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