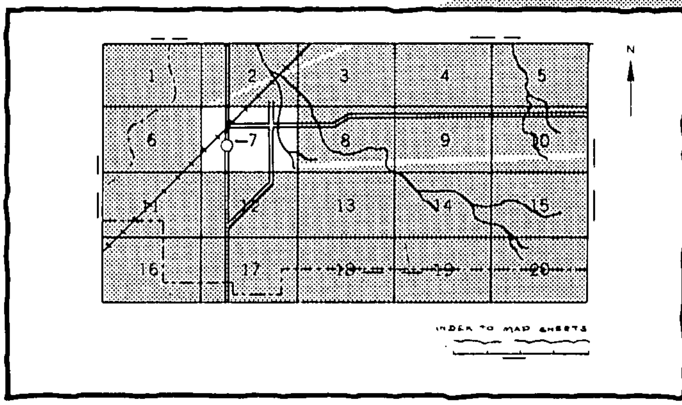
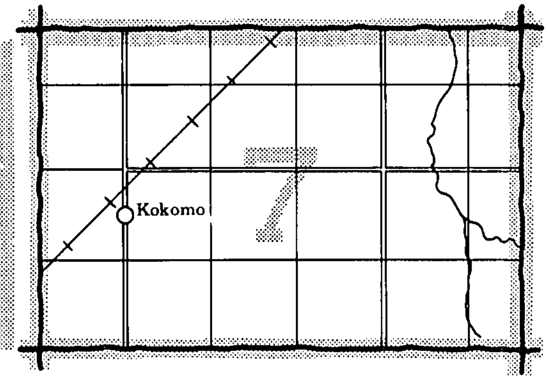
Soil survey of
CASS COUNTY INDIANA

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Purdue University Agricultural Experiment Station and
Indiana Department of Natural Resources
Soil and Water Conservation Committee

HOW TO USE

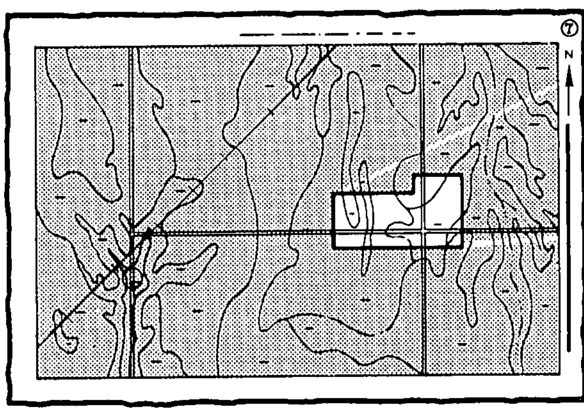
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

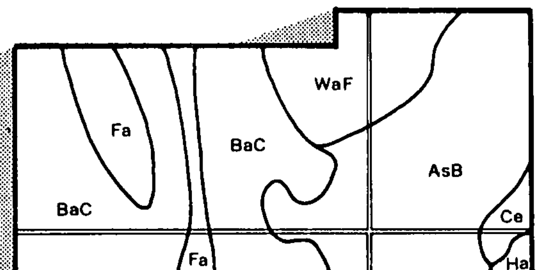




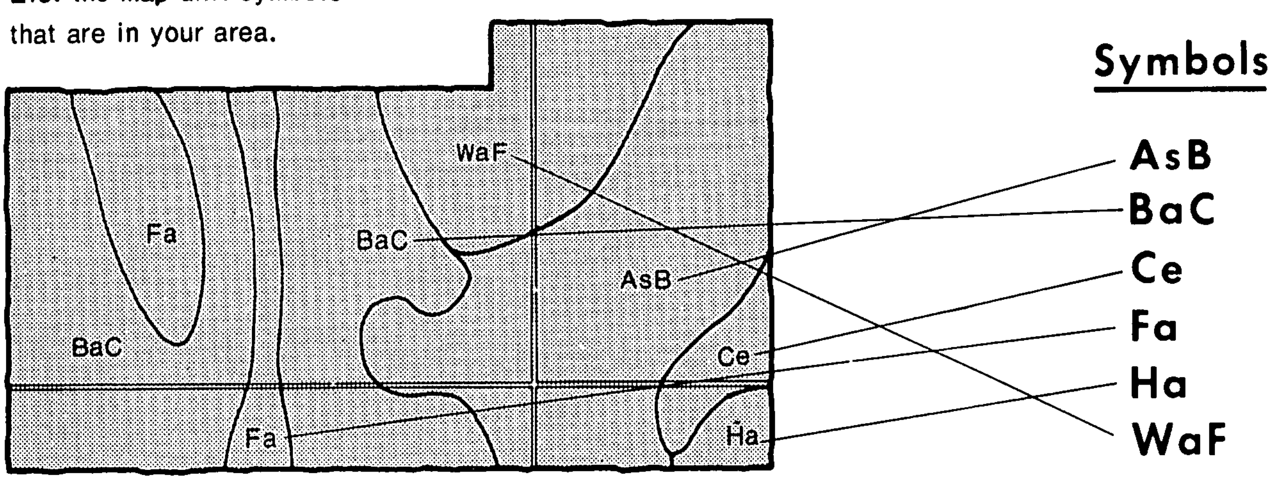
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



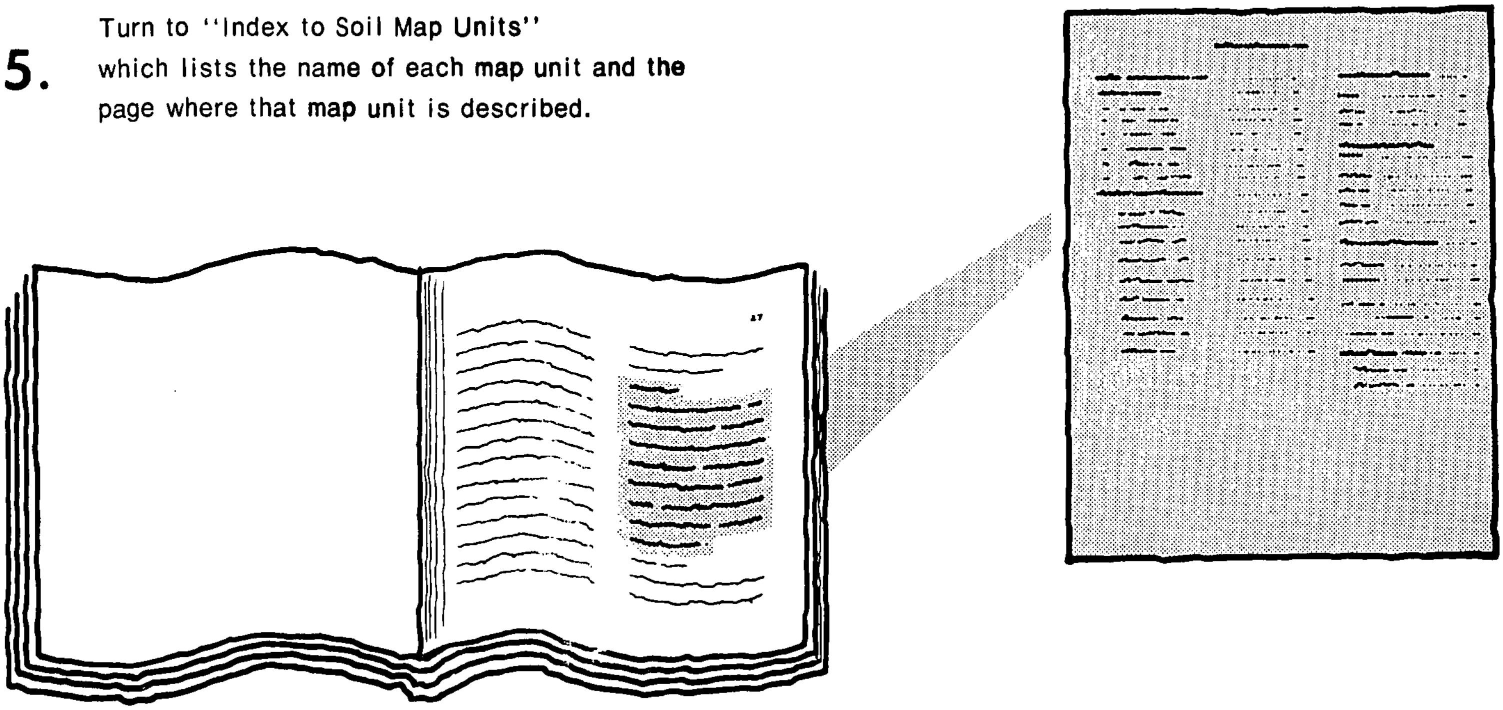


4. List the map unit symbols that are in your area.

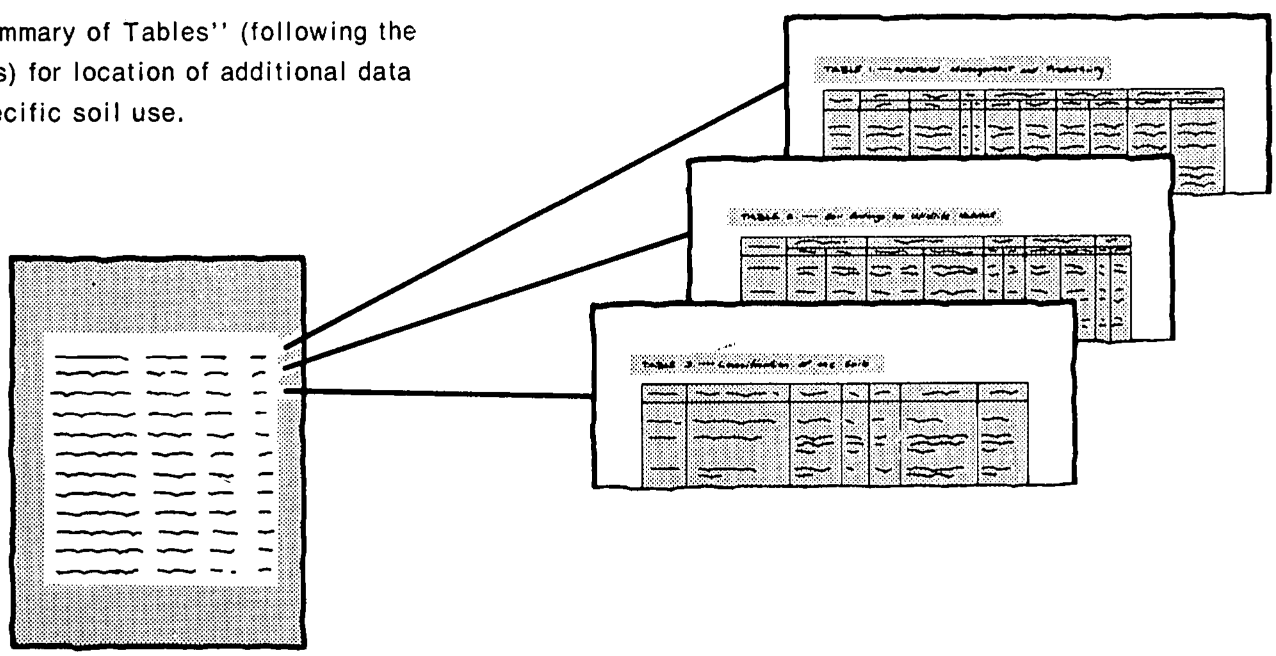


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service, the Purdue University Agriculture Experiment Station, and the Indiana Department of Natural Resources, Soil and Water Conservation Committee. It is part of the technical assistance furnished to the Cass County Soil and Water Conservation District. Financial assistance was provided by the Cass County Board of Commissioners and the county council. Major fieldwork was performed in the period 1973-78. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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soil series

Issued October 1981

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summary of tables

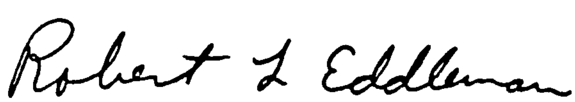
foreword

This soil survey contains information that can be used in land-planning programs in Cass County, Indiana. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

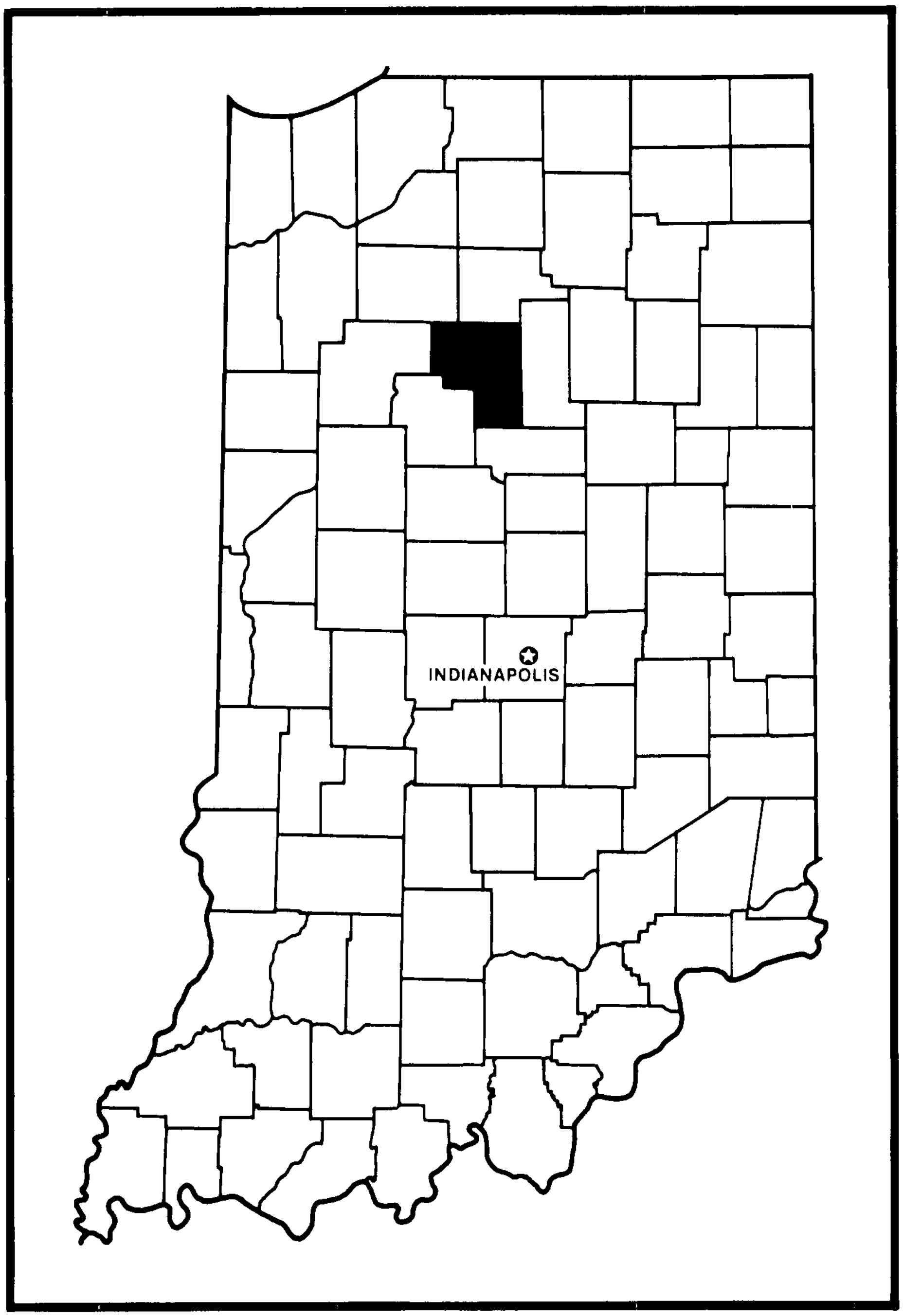
This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



Robert L. Eddleman
State Conservationist
Soil Conservation Service



Location of Cass County in Indiana.

Soil survey of
Cass County, Indiana

By Walter W. Douglas, Soil Conservation Service

Fieldwork by Walter W. Douglas, Soil Conservation Service and
Steven H. Strenger and David A. Tuszynski
Indiana Department of Natural Resources
Soil and Water Conservation Committee

United States Department of Agriculture
Soil Conservation Service in cooperation with
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Cass County is in the north-central part of Indiana. It covers an area of 415 square miles, or 265,600 acres. At the widest points, the county extends about 24 miles from north to south and about 22 miles from west to east. The population of Cass County is about 40,000. Logansport, the largest city, is the county seat. Agricultural business and industry provide job opportunities for many local residents. A variety of small privately owned recreational facilities draw people from surrounding areas. Also, France Park, a county facility, offers a broad range of recreational activities and attracts people from a large area that includes Indianapolis and Chicago.

The first soil survey of Cass County, Indiana, was published in 1955. This survey updates the first survey and provides additional information and larger maps that show the soils in greater detail (*5*).

The county is a flat plain that is dissected by the Wabash and Eel Rivers and numerous creeks, streams, and drainageways. Low relief and a few abrupt changes characterize the physiography of the area.

About 80 percent of the county is cropland and pasture. Corn, soybeans, and small grains are the principal crops. A few small but productive truck farms and orchards are in the county. Some farms have cattle, hogs, or poultry enterprises. Most of the hog and poultry operations are managed in confined quarters and in conjunction with grain farming. There are very few dairies.

general nature of the county

This section gives general information about the county. It discusses topographic relief, drainage, water, climate, and a few facilities that are available to the general public.

topographic relief

The highest point in Cass County is approximately 825 feet above sea level. It is in Bethlehem Township near the town of Metea. The lowest point is 550 feet above sea level. It is located in the southwestern part where the Wabash River leaves the county.

Cass County is generally a flat plain dissected by the Wabash and Eel Rivers and numerous creeks, streams, and ditches. The greatest relief is along the Wabash River Valley in the western part of the county. The southern part of the county is characterized by very flat topography that is occasionally gently rolling. The northern part is undulating with low relief and abrupt changes.

drainage

Cass County is drained by the Wabash and the Eel Rivers and their tributaries, except for a small area in the northern part which is drained by tributaries to the Tippecanoe River.

The Wabash River enters the central part of the county from the east, flows west past Logansport to Georgetown, then turns sharply southwest and leaves the county. Its tributaries are Pipe, Rock, Deer, and Crooked Creeks. The first three drain most of the county south of the Wabash River; Crooked Creek drains much of the central and western area north of the river. The Eel River also enters the county from the east—about 6 1/2 miles south of the northern boundary—flows southwest, and unites with the Wabash River at Logansport. Its tributary, Twelve Mile Creek, drains the northeastern part of the county.

The greater part of Boone township, the northern half of Harrison township, and the northwestern part of Bethlehem township are drained by small streams that flow west or northwest and are tributary to the Tippecanoe River.

water

Water for cities, towns, and rural areas is obtained from municipal and private wells and the Eel River. Most of the water used in the county is ground water pumped from glacial drift. The average depth of wells in the area is 150 to 250 feet.

Most of the water supplied to the city of Logansport is provided by a dam across the Eel River. The U.S. Geological Survey installed a number of test wells along the Teays River Valley to determine the amount of water that can be extracted to help meet the city's future demand for water.

climate

Cass County is cold in winter but quite hot in summer. Winter precipitation, frequently snow, results in a good accumulation of soil moisture by spring and minimizes drought during summer on most soils. Normal annual precipitation is adequate for all crops that are adapted to the temperature and length of growing season in the area.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Delphi, Indiana in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 29 degrees F, and the average daily minimum temperature is 21 degrees. The lowest temperature on record, which occurred at Delphi on January 28, 1963, is -25 degrees. In summer the average temperature is 73 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 107 degrees.

Growing degree days shown in table 1 are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 23 inches, or 62 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 6.96 inches at Delphi on May 16, 1968. Tornadoes and severe thunderstorms occur occasionally. These storms are usually local and of short duration and cause damage in a variable pattern.

Average seasonal snowfall is 21 inches. The greatest snow depth at any one time during the period of record was 16 inches. On the average 14 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 65 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 in summer and 45 in winter.

The prevailing wind is from the southwest. Average windspeed is highest, 12 miles per hour, in March.

Climatic data for this section were specially prepared for the Soil Conservation Service by the National Climatic Center, Asheville, North Carolina.

transportation facilities

There are two federal highways in Cass County, six state highways, and approximately 960 miles of county roads. Most county roads are on section lines and many have a bituminous surface.

A municipal airport serves small private planes. It has limited air freight services. A number of communities have rail service. Commercial bus transportation is also available.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study 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, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the potential of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, specialty crops, woodland, urban uses,* and *recreation areas.* Cultivated crops are those grown extensively in the survey area. Specialty crops are the vegetables and fruits that generally require intensive management. Woodland refers to areas of native or introduced trees. Urban uses include residential, commercial, and industrial developments. Intensive recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic. Extensive recreation areas are those used for nature study and as wilderness.

Map units along the county lines may not be the same in this soil survey as in surveys of adjacent counties that were published at a different date. The soil names and descriptions may also be different from those published for an adjacent county. These differences are a result of changes and refinements in the classification, correlation, and identification of the soils.

soil descriptions

Nearly level to strongly sloping soils that are very poorly drained to well drained

This group of map units makes up about 80 percent of the county. It is made up mostly of soils that have glacial till as the underlying material. They are used mainly for corn, soybeans, and small grains. Many of the steeper areas are used for hay or are in pasture or woodland. These soils are generally well suited to farming. They are generally suited to residential and urban development in sloping areas but are poorly suited in nearly level and depressional areas.

1. Cyclone-Fincastle

Deep, nearly level and gently sloping, poorly drained and somewhat poorly drained, silty soils that formed in loess and glacial till

This map unit consists of soils on till plains characterized by a gently undulating topography. Slopes range from 0 to 3 percent.

This map unit covers about 28 percent of the county. It is about 42 percent Cyclone soils, 37 percent Fincastle soils, and 21 percent minor soils.

Cyclone soils are poorly drained and are on broad flats and in depressional areas. They have a very dark gray silt loam surface layer. The subsoil is dark gray, grayish brown, and gray silt loam. The underlying material is gray loam. Fincastle soils are somewhat poorly drained and are in broad, low-lying areas. They have a dark grayish brown silt loam surface layer. The subsoil is brown and grayish brown silt loam and silty clay loam and brown clay loam. The underlying material is yellowish brown loam.

The minor soils in this unit are the well drained Russell soils on knobs and breaks along drainageways, the moderately well drained Xenia soils and somewhat poorly drained Starks soils in gently sloping areas, and the somewhat poorly drained Shoals soils and very poorly drained Patton soils in the lowest lying areas.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. A few areas are used for hay or are in pasture or woodland.

The soils in this map unit are well suited to cultivated crops. The main limitations are ponding and wetness.

These soils are generally well suited to woodland. The main limitations are ponding and wetness. These soils are generally poorly suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, low strength, ponding, moderately slow and slow permeability, and wetness.

2. Russell-Miami

Deep, gently sloping to strongly sloping, well drained, silty soils that formed in loess and glacial till

This map unit consists of soils on till plains dissected by numerous natural drainageways. The topography of the unit is sloping. The steeper soils are on the sides of the drainageways, and the more gently sloping soils are between the drainageways. Slopes range from 2 to 18 percent.

This map unit covers about 9 percent of the county. It is about 46 percent Russell soils, 24 percent Miami soils, and 30 percent minor soils.

Russell soils are well drained and are on ridgetops near the edge of the upland and on knobs adjacent to drainageways. They have a dark grayish brown silt loam surface layer and a brown silt loam subsurface layer. The subsoil is yellowish brown silt loam, yellowish brown and dark yellowish brown silty clay loam, and dark yellowish brown and brown loam. The underlying material is brown loam. Miami soils are well drained and are on side slopes of natural drainageways and in slightly elevated areas. They have a dark grayish brown silt loam surface layer. The subsoil is dark yellowish brown silty clay loam and clay loam and dark brown clay loam. The underlying material is yellowish brown loam.

The minor soils in this unit are the well drained Hennepin soils on steep and very steep breaks, the well drained Kosciusko soils in less sloping areas, the moderately well drained Xenia soils in slightly convex areas, the somewhat poorly drained Fincastle soils on lower lying flats, and the somewhat poorly drained Shoals soils and poorly drained Cyclone soils in the lowest lying and depressional areas.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. Some areas are used for hay, are in pasture or woodland, or are used for urban development. The soils in this map unit are generally suited to cultivated crops. The main limitation is erosion.

These soils are well suited to woodland. They are generally suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, low strength, shrinking and swelling, slope, and moderately slow and moderate permeability.

3. Riddles-Rensselaer-Crosier

Deep, nearly level to moderately sloping, well drained, very poorly drained, and somewhat poorly drained, silty and loamy soils that formed in glacial till or in outwash deposits and glacial till

This map unit consists of soils on sloping till plains that have well defined depressional areas. The steeper soils are on breaks along drainageways and in depressional areas. Slopes range from 0 to 12 percent.

This map unit covers about 27 percent of the county. It is about 28 percent Riddles soils, 23 percent Rensselaer soils, and 16 percent Crosier soils. The remaining 33 percent is minor soils.

Riddles soils are well drained and are on side slopes of natural drainageways and on low rises. They have a dark brown silt loam surface layer. The subsoil is dark yellowish brown and yellowish brown clay loam and brown loam. The underlying material is yellowish brown loam. Rensselaer soils are very poorly drained and are in broad, low-lying areas and in depressional areas. They have a black loam surface layer. The subsoil is very dark gray and dark gray clay loam and gray stratified sandy loam, loam, and loamy sand. The underlying material is grayish brown loam. Crosier soils are somewhat poorly drained and are in broad, low-lying areas. They have a dark grayish brown loam surface layer. The subsoil is brown clay loam and light brownish gray loam. The underlying material is grayish brown loam.

The minor soils in this unit are the well drained Miami soils in steeper, more eroded areas; the well drained Metea and Wawasee soils on the higher, narrow, elongated ridges; and the very poorly drained Houghton and Ackerman soils in the deeper depressional areas.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. A few areas are used for hay, are in pasture or woodland, or are used for urban development.

The soils in this map unit are generally well suited to cultivated crops. The main limitations are erosion, ponding, and wetness.

The soils in this map unit are generally suited to woodland. The main limitations are ponding and wetness. These soils are generally suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, shrinking and swelling, low strength, ponding, slope, moderate and moderately slow permeability, and wetness.

4. Metea-Miami-Rensselaer

Deep, nearly level to strongly sloping, well drained and very poorly drained, sandy, silty, and loamy soils that formed in outwash deposits and glacial till or in loess and glacial till

This map unit consists of soils on sloping till plains that have well defined depressional areas and higher narrow, elongated ridges. The steeper soils are on breaks along drainageways and in depressional areas. Slopes range from 0 to 18 percent.

This map unit covers about 5 percent of the county. It is about 35 percent Metea soils, 29 percent Miami soils, and 22 percent Rensselaer soils. The remaining 14 percent is minor soils.

Metea soils are well drained and are on side slopes of natural drainageways and on knolls and ridges of the upland. They have a dark brown loamy fine sand surface layer. The subsurface layer is yellowish brown sand. The subsoil is yellowish brown sandy loam and dark yellowish brown clay loam and loam. The underlying material is yellowish brown loam. Miami soils are well drained and are on side slopes of natural drainageways and in slightly elevated areas. They have a dark grayish brown silt loam surface layer. The subsoil is dark yellowish brown silty clay loam and clay loam and dark brown clay loam. The underlying material is yellowish brown loam. Rensselaer soils are very poorly drained and are in broad, low-lying areas and in depressional areas. They have a black loam surface layer. The subsoil is very dark gray and dark gray clay loam and gray stratified sandy loam, loam, and loamy sand. The underlying material is grayish brown loam.

The minor soils in this unit are the excessively drained Chelsea soils on the higher narrow, elongated ridges; the somewhat poorly drained Crosier soils on low rises; the very poorly drained Houghton and Ackerman soils in the deeper depressional areas; and the very poorly drained Maumee soils in depressional areas adjacent to Chelsea and Metea soils on ridges.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. In some areas these soils are used for hay, are in pasture or woodland, or are used for urban development.

The soils in this map unit are generally suited to cultivated crops. The main limitations are droughtiness, erosion, ponding, and soil blowing.

These soils are generally well suited to woodland. The main limitations are droughtiness, ponding, and soil blowing. These soils are generally suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, low strength, moderately slow permeability, ponding, shrinking and swelling, and slope.

5. Rensselaer-Crosier

Deep, nearly level and gently sloping, very poorly drained and somewhat poorly drained, loamy soils that formed in outwash deposits and glacial till or in glacial till

This map unit consists of soils on till plains characterized by gently undulating topography. Slopes range from 0 to 3 percent.

This map unit covers about 5 percent of the county. It is about 44 percent Rensselaer soils, 35 percent Crosier soils, and 21 percent minor soils.

Rensselaer soils are very poorly drained and are in broad, low-lying areas and in depressional areas. They have a black loam surface layer. The subsoil is very dark gray and dark gray clay loam and gray stratified sandy loam, loam, and loamy sand. The underlying material is grayish brown loam. Crosier soils are somewhat poorly drained and in broad, low-lying areas. They have a dark grayish brown loam surface layer. The subsoil is brown clay loam and light brownish gray loam. The underlying material is grayish brown loam.

The minor soils in this unit are the well drained Metea, Riddles, and Wawasee soils on convex knobs and breaks along drainageways and the very poorly drained Houghton and Ackerman soils in the deeper depressional areas.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. A few areas are used for hay or are in pasture or woodland.

The soils in this map unit are well suited to cultivated crops. The main limitations are ponding and wetness.

These soils are generally well suited to woodland. The main limitations are ponding and wetness. They are poorly suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, low strength, ponding, moderately slow permeability, and wetness.

6. Glynwood-Morley

Deep, gently sloping and moderately sloping, moderately well drained and well drained, silty and loamy soils that formed in loess and glacial till

This map unit consists of soils on till plains dissected by numerous natural drainageways. The topography of the unit is sloping. The steeper soils are on breaks next to the drainageways. Slopes range from 2 to 12 percent.

This map unit covers about 6 percent of the county. It is about 27 percent Glynwood soils, 14 percent Morley soils, and 59 percent minor soils.

Glynwood soils are moderately well drained and are on the sides of natural drainageways and in slightly elevated areas. They have a dark grayish brown silt loam surface layer. The subsoil is yellowish brown silty clay loam and dark yellowish brown clay loam. The underlying material is dark brown clay loam. Morley soils are well drained and are on side slopes of natural drainageways, knolls, and narrow, elongated ridges of the upland. They have a dark yellowish brown clay loam surface layer. The subsoil is dark yellowish brown and yellowish brown clay loam. The underlying material is yellowish brown clay loam.

The minor soils in this unit are the well drained Hennepin soils on steep breaks, the well drained Riddles and Wawasee soils on breaks next to the drainageways, and the somewhat poorly drained Blount soils in lower-lying areas.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. Some areas are used for hay, are in pasture or woodland, or are used for urban development.

The soils in this map unit are generally suited to cultivated crops. The main limitation is erosion.

These soils are well suited to woodland. They are suited to building sites, local roads and streets, and sanitary facilities. The main limitations are shrinking and swelling, frost action, low strength, slope, moderately slow or slow permeability, and wetness.

Nearly level to moderately sloping soils that are very poorly drained, somewhat poorly drained, and well drained

This group of map units makes up about 12 percent of the county. It is made up mostly of soils that have sand and gravelly sand as the underlying material. They are used mainly for corn, soybeans, and small grains. Many of the steeper areas are used for hay or are in pasture or woodland. These soils are generally well suited to farming. They are generally suited to residential and urban development in sloping areas but are poorly suited in nearly level and depressional areas.

7. Rush-Kosciusko

Deep, nearly level to moderately sloping, well drained, silty and loamy soils that formed in loess and outwash deposits or in outwash deposits

This map unit consists of soils on outwash plains and river terraces that have one to three steplike areas progressing upward from the river bottom lands. Slopes range from 0 to 12 percent.

This map unit covers about 10 percent of the county. It is about 33 percent Rush soils, 18 percent Kosciusko soils, and 49 percent minor soils.

Rush soils are well drained and are on the top of high river terraces and on the sides of these terraces that face away from the river. They have a dark brown silt loam surface layer. The subsoil is dark yellowish brown silty clay loam, dark brown clay loam and loam, and reddish brown gravelly sandy clay loam. The underlying material is brown very gravelly coarse sand. Kosciusko soils are well drained and are in broad areas, on side slopes, and on small knobs. They have a dark brown silt loam or sandy clay loam surface layer. The subsoil is dark yellowish brown and dark brown sandy clay loam and dark brown gravelly sandy clay loam and gravelly sandy loam. The underlying material is yellowish brown gravelly coarse sand.

The minor soils in this unit are the somewhat excessively drained Bloomfield soils on knobs and narrow, elongated ridges, the well drained Gessie Variant and Stonelick soils on higher rises of flood plains, the somewhat poorly drained Sleeth soils in the lower-lying areas, the somewhat poorly drained Shoals soils in depressional areas on flood plains, and the very poorly drained Gilford gravelly substratum soils in depressional areas and along drainageways.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. Some areas are used for hay, are in pasture or woodland, or are used for urban development.

The soils in this map unit are generally well suited to cultivated crops. The main limitation is erosion.

These soils are well suited to woodland. They are generally suited to building sites, local roads and streets, and sanitary facilities. The main limitations are shrinking and swelling, frost action, low strength, poor filter, and slope.

8. Rush-Gilford-Sleeth

Deep, nearly level and gently sloping, well drained, very poorly drained, and somewhat poorly drained, silty and loamy soils that formed in loess and outwash deposits or in outwash deposits and lake sediments

This map unit consists of soils on sloping outwash plains and river terraces that have some broad, low-lying areas. Slopes range from 0 to 6 percent.

This map unit covers about 2 percent of the county. It is about 35 percent Rush soils, 34 percent Gilford soils, and 18 percent Sleeth soils. The remaining 13 percent is minor soils.

Rush soils are well drained and are on top of high river terraces and on the sides of these terraces that face away from the river. They have a dark brown silt loam surface layer. The subsoil is dark yellowish brown silty clay loam, dark brown clay loam and loam, and reddish brown gravelly sandy clay loam. The underlying material is brown very gravelly coarse sand. Gilford soils are very poorly drained and are on broad flats and in depressional areas. They have a black sandy loam surface layer and a very dark gray sandy loam subsurface layer. The subsoil is dark gray sandy loam and grayish brown loamy sand. The underlying material is pale brown and light brownish gray sand. Sleeth soils are somewhat poorly drained and are in the flatter areas of oval river terraces or at the base of these terraces. They have a dark grayish brown silt loam surface layer. The subsoil is dark grayish brown silt loam, brown and grayish brown silty clay loam, grayish brown and yellowish brown clay loam, and yellowish brown gravelly clay loam. The underlying material is brown stratified sand and very gravelly sand.

The minor soils are the excessively drained Chelsea soils and the well drained Ormas soils on slightly higher knobs and elongated ridges, the somewhat poorly drained Morocco soils in nearly level areas adjacent to Ormas and Chelsea soils, and the very poorly drained Houghton and Ackerman soils in deeper depressional areas.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. A few areas are used for hay or are in pasture or woodland.

The soils in this map unit are generally well suited to cultivated crops. The main limitations are erosion, ponding, and wetness.

The soils in this map unit are generally suited to woodland. The main limitations are ponding and wetness. These soils are generally poorly suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, shrinking and swelling, low strength, ponding, poor filtering ability, and wetness.

Nearly level to moderately sloping soils that are very poorly drained, moderately well drained, and excessively drained

The map unit of this group makes up about 4 percent of the county. It is made up mostly of soils that have sand as the underlying material. They are used mainly for corn, soybeans, and small grains. Many areas are used for hay or are in pasture or woodland. These soils are generally suited to farming. They are generally well suited to residential and urban development in sloping areas but are poorly suited in nearly level and depressional areas.

9. Gilford-Chelsea-Oakville

Deep, nearly level to moderately sloping, very poorly drained, excessively drained, and moderately well drained, loamy and sandy soils that formed in outwash deposits and lake sediments or in outwash deposits

This map unit consists of soils on outwash plains and lake plains that have slight rises and high, elongated ridges. Slopes range from 0 to 12 percent.

This map unit covers about 4 percent of the county. It is about 41 percent Gilford soils, 18 percent Chelsea soils, and 16 percent Oakville soils. The remaining 25 percent is minor soils.

Gilford soils are very poorly drained and are on broad flats and in depressional areas. They have a black sandy loam surface layer and a very dark gray sandy loam subsurface layer. The subsoil is dark gray sandy loam and grayish brown loamy sand. The underlying material is pale brown and light brownish gray sand. Chelsea soils are excessively drained and are on east-facing slopes of ridges and dunes. They have a very dark gray loamy fine sand surface layer. The subsurface layer is brown and dark yellowish brown fine sand. The next layer is brownish yellow fine sand with strong brown bands of loamy sand. Oakville soils are moderately well drained and are on slight rises. They have a dark brown loamy fine sand surface layer. The subsoil is yellowish brown and brownish yellow fine sand. The underlying material is pale brown fine sand.

The minor soils in this unit are the somewhat poorly drained Morocco soils on low rises in the depressional areas and in low areas on ridges and the very poorly drained Maumee, Houghton, and Ackerman soils in the deeper depressional areas.

The soils in this map unit are used mainly for cultivated crops. Corn, soybeans, and small grains are the major crops. Many areas are used for hay or are in pasture or woodland.

The soils in this map unit are generally suited to cultivated crops. The main limitations are droughtiness, ponding, and soil blowing.

These soils are suited to woodland. The main limitations are droughtiness, ponding, and soil blowing. These soils are generally suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, ponding, poor filtering ability, and wetness.

Nearly level to moderately sloping soils that are well drained and very poorly drained

The map unit of this group makes up about 4 percent of the county. It is made up mostly of soils that have limestone as the underlying material. They are used mainly for hay or are in pasture. Some areas are used for corn, soybeans, and small grains. A few areas are in woodland. These soils are generally suited to farming. They are generally poorly suited to residential and urban development.

10. NewGlarus-Millsdale

Moderately deep, nearly level to moderately sloping, well drained and very poorly drained, silty soils that formed in loess and residuum from limestone or in glacial till or outwash deposits over limestone

This map unit consists of soils on sloping till plains and on river terraces. Some steep soils are along river channels. Slopes range from 0 to 12 percent.

This map unit makes up about 4 percent of the county. It is about 56 percent NewGlarus soils, 30 percent Millsdale soils, and 14 percent minor soils.

NewGlarus soils are well drained and are in broad, higher-lying areas and on low knolls. They have a dark grayish brown silt loam surface layer. The subsoil is brown silt loam, dark yellowish brown silty clay loam, and dark brown clay. The underlying material is hard limestone bedrock. Millsdale soils are very poorly drained and are in low-lying depressional areas. They have a very dark gray silty clay loam surface layer. The subsoil is very dark gray and dark gray silty clay. The underlying material is limestone bedrock.

The minor soils are the well drained Rush soils on the higher convex knobs, the well drained Gessie Variant and Stonelick soils on rises on the flood plains, the somewhat poorly drained Shoals soils in depressional areas on flood plains, and the very poorly drained Gilford gravelly substratum soils in depressional areas.

The soils in this map unit are used mainly for hay or are in pasture or woodland. In some areas they are used for cultivated crops. Corn, soybeans, and small grains are the major crops.

The soils in this map unit are generally suited to cultivated crops and are well suited to hay and pasture. The main limitations are ponding, erosion, and shallowness to bedrock.

These soils are well suited to woodland. The main limitations are ponding and shallowness to bedrock.

They are poorly suited to building sites, local roads and streets, and sanitary facilities. The main limitations are frost action, low strength, shrinking and swelling, ponding, shallowness to bedrock, slope, and moderately slow permeability.

broad land use considerations

The land in Cass County is mainly used for cultivated farm crops. Table 4 shows that most of the map units on the general soil map have soils that are well suited or suited to cultivated farm crops. The soils in the northern and eastern parts of the county typically have a medium and moderately fine textured subsoil and are moderately deep to the underlying material. The soils in the southern part of the county typically have a medium and moderately fine textured subsoil and are deep to the underlying material. All of these soils formed in a thin mantle of loess and the underlying loamy glacial till.

Most of the map units on the general soil map contain some soils in which wetness is a limitation for cultivated farm crops. Many areas have adequate drainage for cultivated farm crops and many areas need to be drained. Soil blowing and erosion are hazards of the Metea-Miami-Rensselaer and the Gilford-Chelsea-Oakville map units. Soils underlain with limestone at a depth of 20 to 40 inches are in the NewGlarus-Millsdale map unit and are adjacent to the Wabash River through most of the county. Water erosion is a hazard on the Russell-Miami, Glynwood-Morley, and Rush-Kosciusko map units.

All of the map units are well suited or suited to woodland. The production of timber for commercial purposes is of limited extent in the county because most land is used for cultivated crops. The few commercially valuable trees that are scattered throughout the county generally do not grow as rapidly on the wetter soils of the Cyclone-Fincastle and the Rensselaer-Crosier map units as they do on the Russell-Miami and the Rush-Kosciusko units. They are also less common on the wetter soils.

The general soil map is most helpful for planning the general outline of urban areas; it cannot be used for the selection of sites for specific urban structures. Table 4 shows that the Russell-Miami, the Riddles-Rensselaer-Crosier, the Metea-Miami-Rensselaer, the Glynwood-Morley, the Rush-Kosciusko, and the Gilford-Chelsea-Oakville map units are suited to residential and urban development. The Cyclone-Fincastle and the Rensselaer-Crosier map units are poorly suited to residential and urban development because of the seasonal high water table. Wetness is a limitation that affects the use and management of many soils for nonfarming purposes. In most areas this limitation is difficult to overcome.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Miami silt loam, 6 to 12 percent slopes, eroded, is one of several phases in the Miami series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

Ad—Ackerman muck, drained. This deep, nearly level, very poorly drained soil is often ponded by surface water runoff from adjacent soils. It is in broad, low-lying areas, in depressional areas, and along drainageways. Individual areas are irregular in shape. They range from 3 to about 40 acres and the dominant size is about 10 acres.

In a typical profile the organic material is black muck about 11 inches thick. The next layer, to a depth of about 23 inches, is very dark grayish brown and gray, mottled coprogenous earth. The underlying material to a depth of 60 inches or more is pale brown fine sand in the upper part and brownish yellow fine sand in the lower part. In some areas the organic material is more than 30 inches thick over sandy material. In some areas the underlying material is loam or sandy loam.

Included with this soil in mapping are a few small areas of very poorly drained Maumee soils. They are at the outer edge of the map unit and make up about 5 percent of it.

The available water capacity of the Ackerman soil is very high. Permeability is moderately slow to moderately rapid in the organic material, slow in the coprogenous earth, and rapid in the underlying material. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. Organic matter content of the surface layer is very high.

Most areas of this soil are used for cultivated crops. Some areas of this soil are used for wildlife habitat or are in woodland.

This soil is poorly suited to corn. Soil blowing and ponding are hazards that affect the use and management. Soil blowing can be controlled by windbreaks and by conservation tillage that returns all or part of the crop residue to the soil surface. Excess water can be removed by open ditches, subsurface drains, pumping, or a combination of these methods. This soil is not suited to intensive row cropping. Intensive cultivation over a period of years causes substantial decomposition of the organic matter and exposes the sedimentary peat. When plowed, the peat generally remains in large clods, and when exposed to air, it quickly dries. These clods, which break down very slowly, make it difficult to prepare a seedbed.

This soil is well suited to grasses and legumes for hay. It is poorly suited to pasture. Soil blowing and ponding are hazards. Insufficient moisture during the summer months can result in droughtiness as a limitation. Frost heaving is also a limitation. Drainage is needed for best results. When this soil is in pasture, plants are easily uprooted by the hoofs of animals.

This soil is suited to trees. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are the major management concerns. The possibility of the muck burning is a limitation. Harvesting and logging during dry periods or during winter months when the surface is frozen will lower the limitations for use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system used to lower the water table reduces seedling mortality and permits deeper penetration of roots. Water-tolerant species that have deep root systems are favored in timber stands. Seedlings grow well if competing vegetation is controlled by plow planting, by site preparation, or by spraying, cutting, or girdling.

This soil is severely limited for building sites and generally is unsuitable for this use because of ponding and the unstable organic soil material. This soil is severely limited for local roads because of ponding and frost action. Hauling in suitable fill material, constructing roads in elevated fill areas, and providing roadside ditches will reduce these limitations. This soil is severely limited for septic tank absorption fields and is generally unsuitable for this use because of ponding and poor filtering qualities of the soil.

This soil is in capability subclass IVw and woodland suitability subclass 4w.

BmC—Bloomfield loamy fine sand, 4 to 12 percent slopes. This deep, gently sloping and moderately sloping, somewhat excessively drained soil is on knobs and narrow elongated ridges. Individual areas are long and narrow. They range from 5 to about 40 acres, and the dominant size is about 15 acres.

In a typical profile the surface layer is dark brown loamy fine sand about 9 inches thick. The subsurface layer is about 16 inches thick. It is yellowish brown loamy sand in the upper part and light yellowish brown sand in the lower part. The subsoil is about 51 inches thick. It is dark yellowish brown, very friable loamy sand and loamy fine sand. The underlying material to a depth of 80 inches or more is yellowish brown fine sand. In some small areas this soil has bands at depths of 18 to 40 inches and is underlain by clay loam.

Included with this soil in mapping are small areas of well drained Metea and Riddles soils near the upland till plain. These inclusions make up about 2 percent of the map unit. Some small areas of steeper soils are throughout the map unit and make up about 2 percent of it.

The available water capacity of the Bloomfield soil is low, and permeability is rapid. Runoff is slow. The organic matter content of the surface layer is low.

Most areas of this soil are used for hay or pasture. Some of it is used for cultivated crops. Crops are grown in areas that are surrounded by more productive soils. Some areas are in woodland.

This soil is suited to small grains and corn if adequately fertilized and irrigated. The main concerns of management are slope, soil blowing, conserving moisture in midsummer, and maintaining the organic matter content and fertility of the soil. Conservation tillage that leaves all or part of the crop residue on the surface, winter cover crops, irrigation, and planting windbreaks are ways to control soil blowing, conserve moisture in midsummer, and help maintain the organic matter content. Other ways to control soil blowing are grass seeding or sodding and fertilization.

This soil is well suited to grasses and legumes for hay or pasture. Erosion in steeper areas and soil blowing are hazards. Droughtiness is a limitation. Overgrazing causes erosion and soil blowing and reduces plant density and hardiness. Proper stocking, strip grazing, timely deferment of grazing during dry periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is suited to trees. Seedling mortality is the major management concern. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later.

This soil is moderately limited for building sites because of slope. Sites should be graded or buildings should be designed to complement the slope. This soil is moderately limited for local roads and streets because of slope. The land can be leveled or the roads constructed on the contour. This soil is severely limited for septic tank absorption fields because it is a poor filter. The rapid permeability could cause the seepage of effluent into ground water supplies to become a hazard. Enlarging the filter field or mixing this soil with a better filtering material help to control seepage.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

BnA—Blount silt loam, 0 to 3 percent slopes. This deep, nearly level or gently sloping, somewhat poorly drained soil is in broad, low areas. Individual areas are irregular in shape. They range from 5 to about 40 acres, and the dominant size is about 25 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 17 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam, and the lower part is yellowish brown, mottled, firm clay loam. The underlying material to a depth of 60 inches or more is yellowish brown, mottled clay loam. In a few areas the surface layer is loam.

Included with this soil in mapping are some small areas of well drained Miami soils on small knobs. They make up about 2 percent of the map unit. A few small areas of well drained Morley soils are in long, narrow areas adjacent to natural drainageways and make up about 2 percent of the map unit. Some areas of very poorly drained Rensselaer soils are in depressions and make up about 3 percent of the unit.

The available water capacity of the Blount soil is moderate, and permeability is low. Runoff is slow. The seasonal high water table fluctuates between a depth of 1 foot to 3 feet. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. Some small areas are in pasture or woodland.

This soil is well suited to corn, soybeans, and small grains. Wetness is a limitation. Excess water can be removed by open ditches, surface and subsurface drains, and pumping. Conservation tillage that returns all or part of the crop residue to the surface and cover crops help to improve and maintain tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion in steeper areas is a hazard, and wetness is a limitation. Drainage is needed for best results. Overgrazing and grazing when the soil is too wet can result in surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is suited to trees. Seedling mortality and windthrow hazard are the major management concerns. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. Species that have deep root systems are favored in timber stands.

This soil is severely limited for building sites because of wetness. An adequate drainage system in conjunction with storm sewers is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. Installing footing drains and backfilling with a coarse material are needed. This soil is severely limited for local roads and streets because of frost action and low strength. Providing graded roadside ditches will lower the water table and reduce damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and control frost action. This soil is severely limited for septic tank absorption fields and is generally unsuitable for this use because of wetness and slow permeability. Enlarging the absorption field or using a nearby suitable site is needed to overcome these limitations. Connecting the facilities to commercial sewer systems, where available, is an alternative solution.

This soil is in capability subclass IIw and woodland suitability subclass 3c.

ChC—Chelsea loamy fine sand, 4 to 12 percent slopes. This deep, gently sloping or moderately sloping, excessively drained soil is on ridges and dunes. Individual areas are linear. They range from 3 to about 15 acres, and the dominant size is about 10 acres.

In a typical profile the surface layer is very dark gray loamy fine sand about 4 inches thick. The subsurface layer, about 18 inches thick, is brown and dark yellowish brown fine sand. The next layer to a depth of 80 inches or more is brownish yellow fine sand with strong brown bands of loamy sand. In some areas the depth to the uppermost band of loamy sand is less than 27 inches. In a few places, the underlying material is gravelly sand. Some places are fine sand throughout the pedon.

Included with this soil in mapping are a few small areas of well drained Metea soils in the lower lying areas, and they make up about 3 percent of the unit. A few areas of steeper soils make up about 2 percent of the map unit.

The available water capacity of the Chelsea soil is low, and permeability is rapid. Runoff is medium. The organic matter content of the surface layer is low.

Most areas of this soil are used for pasture or woodland. A few areas are used for cultivated crops.

This soil is suited to small grains and corn if adequately fertilized and irrigated. The main concerns of management are droughtiness and soil blowing. Small grains are better suited than corn because they normally mature before the drier part of the year. If this soil is used for cultivated crops, there is a hazard of soil blowing. Conservation tillage, mulches, cover crops, and windbreaks help control excessive soil loss. Returning all or part of the crop residue to the surface or the regular addition of other organic material helps to improve fertility and the available water capacity.

This soil is suited to grasses and legumes for hay or pasture. Erosion in steeper areas and soil blowing are hazards. Droughtiness is a limitation. Overgrazing causes erosion and soil blowing and reduces plant density and hardiness. Proper stocking, strip grazing, and timely deferment of grazing during the summer months help to keep the soil and pasture in good condition.

This soil is suited to trees. Seedling mortality is the major management concern. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later.

Limitations are few on this soil for building sites and local roads and streets. This soil is severely limited for septic tank absorption fields because it is a poor filter. Rapid permeability could result in seepage of effluent into ground water supplies. Enlarging the absorption field and mixing this soil with suitable material help to control seepage.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

CpA—Crosier loam, 0 to 3 percent slopes. This deep, nearly level or gently sloping, somewhat poorly drained soil is in broad, low-lying areas. Individual areas are mainly irregular in shape. They range from 5 to about 120 acres, and the dominant size is about 40 acres.

In a typical profile the surface layer is dark grayish brown loam about 10 inches thick. The subsoil is about 20 inches thick. It is brown, mottled, firm clay loam in the upper part and light brownish gray, mottled, firm loam in the lower part. The underlying material to a depth of 60 inches or more is grayish brown loam. In some small areas the solum is thicker than 40 inches.

Included with this soil in mapping are some small areas of well drained Miami soils on long, narrow strips adjacent to natural drainageways. They make up about 2 percent of the map unit. A few small areas of very poorly drained Rensselaer soils are included in depressions where they make up about 5 percent of the map unit. Some areas of well drained Riddles soils are in higher lying areas and make up about 2 percent of the map unit.

The available water capacity of the Crosier soil is high, and permeability is moderately slow. Runoff is slow or medium. The seasonal high water table is at a depth of 1 foot to 3 feet. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. Some small areas are in pasture or woodland.

This soil is well suited to corn, soybeans, and small grains. Wetness is the major limitation. Excess water can be removed by open ditches and surface and subsurface drains. Conservation tillage, which returns all or part of the crop residue to the surface, and cover crops help keep this soil productive and in good tilth.

This soil is well suited to grasses and legumes for hay or pasture. Erosion in steeper areas is a hazard, and wetness is a limitation. Drainage is needed for best results. Overgrazing and grazing when the soil is too wet cause surface compaction, poor soil tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, strip grazing, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil is suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation, or by spraying, cutting, or girdling.

This soil is severely limited for building sites because of wetness. An adequate drainage system in conjunction with storm sewers is needed to lower the water table. Footing drains and a backfilling of coarser material around foundations and basement walls are needed. This soil is severely limited for local roads and streets because of frost action and low strength. Providing graded roadside ditches will lower the water table and reduce damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and helps control frost action. This soil is severely limited for septic tank absorption fields because of wetness and moderately slow permeability. Enlarging the absorption field or using a higher nearby suitable site is needed to overcome these limitations. Connecting the facilities to commercial sewer systems is an alternate solution.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Cy—Cyclone silt loam. This deep, nearly level, poorly drained soil is often ponded by surface water runoff from adjacent soils. It is on broad flats and in depressional areas. Individual areas are irregular in shape. They range from 5 to about 200 acres, and the dominant size is about 80 acres.

In a typical profile the surface layer is very dark gray silt loam about 12 inches thick. The mottled subsoil is about 42 inches thick. The upper part is dark gray, firm silt loam; the next part is grayish brown, firm silt loam; and the lower part is gray, friable silt loam. The underlying material to a depth of 60 inches or more is gray mottled loam. In some areas there is more sand in the solum. In a few areas there is a stratified loamy, silty, and sandy subsoil. In some areas there is less clay throughout.

Included with this soil in mapping are a few small areas of somewhat poorly drained Fincastle and Starks soils on slightly convex slopes. These inclusions make up about 8 percent of the map unit. A few areas of very poorly drained Millsdale soils are in more depressional areas and make up about 2 percent of the map unit.

The available water capacity of the Cyclone soil is high. Permeability is moderate in the solum and moderately slow in the underlying material. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is high.

Most areas of this soil are used for cultivated crops. A few areas are used for hay and pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Ponding is a major hazard. Excess water can be removed by open ditches, subsurface and surface drains, pumping, or a combination of these methods. Conservation tillage that leaves all or part of the crop residue on the surface improves and maintains tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Ponding is a hazard. Drainage is needed for optimum yields. Overgrazing and grazing when the soil is too wet cause surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is well suited to trees. Equipment limitation, seedling mortality, windthrow hazard, and plant competition are the major management concerns.

Harvesting and logging during dry periods or during winter months when the surface is frozen will lower the limitations to use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system used to lower the water table reduces seedling mortality and permits deeper penetration of roots. Water-tolerant species that have deep root systems are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities, and it is generally unsuitable for these uses because of ponding. This soil is severely limited for local roads because of ponding, low strength, and frost action. Hauling in suitable fill, constructing roads in elevated areas, and providing roadside ditches help in avoiding excess water and reducing damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and helps to control frost action.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

FcA—Fincastle silt loam, 0 to 3 percent slopes. This deep, nearly level or gently sloping, somewhat poorly drained soil is in broad, low-lying areas. Individual areas are irregular in shape. They range from 3 to about 120 acres, and the dominant size is about 80 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. The mottled subsoil is about 47 inches thick. The upper part is brown and grayish brown, firm silt loam and silty clay loam, and the lower part is brown, firm and friable clay loam. The underlying material to a depth of 60 inches or more is yellowish brown, mottled loam. Some small areas are shallower to the underlying till. A few areas are sandy loam, clay loam, or stratified loamy underlying material.

Included with this soil in mapping are some small areas of poorly drained Cyclone soils in depressions. They make up about 2 percent of the map unit. Some areas of well drained Russell soils are on higher lying knolls and make up about 1 percent of the map unit. A few small areas of moderately well drained Xenia soils are in slightly higher areas and make up about 1 percent of the map unit.

The available water capacity of the Fincastle soil is high. Permeability is moderately slow in the upper part and slow in the lower part. Runoff is slow or medium. The seasonal high water table is at a depth of 1 foot to 3 feet. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. Some small areas are in pasture or woodland.

This soil is well suited to corn, soybeans, and small grains. Wetness is the major limitation. Excess water can be removed by surface and subsurface drains and open ditches. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops help to keep this soil productive and in good tilth.

This soil is well suited to grasses and legumes for hay or pasture. Erosion in steeper areas is a hazard, and wetness is a limitation. Drainage is needed for optimum yields. Overgrazing and grazing when this soil is too wet can result in surface compaction, poor soil tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites because of wetness. Installing an adequate drainage system around the footings of buildings and backfilling with a coarser material are needed to lower the water table. Pumping may be necessary if drainage outlets are not suitable. This soil is severely limited for local roads and streets because of frost action and low strength. Providing graded roadside ditches will lower the water table and reduce damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material will help to support vehicular traffic and help control frost action. This soil is severely limited for septic tank absorption fields because of wetness and moderately slow and slow permeability. Enlarging the absorption field or using a nearby suitable site overcomes these limitations.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Ge—Gessie Variant silt loam, occasionally flooded. This deep, nearly level, well drained soil is occasionally flooded for brief periods. It is on the higher positions on the flood plains. Individual areas are elongated. They range from 3 to 30 acres, and the dominant size is about 20 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 31 inches thick. It is brown, friable silt loam and loam. The underlying material to a depth of 60 inches or more is brown gravelly coarse sand.

Included with this soil in mapping are a few small areas of somewhat poorly drained Shoals soils in the lower lying swales. They make up about 5 percent of the unit. In a few places well drained Stonelick soils make up about 5 percent of mapped areas.

The available water capacity of the Gessie Variant is high. Permeability is moderate in the surface layer and subsoil and rapid in the underlying material. Runoff is slow. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Many small areas are in pasture and woodland.

This soil is well suited to corn, soybeans, and small grains. Flooding is the major hazard. Because of flooding, crops are often replanted or planting is delayed. Levees help to control flooding. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops are used to help maintain and improve tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Flooding can damage the grasses and legumes and can restrict the use of this soil for pasture. Levees help to control flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing and strip grazing during the summer months, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities because of flooding, and it is generally unsuitable for these uses. This soil is severely limited for local roads and streets because of flooding. It is extremely difficult to overcome this limitation unless areas are protected in accordance with state and local requirements.

This soil is in capability subclass IIw and woodland suitability subclass 1o.

Gf—Gilford sandy loam. This deep, nearly level, very poorly drained soil is often ponded by surface water runoff from adjacent soils. It is on broad flats and in depressional areas. Individual areas are irregular in shape. They range from 3 to about 120 acres, and the dominant size is about 60 acres.

In a typical profile the surface layer is black sandy loam about 11 inches thick. The subsurface layer is very dark gray, mottled sandy loam about 6 inches thick. The mottled subsoil is about 14 inches thick. The upper part is dark gray, friable sandy loam, and the lower part is grayish brown, very friable loamy sand. The underlying material to a depth of 60 inches or more is pale brown and light brownish gray, mottled sand. In a few small areas, the surface layer and subsoil have more clay than is typical, or they have more sand and less clay. In a few areas the underlying material is loam below a depth of 40 inches. In a few areas the lower part of the subsoil is stratified sand, sandy loam, and loam.

Included with this soil in mapping are a few small areas of very poorly drained Ackerman soils in depressions. They make up about 2 percent of the unit. A few areas of somewhat poorly drained Morocco soils and soils that have a browner subsoil than the Gilford soil are on the higher knolls and make up about 5 percent of the unit.

The available water capacity of the Gilford soil is moderate. Permeability is moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. A few areas are used for hay and pasture or woodland.

This soil is well suited to corn, soybeans, and small grains. Ponding is a hazard that affects the use and management of this soil. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these methods. Some areas can be difficult to drain because they do not have a suitable drainage outlet. Conservation tillage, which leaves all or part of the crop residue on the surface, green manure, and cover crops help to improve and maintain tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Ponding is a hazard. Drainage is needed for optimum yields. Overgrazing and grazing when the soil is too wet cause surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is suited to trees. Equipment limitation, seedling mortality, windthrow hazard, and plant competition are the major management concerns. Harvesting and logging during dry periods or during winter months will lower the limitations to use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system used to lower the water table reduces seedling mortality and permits deeper penetration of roots. Water-tolerant species that have deep root systems are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities, and it is generally unsuitable for these uses because of ponding. This soil is severely limited for local roads and streets because of ponding and frost action. Hauling in suitable fill, constructing roads on elevated areas, and providing roadside ditches will reduce these limitations.

This soil is in capability subclass IIw and woodland suitability subclass 4w.

Gg—Gilford loam, gravelly substratum. This deep, nearly level, very poorly drained soil is in the depressional areas of river terraces or at the base of these terraces. It is often ponded by runoff from adjacent soils. Individual areas are irregular in shape. They range from 3 to about 80 acres, and the dominant size is about 40 acres.

In a typical profile the surface layer is black loam about 11 inches thick. The mottled subsoil is about 27 inches thick. The upper part is gray, firm sandy clay loam, and the lower part is grayish brown, friable coarse sandy loam. The underlying material to a depth of 60 inches or more is brown and light brownish gray loamy sand and gravelly sand. In some places the underlying material consists of stratified sands and silts. In a few small areas there is up to 20 inches of overwash. In some places the underlying material is up to 35 percent cobbles.

Included with this soil in mapping are a few small, more sloping areas of well drained Rush soils. They make up about 1 percent of the map unit. A few areas of somewhat poorly drained Sleeth soils are on slightly convex tops of terraces and along drainageways where they make up about 5 percent of the map unit.

The available water capacity of the Gilford soil is moderate. Permeability is moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. A few small areas are used for pasture or are in woodland.

This soil is suitable for corn, soybeans, and small grains. Ponding is a hazard that affects the use and management of this soil. Excess water can be removed by open ditches, subsurface and surface drains, or pumping or a combination of these methods. Conservation tillage, which leaves all or part of the crop residue on the surface, green manure, and cover crops help to maintain and improve the organic matter content and tilth of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Ponding is a hazard. Drainage is needed for optimum yields. Overgrazing and grazing when the soil is too wet cause surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is suited to trees. Equipment limitation, seedling mortality, windthrow hazard, and plant competition are the major management concerns. If the soil surface is frozen, harvesting and logging during dry periods or during winter months can lower the limitation to use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system used to lower the water table reduces seedling mortality and permits deeper root penetration. Water-tolerant species that have deep root systems are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities, and it is generally unsuitable for these uses because of ponding. This soil is severely limited for local roads and streets because of ponding and frost action. Hauling in suitable fill, constructing roads in elevated areas, and providing roadside ditches will reduce these limitations.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

GwB—Glynwood silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on sides of natural drainageways and in slightly elevated areas. Individual areas are irregular in shape. They range from 5 to about 8 acres, and the dominant size is about 40 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. The mottled subsoil is about 24 inches thick. The upper part is yellowish brown, firm silty clay loam, and the lower part is dark yellowish brown, firm clay loam. The underlying material to a depth of 60 inches or more is dark brown, mottled clay loam. In some areas the lower part of the subsoil is stratified loamy material. In a few places there is less clay throughout the pedon.

Included with this soil in mapping are a few small areas of somewhat poorly drained Blount soils in lower lying areas. They make up about 5 percent of the map unit. A few areas of well drained Morley soils are in higher lying areas and make up about 3 percent of the map unit.

The available water capacity of the Glynwood soil is high. Permeability is slow. Runoff is medium. The seasonal high water table is at a depth of 2 to 3 1/2 feet. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. Some areas are in hay and pasture. A few small areas are in woodland.

This soil is well suited to corn, soybeans, and small grains. If cultivated crops are grown, erosion and runoff need to be controlled. Crop rotation, conservation tillage, diversions, grassed waterways, terraces, contour strips, stripcropping, or grade stabilization structures help to prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Seedling mortality, windthrow hazard, and plant competition are the major management concerns. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. Species that have deep root systems are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for dwellings without basements because of shrinking and swelling and wetness. It is severely limited for dwellings with basements because of wetness. Foundations, footings, and basement walls should be properly designed and foundation drain tile should be used to prevent structural damage. Sites should be graded or buildings should be designed to complement the slope. An adequate drainage system is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. Backfilling along foundation walls with a coarser material is also helpful.

This soil is severely limited for local roads and streets because of frost action and low strength. Providing roadside ditches will lower the water table and reduce damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material will help to support vehicular traffic and control frost action. This soil is severely limited for septic tank absorption fields because of wetness and slow permeability. Enlarging the absorption field and hauling in enough suitable fill help to overcome these limitations. Connecting the facilities to commercial sewer systems is an alternate solution. Selection of a more suitable nearby site is suggested.

This soil is in capability subclass IIe and woodland suitability subclass 2c.

HeE—Hennepin loam, 25 to 60 percent slopes. This deep, steep and very steep, well drained soil is on side slopes of natural drainageways. Individual areas are mainly irregular in shape, but some are long and narrow. They range from 3 to about 40 acres, and the dominant size is about 25 acres.

In a typical profile the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is yellowish brown, friable sandy loam about 13 inches thick. The underlying material to a depth of 60 inches or more is brown loam. In some areas the underlying material has more sand and gravel.

Included in mapping are a few small areas of well drained Miami and NewGlarus soils on short, steep breaks. They make up about 10 percent of the unit. A few areas of well drained Riddles soils make up about 5 percent of the unit.

The available water capacity of the Hennepin soil is high. Permeability is moderate in the solum and moderately slow in the underlying material. Runoff is very rapid. Organic matter content of the surface layer is low.

Most areas of this soil are in woodland or are used for pasture. This soil is generally unsuitable for corn, soybeans, and small grains. It is too steep and too erodible for cultivation.

This soil is suited to grasses and legumes for hay. It is poorly suited to pasture. Erosion is a hazard, and steep slope is a limitation. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. The erosion hazard, equipment limitation, and plant competition are the major management concerns. Proper road design and management are needed during harvesting. Seedlings survive and grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites because of slope. It is generally unsuitable for this use. It is severely limited for local roads and streets by slope. The land should be leveled or the roads constructed on the contour. This soil is severely limited for septic tank absorption fields by slope and moderately slow permeability. It is generally unsuitable for this use.

This soil is in capability subclass VIIe and woodland suitability subclass 1r.

Hh—Houghton muck, drained. This deep, nearly level, very poorly drained soil is often ponded by surf water runoff from adjacent soils. It is in small depressional areas on large, old lakebeds and in natu drainageways. Individual areas are irregular in shape, b some are circular or elongated. They range from 3 to about 60 acres, and the dominant size is about 10 acr

In a typical profile the surface layer is black muck about 7 inches thick. The organic material extends to a depth of about 60 inches. The upper part is black and dark reddish brown, friable muck, and the lower part is very dark gray, friable muck. In a few areas a thin layer of coprogenous earth is below a depth of 7 inches.

Included with this soil in mapping are a few areas of very poorly drained Ackerman soils at the outer edges o the mapped area. They make up about 5 percent of th map unit. Some areas of very poorly drained Gilford an Maumee soils are on slightly higher lying knobs and make up about 3 percent of the map unit.

The available water capacity of the Houghton soil is very high. Permeability is moderately slow to moderately rapid. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is very high.

Most areas of this soil are used for cultivated crops; some for wildlife habitat; and a few for woodland.

This soil is suitable for corn. Soil blowing and ponding are hazards that affect the use and management of this soil. Soil blowing can be controlled by windbreaks and conservation tillage that leaves all or part of the crop residue on the surface. Excess water can be removed by open ditches, subsurface drains, pumping, or a combination of these methods. The initial removal of water from this soil causes some subsidence. Subsidence and the unstable soil material can cause tile to settle and become out of line. In some areas the water inlets quickly plug with soil material as a result of chemical and biological reactions within the soil. Intensive cultivation over a period of many years causes substantial decomposition of the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay. It is poorly suited to pasture. Soil blowing and ponding are hazards. Insufficient moisture during the summer months results in droughtiness as a limitation. Frost heaving is also a limitation. Drainage is needed for optimum yields. When this soil is in pasture, plants are easily uprooted by the hoofs of animals.

This soil is suited to trees. Equipment limitation, seedling mortality, windthrow hazard, and plant competition are the major management concerns. The possibility of the muck burning is a limitation. Harvesting and logging during dry periods or during winter months when the surface is frozen will lower the limitations to use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system to lower the water table reduces seedling mortality and permits deeper penetration of roots. Water-tolerant species that have deep root systems are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities and is generally unsuitable for these uses because of ponding and low strength. This soil is severely limited for local roads because of ponding, low strength, and frost action. Ditches are needed along roads to lower the water table and reduce damage from frost action. All organic material needs to be replaced with suitable coarse base material to reduce the susceptibility to frost action, reduce excessive wetness, and help to support vehicular traffic.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

KoB—Kosciusko silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in broad areas, on side slopes, and on small knobs. Individual areas are irregular in shape. They range from 3 to about 90 acres, and the dominant size is about 40 acres.

In a typical profile the surface layer is dark brown silt loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, friable sandy clay loam; the next part is dark brown, firm, sandy clay loam and gravelly sandy clay loam; and the lower part is dark brown, friable gravelly sandy loam. The underlying material to a depth of 60 inches or more is yellowish brown gravelly coarse sand. A few areas are more than 40 inches to the underlying material.

Included with this soil in mapping are a few areas of very poorly drained Gilford soils in depressions. They make up about 3 percent of the unit. Some areas of well drained Miami and NewGlarus soils make up about 5 percent of the unit.

The available water capacity of the Kosciusko soil is moderate. Permeability is moderate in the subsoil and very rapid in the underlying material. Runoff is medium. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for hay and pasture or are in woodland.

This soil is suited to corn, soybeans, and small grains. If cultivated crops are grown, erosion and runoff need to be controlled. Crop rotation, conservation tillage, diversions, terraces, contour strips, grassed waterways, and grade stabilization stuctures help prevent excessive soil loss. Leaving all or part of the crop residue on the surface and cover crops also help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of the soil.

This soil is suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing and strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for dwellings without basements because of shrinking and swelling. It is slightly limited for dwellings with basements. Foundations, footings, and basement walls should be properly designed to prevent structural damage. This soil is moderately limited for local roads and streets because of frost action and shrinking and swelling. Replacing or covering the upper layer of the soil with a suitable base material helps to control frost action and shrinking and swelling. Crowning the roads to provide drainage reduces the effects of shrinking and swelling.

This soil is severely limited for septic tank absorption fields because it is a poor filter. The very rapid permeability could result in seepage of effluent into ground water supplies. This soil could be mixed with suitable material to help control seepage. Enlarging the absorption field is an alternate solution.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

KsC3—Kosciusko sandy clay loam, 6 to 12 percent slopes, severely eroded. This deep, moderately sloping, well drained soil is on short side slopes. Individual areas are long and narrow in shape. They range from 5 to about 60 acres, and the dominant size is about 25 acres.

In a typical profile the surface layer is brown sandy clay loam about 4 inches thick. The subsoil is about 28 inches thick. The upper part is yellowish brown, friable sandy clay loam, and the lower part is dark yellowish brown, friable sandy loam. The underlying material to a depth of 60 inches or more is yellowish brown gravelly coarse sand.

Included with this soil in mapping are a few areas of well drained Miami, NewGlarus, and Rush soils. They make up about 6 percent of the map unit. Areas of steeper soils are throughout the unit and make up about 2 percent of it.

The available water capacity of the Kosciusko soil is moderate. Permeability is moderate in the subsoil and very rapid in the underlying material. Runoff is rapid. The organic matter content of the surface layer is low. The surface layer is firm. Tilling within the proper range of moisture reduces soil compaction and the tendency to clod.

Most areas of this soil are used for pasture or are in woodland. Some areas are used for urban development, and a few areas are used for cultivated crops.

This soil is poorly suited to corn, soybeans, and small grains. If this soil is cultivated, erosion and runoff need to be controlled. Crop rotation, conservation tillage, diversions, terraces, stripcropping, contour strips, grassed waterways, and grade stabilization structures help to prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of this soil.

This soil is suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling. The harvest of mature trees and elimination of undergrowth and diseased and damaged trees help to make the stand more productive.

This soil is moderately limited for building sites because of shrinking and swelling and slope. Foundations, footings, and basement walls should be properly designed to prevent structural damage. Buildings should be designed to complement the slope or sites should be graded. This soil is moderately limited for local roads and streets because of slope, frost action, and shrinking and swelling. The land could be leveled or the roads constructed on the contour. Replacing or covering the upper layer of soil with a suitable base material helps to control frost action and shrinking and swelling. Crowning the roads to provide drainage reduces the effect of shrinking and swelling.

This soil is severely limited for septic tank absorption fields because it is a poor filter. The very rapid permeability could result in seepage of effluent into ground water supplies. This soil could be mixed with suitable material to help control seepage. Enlarging the filter field or connecting the sanitary facilities to a commercial sewer system is an alternate solution.

This soil is in capability subclass IVe and woodland suitability subclass 2o.

Ma—Maumee loamy fine sand. This deep, nearly level, very poorly drained soil is often ponded with surface water runoff from adjacent higher lying areas. It is in depressional areas. Individual areas are irregular in shape. They range in size from 3 to about 80 acres, and the dominant size is about 50 acres.

In a typical profile the surface layer is black loamy fine sand about 13 inches thick. The subsurface layer is very dark gray, mottled loamy fine sand about 6 inches thick. The underlying material, from a depth of about 19 to 31 inches, is dark gray, mottled fine sand. Below this, to a depth of 60 inches or more, the underlying material is dark grayish brown, mottled sand in the upper part and grayish brown, mottled sand in the lower part. Thin layers of sedimentary peat are in some places. In some small areas thin lenses of sandy loam or sandy clay loam are in the underlying material. In a few areas more clay and less sand are in the upper part of the pedon.

Included with this soil in mapping are a few small areas of very poorly drained Ackerman soils in depressions. They make up about 3 percent of the unit. A few areas of somewhat poorly drained Morocco soils are in higher lying areas and make up about 3 percent of the map unit. A few areas of somewhat poorly drained soils with browner colors in the solum are in slightly higher areas. They make up about 2 percent of the map unit.

The available water capacity of the Maumee soil is low. Permeability is rapid. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. A few areas are used for hay and pasture or are in woodland.

This soil is suitable for corn, soybeans, and small grains. Ponding and soil blowing are hazards. Excess water can be removed by subsurface and surface drains, open ditches, and pumping. Some areas are too low on the landscape to have a suitable drainage outlet. Soil blowing can be controlled by windbreaks, crop residues, conservation tillage, stripcropping, cover crops, and permanent vegetation. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops help to improve and maintain tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing and ponding are hazards. Insufficient moisture during the summer months can result in droughtiness as a limitation. Drainage is needed for optimum yields. Overgrazing and grazing when the soil is too wet cause surface compaction, reduced plant density and hardiness, poor tilth, sod damage, and reduced forage yields. Overgrazing also causes soil blowing. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil is suited to trees. Equipment limitation, windthrow hazard, and plant competition are the major management concerns. Trees should be harvested during dry periods or when the soil is frozen. Drainage used to lower the water table permits deeper penetration of roots. Water-tolerant species that have deep root systems are favored in timber stands. Competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and is generally unsuitable for this use because of ponding. This soil is severely limited for local roads and streets because of ponding. Hauling in suitable fill, constructing roads in elevated areas, and roadside ditches reduce excess water. This soil is severely limited for septic tank absorption fields because it is ponded and it is a poor filter. It is generally unsuitable for this use.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

MkC—Metea loamy fine sand, 3 to 10 percent slopes. This deep, gently sloping or moderately sloping, well drained soil is on side slopes of natural drainageways, knolls, and ridges of the upland. Individual areas are mainly irregular in shape, but some are elongated. They range from 3 to about 80 acres, and the dominant size is about 25 acres.

In a typical profile the surface layer is dark brown loamy fine sand about 13 inches thick. The subsurface layer, about 16 inches thick, is yellowish brown sand. The subsoil, about 17 inches thick, is yellowish brown, firm sandy loam in the upper part and dark yellowish brown, firm clay loam and loam in the lower part. The underlying material to a depth of 60 inches or more is yellowish brown loam. In some areas the surface layer is fine sandy loam. In some small areas there is less than 20 inches or more than 40 inches of sandy material in the upper part. In a few areas there are brown mottles in the lower part of the subsoil. In some places the underlying material is stratified loams and sands.

Included with this soil in mapping are a few small areas of well drained Miami and Riddles soils. They make up about 5 percent of the map unit. A few areas with steeper soils make up about 2 percent of the map unit.

The available water capacity of the Metea soil is moderate. Permeability is rapid in the upper part and moderately slow in the lower part. Runoff is medium. The organic matter of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for hay and pasture or are in woodland.

This soil is suited to corn, soybeans, and small grains. Erosion and runoff on steeper soils and soil blowing are hazards. Droughtiness is a limitation. Erosion and runoff can be controlled by terraces, diversions, leaving the crop residue on the surface, contour strips, stripcropping, cover crops, grassed waterways, conservation tillage, crop rotation, or grade stabilization structures. Soil blowing can be controlled by windbreaks; conservation tillage, which leaves all or part of the crop residue on the surface; stripcropping; and cover crops. A combination of these methods helps to improve and maintain tilth, moisture content, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion on steeper soils and soil blowing are hazards. Droughtiness is a limitation. Overgrazing causes erosion and soil blowing and reduces plant density and hardiness. Strip grazing, timely deferment of grazing during the summer months, and proper stocking help to keep the soil and pasture in good condition.

This soil is well suited to trees. Seedling mortality is the major management concern. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later.

This soil is moderately limited for building sites because of slope. Buildings should be designed to complement the slope or sites should be graded to modify the slope. This soil is moderately limited for local roads and streets because of slope and frost action. The land could be leveled or the roads constructed on the contour to help overcome these limitations. Replacing or covering the upper layer of the soil with a suitable base material helps to support vehicular traffic. This soil is severely limited for septic tank absorption fields because of moderately slow permeability. Enlarging the absorption field or hauling in enough suitable fill helps to overcome this limitation.

This soil is in capability subclass IIIe and woodland suitability subclass 2s.

MnB2—Miami silt loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is on side slopes of natural drainageways and in slightly elevated areas. Individual areas are irregular in shape. They range from 3 to about 80 acres, and the dominant size is about 40 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, firm silty clay loam, and the lower part is dark yellowish brown and dark brown, firm clay loam. The underlying material to a depth of 60 inches or more is yellowish brown loam. In some places the solum is more than 42 inches thick. In a few areas brown mottles or stratified sandy loam, loamy sand, and sandy clay loam are in the lower part of the subsoil. Also, in a few areas more silt is throughout the pedon.

Included with this soil in mapping are a few small, lower areas of somewhat poorly drained Crosier and Fincastle soils. They make up about 8 percent of the map unit. A few small areas of well drained Russell soils make up about 3 percent of the map unit. In a few steeper areas there are severely eroded soils that make up about 2 percent of the map unit.

The available water capacity of the Miami soil is high. Permeability is moderate in the subsoil and moderately slow in the underlying material. Runoff is medium. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. Some areas are used for hay or pasture. A few small areas are in woodland or are used for urban development.

This soil is well suited to corn, soybeans, and small grains. If cultivated crops are grown, erosion and runoff need to be controlled. Crop rotation, conservation tillage, diversions, grassed waterways, terraces, stripcropping, contour strips, or grade stabilization structures help to prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling. Foundations, footings, and basement walls should be properly designed, and foundation drain tile should be used to prevent structural damage. Backfilling with a coarser material is also helpful. This soil is moderately limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with a more suitable material helps to support vehicular traffic and to control frost action. This soil is severely limited for septic tank absorption fields because of moderately slow permeability. Enlarging the filter field, hauling in enough suitable fill, and connecting the facilities to commercial sewer systems can overcome this limitation.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

MnC2—Miami silt loam, 6 to 12 percent slopes, eroded. This deep, moderately sloping, well drained soil is on side slopes of natural drainageways, on knolls, and on ridges. Individual areas are irregular in shape. They range from 3 to about 120 acres, and the dominant size is about 40 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is dark yellowish brown, firm clay loam, and the lower part is dark yellowish brown, friable loam. The underlying material to a depth of 60 inches or more is yellowish brown loam. In some places the solum is more than 42 inches thick. In a few places brown mottles are in the lower part of the subsoil. In some areas more silt is throughout the pedon.

Included with this soil in mapping are a few small areas of somewhat poorly drained Crosier and Fincastle soils in lower lying areas. They make up about 3 percent of the map unit. A few areas of well drained Russell soils are throughout the unit and make up about 3 percent of it. In some steeper areas there are severely eroded soils that make up about 4 percent of the map unit.

The available water capacity of the Miami soil is high. Permeabilty is moderate in the subsoil and moderately slow in the underlying material. Runoff is rapid. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. Some areas are used for hay or pasture. A few areas are in woodland or are used for urban development.

This soil is suited to corn, soybeans, and small grains. If cultivated crops are grown, erosion and runoff need to be controlled. Crop rotation, conservation tillage, diversions, terraces, stripcropping, contour strips, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling and slope. Foundations, footings, and basement walls should be properly designed and foundation drain tile should be used to prevent structural damage. Backfilling with a coarser material also helps. Buildings should be designed to complement the slope. Some areas may need grading. This soil is moderately limited for local roads and streets because of slope, frost action, and low strength. The land could be leveled or the roads constructed on the contour. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and to control frost action.

This soil is severely limited for septic tank absorption fields because of moderately slow permeability. Enlarging the filter field, hauling in enough suitable fill, and connecting the facilities to a commercial sewer system can overcome this limitation.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

MnD2—Miami silt loam, 12 to 18 percent slopes, eroded. This deep, strongly sloping, well drained soil is on side slopes of natural drainageways. Individual areas are irregular in shape. They range from 3 to about 120 acres, and the dominant size is about 35 acres.

In a typical profile the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is yellowish brown, firm clay loam, and the lower part is yellowish brown, firm loam. The underlying material to a depth of 60 inches or more is pale brown loam. In a few areas more sand is in the lower part of the subsoil. In some places brown mottles are in the lower part of the solum. A few areas are less than 24 inches to the underlying material.

Included with this soil in mapping are small areas of well drained Russell soils. They are throughout the unit and make up about 3 percent of it. Some small areas of steeper soils and severely eroded soils are throughout the map unit and make up about 5 percent of it.

The available water capacity of the Miami soil is high. Permeability is moderate in the subsoil and moderately slow in the underlying material. Runoff is very rapid. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for grasses and legumes for forage or pasture. Some areas are in woodland.

This soil is poorly suited to corn, soybeans, and small grains. Conservation methods are needed to control erosion and runoff. Conservation tillage, crop rotation, terraces, stripcropping, contour strips, diversions, and grassed waterways help prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard, and steep slopes are a limitation. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites because of slope. Buildings should be designed to complement the slope. Some areas may need grading. This soil is severely limited for local roads and streets because of slope. The land could be leveled or the roads constructed on the contour. Maintaining a good vegetation along the road banks reduces roadside erosion.

This soil is severely limited for septic tank absorption fields because of slope and moderately slow permeability. Land leveling, the use of contour systems, enlarging the filter field, and hauling in enough suitable fill help to overcome these limitations.

This soil is in capability subclass IVe and woodland suitability subclass 1o.

MoC3—Miami clay loam, 6 to 14 percent slopes, severely eroded. This deep, moderately sloping or strongly sloping, well drained soil is on side slopes of natural drainageways; knolls; and narrow elongated ridges of the uplands. Individual areas are irregular in shape. They range from 3 to about 40 acres, and the dominant size is about 20 acres.

In a typical profile the surface layer is brown clay loam about 6 inches thick. The subsoil is about 21 inches thick. The upper part is yellowish brown, firm clay loam, and the lower part is light yellowish brown, firm clay loam and loam. The underlying material to a depth of 60 inches or more is pale brown loam. Many areas of this soil are less than 24 inches to the underlying material. In a few places brown mottles are in the lower part of the solum. In some places there is more sand and gravel in the underlying material.

Included with this soil in mapping are a few small areas of somewhat poorly drained Crosier soils. They are in lower lying areas and make up about 3 percent of the unit. A few areas of well drained Riddles soils are throughout the unit and make up about 3 percent of it. Some areas of less eroded soils and steeper soils are throughout the unit and make up about 4 percent of it.

The available water capacity of the Miami soil is high. Permeability is moderate in the subsoil and moderately slow in the underlying material. Runoff is rapid. The organic matter content of the surface layer is low. The surface layer is firm. Tilling within the proper range of moisture content reduces soil compaction and the tendency to clod.

Most areas of this soil are used for cultivated crops. Some areas are used for hay and pasture, are in woodland, or are used for urban development.

This soil is poorly suited to corn, soybeans, and small grains. Conservation methods are needed to control erosion and runoff. Conservation tillage that leaves all or part of the crop residue on the surface, crop rotation, terraces, stripcropping, contour strips, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling and slope. Foundations, footings, and basement walls should be properly designed and foundation drain tile should be used to prevent structural damage. Backfilling with a coarser material is helpful. Buildings should be designed to complement the slope. Some areas may need grading. This soil is moderately limited for local roads and streets because of slope, frost action, and low strength. The land could be leveled or the roads constructed on the contour. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and to control frost action. This soil is severely limited for septic tank absorption fields because of moderately slow permeability. Enlarging the absorption field, hauling in enough suitable fill, and connecting the facilities to a commercial sewer system help to overcome this limitation.

This soil is in capability subclass IVe and woodland suitability subclass 1o.

Ms—Millsdale silty clay loam. This moderately deep, nearly level, very poorly drained soil is often ponded with surface water runoff from adjacent higher lying areas. It is in low-lying areas that are irregular in shape. They range from 5 to about 110 acres, and the dominant size is about 25 acres.

In a typical profile the surface layer is very dark gray silty clay loam about 8 inches thick. The subsoil is about 13 inches thick. It is very dark gray and dark gray, mottled, firm silty clay. The underlying material is limestone bedrock. In some areas there is less than 20 inches of soil over bedrock.

Included with this soil in mapping are a few small areas of very poorly drained Gilford soils. They are throughout the map unit and make up about 3 percent of it. A few areas of well drained NewGlarus soils are on convex knobs. They make up about 3 percent of the map unit. Some areas of somewhat poorly drained Sleeth soils are on slightly higher elevations near the base of high river terraces. They make up about 2 percent of the map unit.

The available water capacity of the Millsdale soil is moderate, and permeability is moderately slow. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is high.

Most areas of this soil are used for hay or pasture. A few areas are used for cultivated crops or are in woodland.

This soil is suitable for corn, soybeans, and small grains. Ponding and shallowness to limestone are major limitations. If the soil is worked when too wet, puddling can result, and hard clods will form upon drying. Subsurface and surface drains, pumping, and open ditches can be used to overcome wetness if a suitable drainage outlet is available. Conservation tillage, which leaves all or part of the crop residue on the surface, keeps the soil in good tilth and maintains the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Ponding is a hazard. Drainage is needed for optimum yields. Overgrazing and grazing when the soil is too wet cause surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, and rotation grazing during the summer months help to keep the soil and pasture in good condition.

This soil is well suited to trees. Equipment limitation, seedling mortality, windthrow hazard, and plant competition are the major management concerns. Harvesting and logging during dry periods or during winter months when the soil surface is frozen will lower the limitations to use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system used to lower the water table reduces seedling mortality and permits deeper penetration of roots. Water-tolerant species are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and is generally unsuitable for this use because of ponding, shrinking and swelling, and shallowness to rock. This soil is severely limited for local roads because of ponding, low strength, and frost action. Hauling in enough suitable fill, constructing roads on elevated areas, and providing roadside ditches reduce excess water and damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material is an alternate solution. This soil is severely limited for septic tank absorption fields because of ponding, shallowness to bedrock, and moderately slow permeability. It is generally unsuitable for this use.

This soil is in capability subclass IIIw and woodland suitability subclass 2w.

MxC3—Morley clay loam, 6 to 12 percent slopes, severely eroded. This deep, moderately sloping, well drained soil is on side slopes of natural drainageways; on knolls; and on narrow elongated ridges of the uplands. Individual areas are irregular in shape. They range from 8 to 100 acres, and the dominant size is about 50 acres.

In a typical profile the surface layer is dark yellowish brown clay loam about 6 inches thick. The subsoil is about 23 inches thick. It is dark yellowish brown and yellowish brown, firm clay loam. The underlying material to a depth of 60 inches or more is yellowish brown clay loam. In some areas the solum is less than 20 inches thick. In some small areas brown mottles are in the lower part of the subsoil. In a few places more sand and gravel are in the underlying material. In some places there is less clay throughout the pedon.

Included with this soil in mapping are a few small areas of somewhat poorly drained Blount soils. They are in lower lying areas and make up about 4 percent of the map unit. A few areas of well drained Miami soils are throughout the map unit and make up about 3 percent of it. A few areas of less eroded soils and steeper soils are throughout the unit and make up about 3 percent of it.

The available water capacity of the Morley soil is high. Permeability is moderately slow or slow. Runoff is rapid. The organic matter content of the surface layer is low. The surface layer is firm. Tilling within the proper range of moisture content reduces soil compaction and the tendency to clod.

Most areas of this soil are used for cultivated crops. Some areas are used for hay and pasture, are in woodland, or are used for urban development.

This soil is poorly suited to corn, soybeans, and small grains. Conservation methods are needed to help control erosion and runoff. Crop rotation, conservation tillage, diversions, terraces, contour strips, stripcropping, grassed waterways, and grade stabilization structures help prevent excessive soil loss. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops help to control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling and slope. Foundations, footings, and basement walls should be properly designed and foundation drain tile used to prevent structural damage. Backfilling with a coarser material is also helpful. Buildings should be designed to complement the slope. Some areas may need grading. This soil is severely limited for local roads and streets because of low strength. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic. This soil is severely limited for septic tank absorption fields because of moderately slow or slow permeability. Enlarging the filter field, hauling in enough suitable fill, and connecting the facilities to a commercial sewer system help to overcome this limitation.

This soil is in capability subclass IVe and woodland suitability subclass 2o.

Mz—Morocco loamy fine sand. This deep, nearly level, somewhat poorly drained soil is on slight rises. Individual areas are irregular in shape. They range in size from 3 to about 90 acres, and the dominant size is about 10 acres.

In a typical profile the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsurface layer is pale brown, mottled, loamy fine sand about 11 inches thick. The subsoil is about 23 inches thick. It is very pale brown and pale brown, mottled, loose fine sand. The underlying material to a depth of 60 inches or more is very pale brown, mottled fine sand. In some places there is a thicker, darker surface layer, and in a few places there is more clay in the subsoil. In some places the underlying material is stratified loamy sand and sand.

Included with this soil in mapping are some small areas of very poorly drained Gilford and Maumee soils. They are in depressions and make up about 10 percent of the map unit. A few areas of moderately well drained Oakville soils are on higher lying positions and make up about 2 percent of the unit.

The available water capacity of the Morocco soil is low, and permeability is rapid. Runoff is very slow. The seasonal high water table is at a depth of 1 foot to 2 feet. Organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for hay and pasture or are in woodland.

This soil is poorly suited to corn, soybeans, and small grains. Wetness is the main limitation, and soil blowing is a hazard that affects use and management of this soil. During dry periods droughtiness is a limitation. Excess water can be removed by open ditches, surface and subsurface drains, pumping, or a combination of these methods. Conservation tillage, which leaves all or part of the crop residue on the surface, windbreaks, stripcropping, and cover crops help to control soil blowing, conserve soil moisture, and keep the soil productive.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing is a hazard. Wetness and insufficient moisture during the summer months can result in droughtiness as a limitation. Drainage is needed for optimum yields. Overgrazing and grazing during dry periods cause reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, strip grazing, restricted use during dry periods, and rotation grazing during the summer months help to keep the pasture and soil in good condition.

This soil is suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites because of wetness. An adequate drainage system is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. This soil is moderately limited for local roads and streets because of wetness and frost action. Hauling in suitable fill, constructing roads on elevated areas, and providing roadside ditches help to support vehicular traffic and reduce damage from frost action. This soil is severely limited for septic tank absorption fields because it is wet and a poor filter. The water table must be lowered with ditches and subsurface drains. Hauling in a more suitable fill material will reduce these limitations. Ground water may be contaminated if precautions are not taken.

This soil is in capability subclass IVs and woodland suitability subclass 3o.

NeB—NewGlarus silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on broad, high areas and on low knolls. Individual areas are irregular in shape. They range from 3 to about 80 acres, and the dominant size is about 35 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 11 inches thick. The subsoil is about 25 inches thick. The upper part is brown, friable silt loam; the next part is dark yellowish brown, firm silty clay loam; and the lower part is dark brown, firm clay. The underlying material is hard limestone bedrock with less than one-half inch of weathered limestone above it. In some places the depth to limestone is more than 40 inches. In some areas there is less than 20 inches of soil over bedrock.

Included with this soil in mapping are a few small areas of well drained Kosciusko and Rush soils. They are throughout the map unit and make up about 2 percent of it. Some areas of very poorly drained Millsdale soils are in lower lying areas and make up about 3 percent of the unit.

The available water capacity of the NewGlarus soil is moderate, and permeability is moderately slow. Runoff is medium. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for pasture. Some small areas are used for cultivated crops. A few areas are in woodland.

This soil is well suited to corn, soybeans, and small grains. Shallowness to bedrock is a major limitation. Erosion and runoff need to be controlled in cultivated areas. Crop rotation, conservation tillage, diversions, terraces, grassed waterways, contour strips, stripcropping, grade stabilization structures, or combinations of these measures help to control erosion and runoff. Leaving all or part of the crop residue on the surface and planting cover crops can also control erosion and runoff and improve and maintain tilth, moisture content, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of depth to rock and shrinking and swelling. Sites should be designed according to depth or the bedrock should be excavated. Building sites should be designed and foundation drain tile used, if possible, to prevent structural damage. Backfilling with a coarser material is also helpful. This soil is severely limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and to control frost action. This soil is severely limited for septic tank absorption fields because of depth to rock and moderately slow permeability. It is generally unsuitable for this use.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

NeC—NewGlarus silt loam, 6 to 12 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes along streams. Individual areas are narrow and elongated to oval. They range from 5 to about 30 acres, and the dominant size is about 10 acres.

In a typical profile the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 21 inches thick. The upper part is dark yellowish brown and dark brown, firm silty clay loam, and the lower part is dark brown, firm clay. The underlying material is about 3 inches of weathered limestone over hard limestone bedrock. In some places the depth to limestone is less than 20 inches, and in a few places it is more than 40 inches.

Included with this soil in mapping are a few small areas of well drained Kosciusko and Rush soils. They are throughout the map unit and make up about 3 percent of it. Some areas of very poorly drained Millsdale soils are in lower lying areas and make up about 3 percent of the map unit.

The available water capacity of the NewGlarus soil is moderate, and permeability is moderately slow. Runoff is medium. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for pasture or are in woodland. Some areas are used for cultivated crops.

This soil is suited to corn, soybeans, and small grains. Shallowness to bedrock is a major limitation. Erosion and runoff need to be controlled in cultivated areas. Crop rotation, conservation tillage, diversions, terraces, contour strips, grassed waterways, stripcropping, grade stabilization structures, or a combination of these measures help to control erosion and runoff. Leaving all or part of the crop residue on the surface and planting cover crops can also control erosion and runoff and maintain and improve tilth, moisture content, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling, depth to rock, and slope. Building sites should be designed and foundation drain tile used, if possible, to prevent structural damage caused by shrinking and swelling. Backfilling with a coarser material is helpful. Sites should be designed according to depth to rock, or the bedrock should be excavated. Sites should be graded, or buildings should be designed to complement the slope.

This soil is severely limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material help to support vehicular traffic and to control frost action. This soil is severely limited for septic tank absorption fields because of depth to rock and moderately slow permeability. This soil is generally unsuitable for this use.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

ObA—Oakville loamy fine sand, 0 to 3 percent slopes. This deep, nearly level or gently sloping, moderately well drained soil is on slight rises. Individual areas are irregular in shape. They range from 2 to about 40 acres, and the dominant size is about 25 acres.

In a typical profile the surface layer is dark brown loamy fine sand about 9 inches thick. The subsoil is about 24 inches thick. It is friable fine sand in the upper part, and brownish yellow, mottled, very friable fine sand in the lower part. The underlying material to a depth of 60 inches or more is pale brown, mottled fine sand. A few areas of this soil are grayer in the subsoil. In some places loamy material is below a depth of 40 inches.

Included with this soil in mapping are a few small areas of excessively drained Chelsea soils in higher lying areas. They make up about 6 percent of the unit. Some areas of somewhat poorly drained Morocco soils are adjacent to depressional areas and make up about 3 percent of the map unit. A few areas of somewhat poorly drained soils that have gravelly sand in the lower part of the profile are in lower lying areas. They make up about 3 percent of the map unit.

The available water capacity of the Oakville soil is low. Permeability is very rapid. Runoff is slow. The seasonal high water table is at a depth of 3 to 6 feet. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for pasture or are in woodland.

This soil is poorly suited to corn, soybeans, and small grains. Droughtiness is the major limitation, and soil blowing is the major hazard. The use of irrigation on this soil helps to control droughtiness. Cover crops, windbreaks, conservation tillage, which leaves all or part of the crop residue on the surface, green manure crops, stripcropping, spreading of manure, and mulching help to conserve soil moisture, prevent soil blowing, and increase the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing is a hazard, and droughtiness is a limitation. Overgrazing causes soil blowing and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, and strip grazing during the summer months help to keep the pasture and soil in good condition.

This soil is suited to trees. Seedling mortality is the major management concern. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later.

This soil is slightly limited for dwellings without basements. It is moderately limited for dwellings with basements because of wetness. An adequate drainage system is needed to lower the water table. This soil is slightly limited for local roads and streets. It is severely limited for septic tank absorption fields because it is wet and a poor filter. The rapid permeability could result in seepage of the effluent into ground water supplies. Hauling in enough suitable fill, installing deep wells, and enlarging the filter field help to overcome these limitations.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

OsB—Ormas loamy fine sand, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on knolls and ridges. Individual areas are mainly irregular in shape, but some are elongated. They range from 3 to about 40 acres, and the dominant size is about 15 acres.

In a typical profile the surface layer is brown loamy fine sand about 11 inches thick. The subsurface layer, about 22 inches thick, is yellowish brown, very friable loamy fine sand. The subsoil, about 23 inches thick, is dark yellowish brown, mottled, friable sandy loam in the upper part; dark brown, mottled, firm gravelly sandy clay loam in the middle part; and brown, friable gravelly sandy loam in the lower part. The underlying material to a depth of 60 inches or more is yellowish brown very gravelly sand. In a few small areas stratified loam, sandy loam, and loamy sand are in the lower part of the subsoil.

Included with this soil in mapping are many small areas of somewhat excessively drained Bloomfield soils and excessively drained Chelsea soils on slightly higher positions. They make up about 6 percent of the map unit. Small areas of well drained Rush soils are on similar positions on the landscape and make up about 2 percent of the map unit. A few areas of somewhat poorly drained soils are in low lying areas and make up about 3 percent of the map unit.

The available water capacity of the Ormas soil is moderate. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is slow. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for pasture or are in woodland.

This soil is suitable for corn, soybeans, and small grains. Droughtiness is the major limitation, and soil blowing is the major hazard. The use of irrigation on this soil helps to control droughtiness. Stripcropping; green manure crops; spreading of manure; conservation tillage, which leaves all or part of the crop residue on the surface; and cover crops help to conserve soil moisture, control soil blowing, and improve the organic matter content of the soil.

This soil is suited to grasses and legumes for hay or pasture. Erosion on steeper soils and soil blowing are hazards. Droughtiness is a limitation. Overgrazing causes erosion and soil blowing and reduces plant density and hardiness. Proper stocking, timely deferment of grazing during dry periods, and strip grazing during the summer months help to keep the pasture and soil in good condition.

This soil is suited to trees. Seedling mortality and plant competition are the major management concerns. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later.

This soil is slightly limited for building sites. It is moderately limited for local roads and streets because of frost action. Replacing or covering the upper layer of the soil with a suitable base material helps to control frost action and support vehicular traffic. This soil is slightly limited for septic tank absorption fields.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

Po—Patton silty clay loam. This deep, nearly level, very poorly drained soil is often ponded with surface water runoff from adjacent areas. It is on broad flats and in slight depressions. Individual areas are irregular in shape. They range from 5 to about 40 acres, and the dominant size is about 20 acres.

In a typical profile the surface layer is very dark gray silty clay loam about 11 inches thick. The mottled subsoil is about 27 inches thick. The upper part is dark gray, firm silt loam; the next part is dark gray, firm silty clay loam; and the lower part is gray, friable silt loam. The underlying material to a depth of 60 inches or more is gray, mottled silt loam in the upper part and grayish brown, mottled loam in the lower part. In some places the subsoil is less than 24 inches thick and the underlying material has more silt. In a few places there is more clay in the subsoil.

Included with this soil in mapping are a few small slightly convex areas of somewhat poorly drained Fincastle and Starks soils. They make up about 5 percent of the map unit. Small depressional areas that stay wet for long periods make up about 2 percent of the map unit.

The available water capacity of the Patton soil is high, and permeability is moderate. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is high. The surface layer is firm. Tilling the soil when it is too wet results in large clods that become very firm when they dry. These clods make it difficult to prepare a seedbed.

Most areas of this soil are used for cultivated crops. A few areas are used for hay and pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Ponding is the major hazard. If the soil is worked when it is too wet, puddling can result, and hard clods will form upon drying. Excess water can be removed by open ditches, subsurface and surface drains, pumping, or a combination of these methods. Conservation tillage, which leaves all or part of the crop residue on the surface, helps to improve and maintain tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Ponding is a hazard. Drainage is needed for optimum yields. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is well suited to trees. Equipment limitation, seedling mortality, windthrow hazard, and plant competition are the major management concerns.

Harvesting and logging during dry periods or during winter months when the surface is frozen will lower the limitations to use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system to lower the water table reduces seedling mortality and permits deeper penetration of roots. Water-tolerant species that have deep root systems are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities and is generally unsuitable for these uses because of ponding. This soil is severely limited for local roads because of ponding and low strength. Hauling in suitable fill, constructing roads in elevated areas, and providing roadside ditches reduce excess water. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Pp—Pits, gravel, These Pits are on terraces and outwash plains, generally in soils of the Kosciusko, Rush, and Ormas series. Areas of this map unit range from 2 to about 40 acres. The deposits of stratified sand and very gravelly sand in the Pits range from 10 to 60 feet in thickness.

Permanent pools of water are in some abandoned Pits. Some of these Pits are used for recreation. Reeds and sedges grow along the edges of some pools and are occasionally used by wildlife.

This map unit is not assigned to interpretive groups.

Ps—Pits, quarries. These Pits are manmade excavations from which limestone is quarried. They are on terraces and upland till plains, generally in soils of the Millsdale and NewGlarus series. Areas of this map unit range from 20 to about 200 acres. The deposits of limestone in the Pits are up to 100 feet in thickness.

Permanent pools of water in abandoned Pits are used for recreation.

This map unit is not assigned to interpretive groups.

Rn—Rensselaer loam, till substratum. This deep, nearly level, very poorly drained soil is often ponded with surface water runoff from adjacent areas. It is in broad, low-lying areas and in depressional areas. Individual areas are irregular in shape. The map units range from 3 to about 80 acres, and the dominant size is about 25 acres.

In a typical profile the surface layer is black loam about 10 inches thick. The subsoil is about 31 inches thick. The upper part is very dark gray and dark gray, mottled, firm clay loam; the lower part is gray, mottled, friable stratified sandy loam, loam, and loamy sand. The underlying material to a depth of 60 inches or more is grayish brown, mottled loam. In some areas of this soil the solum has more clay. In a few places there is more silt throughout the profile.

Included with this soil in mapping are a few small areas of somewhat poorly drained Crosier and Fincastle soils. They are on slightly convex positions and make up about 6 percent of the map unit. Small areas of very poorly drained Gilford soils make up about 2 percent of the map unit. They have less clay throughout and are on similar positions on the landscape.

The available water capacity of the Rensselaer soil is high. The permeability is moderate in the solum and moderately slow in the underlying material. Runoff is very slow or ponded. The seasonal high water table is at or above the surface for a significant part of the year. The organic matter content of the surface layer is high.

Most areas of this soil are used for cultivated crops. A few areas are used for hay and pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Ponding is a major hazard. If the soil is worked when it is too wet, it becomes puddled, and upon drying, it becomes hard. Subsurface and surface drains, open ditches, pumping, or a combination of these methods can be used to overcome wetness. Conservation tillage, which leaves part or all of the crop residue on the surface, helps to improve soil tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Ponding is a hazard. Drainage is needed for optimum yields. Overgrazing and grazing when the soil is too wet cause surface compaction, poor tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil and pasture in good condition.

This soil is well suited to trees. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are the major management concerns. Harvesting and logging during dry periods or during winter months when the surface is frozen will lower the limitations to use of equipment. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. A drainage system used to lower the water table reduces seedling mortality and permits deeper root penetration. Water-tolerant species are favored in timber stands. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities and is generally unsuitable for these uses because of ponding. This soil is severely limited for local roads because of ponding, low strength, and frost action. Hauling in enough suitable fill, constructing roads in elevated areas, and providing roadside ditches help remove excess water and reduce damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and to control frost action.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

RsB—Riddles silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on side slopes of natural drainageways and on low rises. Individual areas are irregular in shape. They range from 5 to about 100 acres, and the dominant size is about 45 acres.

In a typical profile the surface layer is dark brown silt loam about 10 inches thick. The subsoil is about 54 inches thick. The upper part is dark yellowish brown and yellowish brown, firm clay loam; and the lower part is brown, firm loam. The underlying material to a depth of 80 inches or more is yellowish brown loam. A few areas are less than 40 inches to the underlying material.

Included with this soil in mapping are small areas of somewhat poorly drained Crosier and Fincastle soils. They are on low knolls and in flat areas and make up about 4 percent of the unit. A few areas of steeper soils are throughout the map unit and make up about 2 percent of it.

The available water capacity of the Riddles soil is high, and permeability is moderate. Runoff is medium. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for hay and pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. If cultivated crops are grown, erosion and runoff need to be controlled. Crop rotation, conservation tillage, terraces, diversions, contour strips, stripcropping, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and to improve and maintain tilth, the available water capacity, and the organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling. Foundations, footings, and basement walls should be properly designed and foundation drain tile should be used to prevent structural damage. Backfilling with a coarser material is also helpful. This soil is moderately limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material will help to overcome these limitations. This soil is moderately limited for septic tank absorption fields because of moderate permeability. Enlarging the absorption field and hauling in enough suitable fill help to overcome this limitation.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

RsC—Riddles silt loam, 6 to 12 percent slopes. This deep, moderately sloping, well drained soil is on side slopes of natural drainageways. Individual areas are narrow and elongated. They range from 5 to about 25 acres, and the dominant size is about 10 acres.

In a typical profile the surface layer is brown silt loam about 6 inches thick. The subsoil is about 52 inches thick. The upper part is dark brown, firm clay loam, and the lower part is brown, friable loam. The underlying material to a depth of 72 inches or more is yellowish brown loam. In some areas the solum is less than 40 inches thick.

Included with this soil in mapping are a few small areas of somewhat poorly drained Crosier soils. They are in low-lying areas and make up about 4 percent of the map unit. Some areas of well drained Metea soils are throughout the map unit and make up about 4 percent of it. In a few areas steeper soils are on the edge of the unit and make up about 2 percent of it.

The available water capacity of the Riddles soil is high, and permeability is moderate. Runoff is medium. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for hay or pasture. A few areas are in woodland or are used for urban development.

This soil is suited to corn, soybeans, and small grains. If cultivated crops are grown, erosion and runoff need to be controlled. Crop rotation, conservation tillage, diversions, grassed waterways, contour strips, stripcropping, terraces, or grade stabilization structures help prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and improve and maintain tilth, the available water capacity, and the organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling and slope. Foundations, footings, and basement walls should be properly designed and foundation drain tile used to prevent structural damage. Backfilling with a coarser material is also helpful. Buildings should be designed to complement the slope or sites should be graded.

This soil is moderately limited for local roads and streets because of slope, frost action, and low strength. The land could be leveled or the roads constructed on the contour. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and to control frost action. This soil is moderately limited for septic tank absorption fields because of moderate permeability and slope. Land leveling, the use of contour systems, enlarging the absorption field, and hauling in enough suitable fill help overcome these limitations.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

RtA—Rush silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is most commonly on the tops of high terraces. Individual areas are elongated or oval. They range from 40 to about 180 acres, and the dominant size is about 50 acres.

In a typical profile the surface layer is dark brown silt loam about 9 inches thick. The subsoil is about 48 inches thick. The upper part is dark brown, firm silty clay loam; the middle part is dark brown, firm clay loam; and the lower part is dark brown, firm gravelly sandy clay loam. The underlying material to a depth of 60 inches or more is brown very gravelly sand. In some areas the underlying material is stratified sandy and silty material. Some places are more than 70 inches to the underlying material. In a few places there is a sandy loam surface layer.

Included with this soil in mapping are a few small areas of well drained Kosciusko soils. They are on short, narrow slopes along drainageways and make up about 2 percent of the map unit. Some areas of well drained Ormas soils are on convex knobs or narrow ridges. They make up about 3 percent of the unit. A few areas of somewhat poorly drained Sleeth soils are in low-lying areas and make up about 3 percent of the unit.

The available water capacity of the Rush soil is high. Permeability is moderate. Runoff is slow. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. A few areas are used for pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops help to maintain or improve soil tilth, the available water capacity, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Overgrazing and grazing when the soil is too wet cause surface compaction, poor tilth, excessive runoff, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling. Foundations, footings, and basement walls should be properly designed and foundation drain tile used to prevent structural damage. Backfilling with a coarser material is also helpful. This soil is severely limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with a more suitable material helps to overcome these limitations. This soil is slightly limited for septic tank absorption fields.

This soil is in capability class I and woodland suitability subclass 1o.

RtB—Rush silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on the top of high river terraces and on the sides of these terraces that face away from the river. Individual areas are elongated or oval. They range from 15 to about 180 acres, and the dominant size is about 60 acres.

In a typical profile the surface layer is dark brown silt loam about 9 inches thick. The subsoil is about 48 inches thick. The upper part is dark yellowish brown, firm silty clay loam; the middle part is dark brown, firm clay loam and loam; and the lower part is reddish brown, firm gravelly sandy clay loam. The underlying material to a depth of 60 inches or more is brown very gravelly coarse sand. In some areas the underlying material is stratified sandy and silty material. A few places are more than 70 inches to the underlying material. In some places there is a sandy loam surface layer.

Included with this soil in mapping are a few small areas of well drained Kosciusko soils. They are on short, narrow slopes and make up about 2 percent of the map unit. A few areas of well drained Ormas soils are on convex knobs and ridges. They make up about 2 percent of the map unit. Some areas of somewhat poorly drained Sleeth soils are in flatter areas and make up about 1 percent of the map unit. A few areas of steeper soils are throughout the unit and make up about 2 percent of it.

The available water capacity of the Rush soil is high. Permeability is moderate. Runoff is medium. The organic matter content of the surface layer is low.

Most areas of this soils are used for cultivated crops. A few areas are used for pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. If this soil is cultivated, erosion and runoff need to be controlled. Crop rotation, conservation tillage, diversions, terraces, contour strips, stripcropping, grassed waterways, grade stabilization structures, or a combination of these methods help prevent excessive soil loss. Leaving all or part of the crop residue on the surface and planting cover crops also help to control erosion and runoff and improve and maintain tilth, the available water capacity, and the organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling. Foundations, footings, and basement walls should be properly designed and foundation drain tile used to prevent structural damage. Backfilling with a coarser material is also helpful. This soil is severely limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with a more suitable material helps to support vehicular traffic and to control frost action. This soil is slightly limited for septic tank absorption fields.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

RuB—Russell silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridgetops near the edge of the uplands and on knobs adjacent to drainageways. Individual areas are irregular in shape. They range from 5 to about 120 acres, and the dominant size is about 45 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 50 inches thick. The upper part is yellowish brown, friable silt loam; the next part is yellowish brown and dark yellowish brown, firm silty clay loam; the next part is dark yellowish brown, firm loam; and the lower part is brown, mottled, friable loam. The underlying material to a depth of 80 inches or more is brown loam. In some areas the depth to the underlying material is less than 40 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Fincastle soils. They are in low-lying areas and make up about 3 percent of the unit. A few areas of moderately well drained Xenia soils are in slightly lower lying areas and make up about 4 percent of the unit. A few areas of steeper soils make up about 2 percent of the map unit.

The available water capacity of the Russell soil is high, and permeability is moderate. Runoff is medium. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. A few areas are used for hay and pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Erosion is the main hazard. Crop rotation, grassed waterways, terraces, contour strips, stripcropping, diversions, and grade stabilization structures are used to control excessive soil loss. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops also help to control erosion and runoff as well as improve and maintain tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling. Foundations, footings, and basement walls should be properly designed and foundation drain tile used to prevent structural damage. Backfilling with a coarser material is also helpful. This soil is severely limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material will help to support vehicular traffic and to control frost action. This soil is moderately limited for septic tank absorption fields because of moderate permeability. Enlarging the absorption field and hauling in enough suitable fill help to overcome this limitation.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

RuC—Russell silt loam, 6 to 12 percent slopes. This deep, moderately sloping, well drained soil is on side slopes that border streams and drainageways. Individual areas are mostly narrow and elongated, but some are oval. They range from 5 to about 20 acres, and the dominant size is about 10 acres.

In a typical profile the surface layer is brown silt loam about 7 inches thick. The subsoil is about 44 inches thick. The upper part is dark yellowish brown and yellowish brown, firm silty clay loam; the middle part is yellowish brown, firm clay loam; and the lower part is dark yellowish brown, friable loam. The underlying material to a depth of 60 inches or more is brown loam.

In some areas the depth to the underlying material is less than 40 inches.

Included with this soil in mapping are a few small areas of somewhat poorly drained Fincastle soils. They are on the foot slopes of ridges and make up about 3 percent of the unit. Small areas of moderately well drained Xenia soils are in slightly lower lying areas and make up about 4 percent of the unit. A few areas of steeper soils make up about 2 percent of the map unit.

The available water capacity of the Russell soil is high, and permeability is moderate. Runoff is medium. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are used for hay and pasture or are in woodland.

This soil is suited to corn, soybeans, and small grains. If cultivated crops are grown, erosion and runoff need to be controlled. Crop rotation, grassed waterways, terraces, contour strips, stripcropping, diversions, and grade stabilization structures help prevent excessive soil loss. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops also help to control erosion and runoff and improve and maintain tilth, the available water capacity, and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay and pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for building sites because of shrinking and swelling and slope. Foundations, footings, and basement walls should be properly designed and foundation drain tile used to prevent structural damage. Backfilling with a coarser material is also helpful. Buildings should be designed to complement the slope or sites should be graded. This soil is severely limited for local roads and streets because of frost action and low strength. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material helps to support vehicular traffic and to control frost action. This soil is moderately limited for septic tank absorption fields because of moderate permeability and slope. Land leveling, the use of contour systems, enlarging the absorption field, and hauling in enough suitable fill help to overcome these limitations.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

Sh—Shoals silty clay loam, frequently flooded. This deep, nearly level, somewhat poorly drained soil is frequently flooded for brief periods. It is on low rises on the flood plain. Individual areas are linear. They range from 3 to about 45 acres, and the dominant size is about 30 acres.

In a typical profile the surface layer is dark grayish brown silty clay loam about 7 inches thick. The subsurface layer is dark grayish brown, mottled silty clay loam about 8 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown and brown, mottled, firm silty clay loam; and the lower part is dark grayish brown, mottled, friable sandy loam. The underlying material to a depth of 60 inches or more is grayish brown, mottled sandy loam.

Included with this soil in mapping are a few small areas of well drained Gessie Variant and Stonelick soils. They are on slightly higher lying positions and make up about 4 percent of the unit. A few small depressional areas of very poorly drained soils make up about 3 percent of the map unit.

The available water capacity of the Shoals soil is high, and permeability is moderate. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. The organic matter content of the surface layer is high.

Most areas of this soil are used for cultivated crops. Some areas are used for pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Flooding is the major hazard, and wetness is the major limitation. Levees help control some flooding. Excess water can be removed by open ditches, surface and subsurface drains, and pumping. Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops help to improve and maintain tilth and the organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Flooding can damage the grasses and legumes and restrict this soil for pasture. Wetness is a limitation. Levees will help control flooding. For optimum yields drainage is needed. Overgrazing and grazing when the soil is too wet cause surface compaction, poor soil tilth, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months help to keep the soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities because of flooding and wetness, and it is generally unsuitable for this use. This soil is severely limited for local roads because of frost action and flooding. Roadside ditches lower the water table and reduce damage from frost action. Resurfacing the base with more suitable material helps to support vehicular traffic. It is extremely difficult to overcome these limitations unless such areas are protected in accordance with state and local requirements.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

Sm—Sleeth silt loam. This deep, nearly level, somewhat poorly drained soil is on the flatter areas of the oval-shaped river terraces or at the base of these terraces. Individual areas are irregular in shape. They range from 3 to about 120 acres, and the dominant size is about 30 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 47 inches thick. The upper part is dark grayish brown, mottled, firm silt loam; the next part is brown and grayish brown, mottled, firm silty clay loam; the next part is grayish brown and yellowish brown, mottled, firm clay loam; and the lower part is yellowish brown, mottled, firm gravelly clay loam. The underlying material to a depth of 60 inches or more is brown stratified sand and very gravelly sand. In some areas the underlying material consists of stratified sandy and silty material. In a few small areas more silt is in the subsoil. Some places have loam underlying material.

Included with this soil in mapping are a few small areas of very poorly drained Gilford soils in depressions and along drainageways. They make up about 5 percent of the map unit. Some small areas of well drained, more sloping Rush soils are on the flat tops of river terraces and make up about 2 percent of the map unit.

The available water capacity of the Sleeth soil is high, and permeability is moderate. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. A few small areas are used for pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Wetness is the major limitation. Excess water can be removed by open ditches, surface and subsurface drains, pumping, or a combination of these methods. Conservation tillage, that leaves all or part of the crop residue on the surface, and cover crops help to maintain and improve tilth and the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Wetness is a limitation. Drainage of this soil is needed for optimum yields. Overgrazing and grazing when the soil is too wet cause surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, and poor tilth. Proper stocking, restricted use during wet periods, timely deferment of grazing, and strip grazing during the summer help to keep the pasture and soil in good condition.

This soil is suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites because of wetness. An adequate drainage system is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. This soil is severely limited for local roads and streets because of frost action and low strength. Providing roadside ditches lowers the water table and reduces damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material also helps to overcome these limitations. This soil is severely limited for septic tank absorption fields because of wetness. The water table should be lowered with ditches and subsurface drains and suitable fill material should be brought to the site to install the absorption field.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

SrA—Starks silt loam, 0 to 3 percent slopes. This deep, nearly level or gently sloping, somewhat poorly drained soil is in broad, low-lying areas and on low rises. Individual areas are irregular in shape. They range from 3 to about 240 acres, and the dominant size is about 80 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 9 inches thick. The mottled subsoil is about 41 inches thick. The upper part is dark grayish brown, friable silt loam; the next part is yellowish brown and grayish brown, firm silty clay loam; and the lower part is yellowish brown, friable silt loam. The underlying material to a depth of 60 inches or more is gray, mottled fine sandy loam. In some areas there is loam underlying material. In some places the lower part of the subsoil is stratified loams and sands.

Included with this soil in mapping are a few areas of poorly drained Cyclone soils and very poorly drained Patton soils. They are in depressions and along drainageways and make up about 5 percent of the unit. Some areas of well drained Russell soils are on small knobs and make up about 2 percent of the map unit.

The available water capacity of the Starks soil is high. Permeability is moderately slow. Runoff is slow or medium. The seasonal high water table is at a depth of 1 foot to 3 feet. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. A few areas are used for pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Wetness is the major limitation. Excess water can be removed by open ditches, surface and subsurface drains, and pumping.

Conservation tillage, which leaves all or part of the crop residue on the surface, and cover crops help improve and maintain the organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard on steep slopes. Wetness is a limitation. Subsurface drainage is needed for best results. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, and poor soil tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites because of wetness. An adequate drainage system is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. This soil is severely limited for local roads and streets because of frost action and low strength. Providing roadside ditches lowers the water table and reduces the damage from frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material is an alternate solution. This soil is severely limited for septic tank absorption fields because of wetness and moderately slow permeability. Ditches and subsurface drains lower the water table. Elevating the absorption field in a more suitable soil material helps the septic tank to function properly.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

St—Stonelick loamy fine sand, occasionally flooded. This deep, nearly level, well drained soil is occasionally flooded for very brief periods. It is in the higher lying areas on the flood plain. Individual areas are elongated. They range from 5 to about 60 acres, and the dominant size is about 20 acres.

In a typical profile the surface layer is dark grayish brown loamy fine sand about 6 inches thick. The subsoil is about 25 inches thick. It is brown and yellowish brown, friable fine sandy loam and loamy sand. The underlying material to a depth of 60 inches or more is yellowish brown fine sandy loam. In a few areas brown mottles are within 40 inches of the surface.

Included with this soil in mapping are a few areas of well drained Gessie Variant soils. They occupy similar positions on the landscape and make up about 5 percent of the map unit. Some areas of somewhat poorly drained Shoals soils are in lower lying areas and make up about 3 percent of the map unit.

The available water capacity of the Stonelick soils is low, and permeability is moderately rapid. Runoff is slow. The organic matter content of the surface layer is low.

Most areas of this soil are used for cultivated crops. Some areas are in woodland or are used for pasture and hay.

This soil is well suited to corn, soybeans, and small grains. Flooding and soil blowing are hazards. During dry periods droughtiness can be a concern. Levees help to control flooding. Irrigation helps to control droughtiness. Conservation tillage, which leaves all or part of the crop residue on the surface, stripcropping, windbreaks, and cover crops help to maintain and improve the organic matter content, available water capacity, and soil tilth and to control soil blowing.

This soil is well suited to grasses and legumes for hay or pasture. Flooding can damage the grasses and legumes and restrict this soil for pasture. Soil blowing is a hazard. Droughtiness is a limitation during dry periods. Levees help control flooding. Overgrazing and grazing during wet periods result in reduced plant density and hardiness, reduced forage yields, poor tilth, surface compaction, and sod damage. Proper stocking, timely deferment of grazing, strip grazing, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil is well suited to trees. Seedling mortality and plant competition are the major management concerns. Planting more trees than necessary can compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is severely limited for building sites and sanitary facilities and is generally unsuitable for this use because of flooding. This soil is severely limited for local roads because of flooding. It is extremely difficult to overcome this limitation unless areas are protected in accordance with state and local requirements.

This soil is in capability subclass IIw and woodland suitability subclass 2s.

WeB—Wawasee sandy loam, 2 to 8 percent slopes. This deep, gently sloping or moderately sloping, well drained soil is in broad flat areas, on sides of natural drainageways, and on low rises. Individual areas are irregular in shape. They range from 4 to about 100 acres, and the dominant size is about 30 acres.

In a typical profile the surface layer is dark grayish brown sandy loam about 4 inches thick. The subsurface layer is yellowish brown sandy loam about 7 inches thick. The subsoil is about 21 inches thick. The upper part is dark yellowish brown, firm loam and sandy clay loam, and the lower part is yellowish brown, firm loam. The underlying material to a depth of 60 inches or more is yellowish brown loam. In some areas the surface layer and subsoil are more than 40 inches thick. In a few places brown mottles are in the lower part of the subsoil. In some places more clay is in the surface layer and subsoil.

Included with this soil in mapping are a few small areas of somewhat poorly drained Crosier soils. They are in low-lying areas and on low knolls and make up about 3 percent of the map unit. A few areas of steeper soils are throughout the map unit and make up about 2 percent of it.

The available water capacity of the Wawasee soil is high. Permeability is moderate. Runoff is medium. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. Some areas are used for hay or pasture. A few areas are in woodland or are used for urban development.

This soil is well suited to corn, soybeans, and small grains. Erosion and runoff are hazards. Crop rotation, conservation tillage, which leaves all or part of the crop residue on the surface, contour strips, stripcropping, cover crops, terraces, diversions, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Conservation tillage, which includes crop residue management, and cover crops help to improve and maintain tilth, available water capacity, and the organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing or grazing when the soil is too wet causes surface compaction, reduced forage yields, sod damage, reduced plant density and hardiness, excessive runoff, and poor tilth. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is slightly limited for building sites. It is moderately limited for local roads and streets because of frost action. Replacing or covering the upper layer of the soil with a suitable base material helps to support vehicular traffic. This soil is slightly limited for septic tank absorption fields.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

XeA—Xenia silt loam, 1 to 3 percent slopes. This deep, nearly level or gently sloping, moderately well drained soil is on ridgetops and in slightly undulating areas on uplands. Individual areas are irregular in shape. They range from 5 to about 45 acres, and the dominant size is about 20 acres.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 41 inches thick. The upper part is yellowish brown, friable silt loam; and the lower part is dark brown and yellowish brown, mottled, firm silty clay loam and clay loam. The underlying material to a depth of 60 inches or more is brown, mottled loam. In a few areas stratified sand, sandy clay loam, and silt loam are in the underlying material.

Included with this soil in mapping are a few small areas of poorly drained Cyclone soils in drainageways and depressions. They make up about 3 percent of the map unit. Some small areas of somewhat poorly drained Fincastle soils are in slightly lower lying areas and make up about 5 percent of the map unit. A few areas of well drained Russell soils are on higher knolls and ridges and make up about 3 percent of the map unit.

The available water capacity of the Xenia soil is high, and permeability is moderately slow. Runoff is slow or medium. The seasonal high water table is at a depth of 2 to 6 feet. The organic matter content of the surface layer is moderate.

Most areas of this soil are used for cultivated crops. A few areas are used for hay and pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grains. Erosion is a hazard on 3 percent slopes. Conservation tillage, which leaves all or part of the crop residue on the surface; terraces; diversions; grassed waterways; grade stabilization structures; crop rotation; or a combination of these methods can help control erosion and runoff. Conservation tillage, cover crops, and green manure crops help to improve and maintain good tilth and organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard on 3 percent slopes. Overgrazing and grazing during wet periods result in surface compaction, poor tilth, excessive runoff, reduced forage yields, sod damage, and reduced plant density and hardiness. Proper stocking, timely deferment of grazing, strip grazing during the summer months, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil is well suited to trees. Plant competition is the major management concern. Seedlings grow well if competing vegetation is controlled by site preparation or by spraying, cutting, or girdling.

This soil is moderately limited for dwellings without basements because of shrinking and swelling and wetness. It is severely limited for dwellings with basements because of wetness. Foundations, footings, and basement walls should be properly designed and foundation drain tile used to prevent structural damage. Backfilling with a coarser material is also helpful. A subsurface drainage system is needed to lower the water table.

This soil is severely limited for local roads and streets because of frost action and low strength. Providing roadside ditches lowers the water table and reduces frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material is an alternate solution. This soil is severely limited for septic tank absorption fields because of wetness and moderately slow permeability. Enlarging the filter field and hauling in enough suitable fill to install the absorption field keep the field above the water table and allow the septic tank to function properly.

This soil is in capability class I and woodland suitability subclass 1o.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

prime farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short and long-range needs for food and fiber. Because the supply of high quality farmland is limited, responsible levels of government, as well as individuals, must encourage and facilitate the use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. This land has the soil quality, growing season, and moisture supply needed to produce a sustained high yield of crops when it is treated and managed with acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland may be used for crops, pasture, woodland, or similar purposes, but not for urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland receives an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and growing season. The level of acidity or alkalinity is acceptable. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not flooded during the growing season. The slope ranges mainly from 0 to 6 percent. For more detailed information on the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

About 222,000 acres, or nearly 84 percent of Cass County, meet the soil requirements for prime farmland. Areas are scattered throughout the county, mainly in map units 1, 2, 3, 4, and 5 of the general soil map. Nearly all of this prime farmland is used for corn and soybeans.

In some parts of the county, there has been a loss of some prime farmlands to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, difficult to cultivate, and less productive.

The map units that make up prime farmland in Cass County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 5. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units."

Soils that have limitations—a high water table, flooding, or inadequate rainfall—may qualify for prime farmland if these limitations are overcome by such measures as drainage, flood control, or irrigation. In the following list, the measures needed to overcome these limitations, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to see if these limitations have been overcome by corrective measures.

The map units that meet the soil requirements for prime farmland are:

Ad—Ackerman muck, drained (where drained)
BnA—Blount silt loam, 0 to 3 percent slopes (where drained)
CpA—Crosier loam, 0 to 3 percent slopes (where drained)
Cy—Cyclone silt loam (where drained)
FcA—Fincastle silt loam, 0 to 3 percent slopes (where drained)
Gf—Gilford sandy loam (where drained)
Gg—Gilford loam, gravelly substratum (where drained)
GwB—Glynwood silt loam, 2 to 6 percent slopes
Hh—Houghton muck, drained (where drained)
KoB—Kosciusko silt loam, 2 to 6 percent slopes
Ma—Maumee loamy fine sand (where drained and irrigated)
MkC—Metea loamy fine sand, 3 to 10 percent slopes
MnB2—Miami silt loam, 2 to 6 percent slopes, eroded
Ms—Millsdale silty clay loam (where drained)
NeB—NewGlarus silt loam, 2 to 6 percent slopes
Po—Patton silty clay loam (where drained)
Rn—Rensselaer loam, till substratum (where drained)
RsB—Riddles silt loam, 2 to 6 percent slopes
RtA—Rush silt loam, 0 to 2 percent slopes
RtB—Rush silt loam, 2 to 6 percent slopes
RuB—Russell silt loam, 2 to 6 percent slopes
Sm—Sleeth silt loam (where drained)
SrA—Starks silt loam, 0 to 3 percent slopes (where drained)
WeB—Wawasee sandy loam, 2 to 8 percent slopes
XeA—Xenia silt loam, 1 to 3 percent slopes

crops and pasture

Marvin O. Hust, district conservationist, Soil Conservation Service, assisted in the preparation of this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some rarely grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

According to the 1967 Conservation Needs Inventory, approximately 80 percent of the survey area was used for crops and pasture (*3*). Of this area, approximately 80 percent was used for corn or soybeans; 7 percent was in pasture; 5 percent was in small grains, mainly wheat; and the rest was used for conservation purposes.

There is some potential for increasing the number of cropland acres in Cass County. About 6 percent of the county that is potentially good cropland is used as woodland and about 5 percent is used as pasture. In addition to the reserve productive capacity represented by this land, food production could be increased considerably by extending the latest crop production technology to all cropland in the county.

The optimum use of the land requires careful planning and good management. This includes overcoming or controlling soil limitations and hazards. The following paragraphs discuss the common soil limitations and hazards of wetness, erosion, soil blowing, and droughtiness. They also discuss soil tilth and fertility and the use of crops and specialty crops on the soils.

Soil drainage is the major soil problem on about 50 percent of the cropland and pasture in Cass County. Most areas of the naturally very poorly drained and poorly drained Rensselaer, Patton, Cyclone, and Gilford soils have been artificially drained for satisfactory agricultural production. However, a few areas of these soils cannot be economically drained, especially the Rensselaer and Patton soils. They are depressional areas and areas along drainage ditches, where a suitable outlet would have to be deep and extend a long distance. Many of these areas can be artificially drained by pumping the water to an outlet.

Most somewhat poorly drained soils are so wet that crops are damaged during most years unless they are artificially drained. These include the Blount, Crosier, Fincastle, Morocco, and Sleeth soils. Draining these soils lowers the seasonal high water table, thereby protecting plant roots from excess water.

Many soils in the county have good natural drainage. Included with many of these well drained and moderately well drained soils, however, are small areas of wetter soils along drainageways and in swales. Artificial drainage is needed in some of these wet areas.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of these drainage systems is needed in most areas of the very poorly drained soils used for intensive row-cropping. Subsurface drains are generally installed at depths of approximately 3 to 4 feet, but depths vary depending upon the topography. Some fields have a complete network of evenly spaced tile, and some fields have randomly placed tile that drain the wetter areas. Distance between tile depends upon the permeability of the soil.

Tile placed in soils that have layers of fine sand, such as Gilford and Maumee soils, need a protective covering so that the sand will not clog the spaces where the water enters the tile. After the tile has been placed in these soils, part of the surface layer or some organic matter should be placed immediately over the tile and its protective covering to keep sand from clogging the openings.

Special drainage systems are sometimes needed for organic soils because they oxidize and subside when the pore space is filled with air. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimizes the oxidation and subsidence of organic soils. Information on drainage design for each kind of soil is available in local offices of the Soil Conservation Service.

Soil erosion is a hazard on about 22 percent of the cropland and pasture in Cass County (*3*). If the slope is more than 2 percent, erosion is a hazard.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils with a subsoil high in clay, such as Blount, Glynwood, and Russell soils, and on soils with a layer in or below the subsoil that limits the depth of the root zone. An example of this is the bedrock in NewGlarus and Millsdale soils. Erosion also reduces productivity on soils that tend to be droughty, such as Kosciusko soils. Second, soil erosion results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves water quality for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult because the original friable surface soil has been eroded away. Such eroded spots are common in areas of Miami and Morley soils.

Erosion can be controlled by grasses and legumes in a crop rotation, crop residue management, conservation tillage, contour farming, grassed waterways, tile outlet terraces, or a combination of these methods. Growing grasses and legumes for hay or pasture is also an effective way to control erosion.

Sloping soils need a cover of vegetation to reduce erosion caused by water. Raindrops that hit bare soil can dislodge soil particles, allowing them to be carried away by moving water. Vegetation reduces the impact of raindrops, allowing the water to gently reach the surface layer of the soil. Substantial vegetation can be left on the surface by allowing the residue from previous crops to remain and by using conservation tillage. Proper crop rotations also help keep soil loss at a minimum.

Slopes are so short and irregular that contour tillage or terracing is not practical in some sloping areas in Cass County. On these soils, cropping systems that provide substantial vegetative cover are needed unless conservation tillage is used. No-tillage for corn, a method common on an increasing acreage, is effective in reducing erosion on sloping land and can be adapted to most soils in the survey area.

Diversions and parallel tile-outlet terraces are used to shorten the effective length of slope and are effective in reducing erosion. They are most practical on deep, well drained soils that are highly susceptible to erosion. The benefits of terracing include a reduction in soil loss and in the associated loss of soil nutrients; a reduction in sediment problems, such as crop damage and damage to watercourses; and a reduction of the need for grassed waterways, which take productive land out of row crops. By making it easier to farm on the contour, terracing may also reduce the use of fuel and reduce the amount of pesticides entering watercourses. Many of the Riddles soils are suitable for terraces.

Grassed waterways are needed in some areas of Cass County on sloping soils such as Bloomfield, Kosciusko, Miami, and Morley soils. In addition, many areas of somewhat poorly drained and very poorly drained soils should have subsurface drainage where they are crossed by waterways. Subsurface drainage is generally needed under most grassed waterways and drainageways.

Because of the numerous open ditches in the county, many grade stabilization structures are needed. These structures reduce erosion where surface water drains into an open ditch.

Soil blowing is a hazard on organic soils when they are drained. Soil blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining vegetative cover, surface mulch, or rough surfaces through proper tillage minimizes soil blowing on these soils. Windbreaks of adapted shrubs and trees are effective in reducing and controlling soil blowing. Soil blowing also occurs on mineral soils with a surface texture of fine sandy loam, loamy fine sand, or fine sand when they are barren. These soils are mostly in the northwestern part of the county.

Most soil blowing occurs in spring when winds are strong. Soils in fields that have little vegetative cover are very susceptible to soil blowing. In early spring, soil blowing occurs most often on cultivated soils. In the latter part of spring, soil blowing severely damages young growing crops, especially young soybeans.

Droughtiness is a limitation of the sandy soils in Cass County. These soils have a moderate or low available water capacity. They generally have enough moisture in the spring for crops to grow well. In some years there is insufficient moisture in the summer, which causes these soils to become droughty.

Where it is feasible, irrigation can supply needed water to plants during dry periods. In some areas large amounts of ground water are within several feet of the surface and could be a source of water for irrigation.

Without irrigation, soils that are droughty are poorly suited for many crops. If row crops are grown on these soils, the plant population is less than on a soil with a high available water capacity.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are friable, granular, and porous. Most of the soils in the county have a friable surface layer and have good tilth. They are generally easy to till under proper moisture conditions. Some of the very poorly drained soils have a clay loam or silty clay loam surface layer. Tillage of these soils when they are too wet will result in large clods that become very firm when they dry. These clods make it difficult to prepare a seedbed. Fall plowing of these soils, however, generally results in good tilth in the spring.

Intensive cultivation of organic soils over a period of many years will cause substantial decomposition of the organic matter. In some areas of organic soils this decomposition will expose coprogenous earth, which, when plowed generally remains in large chunks. Exposure to air quickly dries coprogenous earth, and when dry, it absorbs water very slowly. The result is very firm clods on the surface. These clods, which break down very slowly, make it difficult to prepare a seedbed.

Soil fertility is naturally moderate or high in most of the soils in the county, and available phosphorus and potash levels are naturally low. Reaction of the soils varies widely. The very poorly drained soils normally are neutral or slightly acid, most of the sandy soils are medium acid or strongly acid, and the loamy soils are normally medium acid. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service or most fertilizer companies can help in determining the kinds and amounts of fertilizer and lime to apply.

Field crops suited to the soils and climate of the survey area include corn, soybeans, and wheat. Other crops that are suited, but are less extensive, are oats, barley, rye, and sorghum. Grass and legume seed could be produced from alfalfa, bromegrass, bluegrass, various clovers, fescue, orchardgrass, and redtop. Legumes and grasses suited to the soils and climate of the survey area include alfalfa, birdsfoot trefoil, ladino clover, little red clover, mammoth clover, sweetclover, bromegrass, bluegrass, fescue, orchardgrass, redtop, reed canarygrass, and sudangrass.

Special crops are of limited commercial importance in the survey area. Only a very small acreage is used for popcorn, vegetables, and small fruit. Deep soils that have good natural drainage and that warm up early in the spring are especially well suited to many vegetables and small fruit. In the survey area these are Riddles and Russell soils that have slopes of less than 6 percent. When adequately drained, organic soils are suited to many vegetable crops. Most of the well drained soils in the survey area are suitable for orchards and nursery plants.

Latest information and suggestions for growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined 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. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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

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

Class IV soils have very severe limitations that reduce the choice of plants or that 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.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

Mitchell G. Hassler, Forester, Soil Conservation Service, assisted in the preparation of this section.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on the soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are predicted to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

James D. McCall, wildlife biologist, Soil Conservation Service, assisted in the preparation of this section.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, sorghum, and sunflower.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, timothy, lovegrass, bromegrass, bluegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, ragweed, polkweed, sheepsorrel, dock, crabgrass, and dandelion.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, beech, wild cherry, sweetgum, willow, black walnut, apple, hawthorn, dogwood, hickory, hazelnut, blackberry, elderberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, pondweed, spikerush, wild millet, wildrice, saltgrass, algae, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, pheasant, dove, meadowlark, field sparrow, cottontail, red fox, and woodchuck.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and white-tailed deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, and beaver.

engineering

Max L. Evans, state conservation engineer, Soil Conservation Service, assisted in the preparation of this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sols*. An example is Alfisols.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisols).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalfs*, the suborder of the Alfisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*6*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Ackerman series

The Ackerman series consists of deep, very poorly drained soils. Permeability is moderately slow to moderately rapid in the organic material, slow in the coprogenous earth, and rapid in the underlying material. These soils are on outwash plains. They formed in organic material underlain by sandy deposits. Slopes range from 0 to 2 percent.

Ackerman soils are similar to Houghton soils and are commonly adjacent to Gilford and Maumee soils. Houghton soils have organic material that is deeper than 51 inches. Gilford and Maumee soils are mineral soils that are slightly higher on the landscape.

Typical pedon of Ackerman muck, drained, in a cultivated field 2,340 feet east and 330 feet north of the center of sec. 6, T. 27 N., R. 1 W.

Oap—0 to 11 inches; black (N 2/0) sapric material; broken face and rubbed, very dark gray (10YR 3/1) dry; about 2 percent fiber, a trace rubbed; moderate medium granular structure; very friable; mostly herbaceous fiber; about 30 percent mineral content; slightly acid; abrupt smooth boundary.

IILco1—11 to 17 inches; very dark grayish brown (10YR 3/2) coprogenous earth; moderate medium platy structure; firm; V-shaped wedges 1/2 inch to 3 inches wide filled with black (N 2/0) sapric material; dark yellowish brown (10YR 4/4) iron oxides along old root channels and plate faces; about 80 percent mineral content; slightly acid; clear wavy boundary.

IILco2—17 to 23 inches; gray (5Y 5/1) coprogenous earth; many medium prominent yellowish brown (10YR 5/4) mottles; weak medium angular blocky structure; firm; V-shaped wedges 1/2 inch to 3 inches wide filled with black (N 2/0) sapric material; dark brown (7.5YR 4/4) iron oxides along old root channels; about 80 percent mineral content; neutral; abrupt irregular boundary.

IIIC1—23 to 27 inches; pale brown (10YR 6/3) fine sand; single grain; loose; many 1/2- to 1-inch yellowish red (5YR 5/6) and dark reddish brown (5YR 3/2) iron oxide accumulations extending vertically through old root channels; neutral; clear wavy boundary.

IIIC2—27 to 39 inches; pale brown (10YR 6/3) fine sand; single grain; loose; pockets of olive gray (5Y 4/2) coprogenous earth extending vertically throughout the horizon; slight effervescence; moderately alkaline; clear wavy boundary.

IIIC3—39 to 60 inches; brownish yellow (10YR 6/6) fine sand; single grain; loose; slight effervescence; moderately alkaline.

The thickness of the sapric material and coprogenous earth is 16 to 30 inches.

The Oap horizon is black (N 2/0 or 10YR 2/1). The mineral content varies from approximatly 30 to 60 percent. In some profiles, there is an Oa2 horizon that is similar to the Oap horizon. The Lco horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 to 5; and chroma of 1 or 2. The IIIC horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 or 6; and chroma of 3 to 6. It is very fine sand, fine sand, sand, or loamy sand.

Bloomfield series

The Bloomfield series consists of deep, somewhat excessively drained, rapidly permeable soils on outwash terraces and upland till plains. These soils formed in sandy material deposited by glacial melt waters. Slopes range from 4 to 12 percent. These soils contain more sand than is defined in the range for the Bloomfield series, but this difference does not alter their use or behavior.

Bloomfield soils are similar to Chelsea and Ormas soils and are commonly adjacent to Metea, Riddles, and Rush soils. Chelsea soils have less clay in the solum than Bloomfield soils. Ormas and Rush soils have more clay in the solum. Metea and Riddles soils are underlain by loamy glacial till. Metea, Riddles, and Rush soils are in the same landscape position as Bloomfield soils.

Typical pedon of Bloomfield loamy fine sand, 4 to 12 percent slopes, in a cultivated field 495 feet east and 900 feet south of the northwest corner of sec. 23, T. 27 N., R. 2 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; many fine and medium roots; neutral; abrupt wavy boundary.

A21—9 to 12 inches; yellowish brown (10YR 5/4) loamy sand; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

A22—12 to 25 inches; light yellowish brown (10YR 6/4) sand; very weak fine subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

B21t—25 to 34 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; slightly acid; clear wavy boundary.

B22t—34 to 76 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak medium subangular blocky structure; very friable; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; slightly acid; clear wavy boundary.

C—76 to 80 inches; yellowish brown (10YR 5/4) fine sand; single grain; very friable; neutral.

The solum is 55 to 80 inches thick.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 or 5. It is neutral or slightly acid. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is loamy sand, fine sand, or loamy fine sand and is slightly acid to mildly alkaline.

Blount series

The Blount series consists of deep, somewhat poorly drained, slowly permeable soils on till plains. These soils formed in loamy glacial till. Slopes range from 0 to 3 percent.

Blount soils are similar to Fincastle soils and are commonly near Glynwood, Morley, Rensselaer, and Riddles soils on the landscape. Fincastle soils have less clay in the solum than Blount soils. Glynwood and Morley soils are better drained and are in higher lying areas. Rensselaer soils have a mollic epipedon, are grayer throughout the pedon, and are in depressional areas. Riddles soils are well drained, have less clay in the solum, and are in higher lying areas.

Typical pedon of Blount silt loam, 0 to 3 percent slopes, in a cultivated field 1,650 feet east and 1,880 feet south of the northwest corner of J. B. Richardville Reserve, T. 27 N., R. 3 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; slightly acid; abrupt wavy boundary.

B1t—8 to 14 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct yellowish brown (10YR 5/8) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; strongly acid; clear wavy boundary.

B21t—14 to 18 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct yellowish brown (10YR 5/8) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous gray (10YR 5/1) clay films on faces of peds; few black (10YR 2/1) manganese oxide accumulations; strongly acid; clear wavy boundary.

B22t—18 to 25 inches; yellowish brown (10YR 5/6) clay loam; many medium distinct gray (10YR 5/1) mottles; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; firm; few fine roots; medium continuous grayish brown (10YR 5/2) clay films on faces of peds and along old root channels; common black (10YR 2/1) manganese oxide accumulations; slightly acid; clear wavy boundary.

C—25 to 60 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct gray (10YR 5/1) mottles; massive; firm; strong effervescence; mildly alkaline.

The solum ranges from 20 to 45 inches in thickness.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. The B21t horizon has hue of 10YR, value of 4 to 6, and chroma of 4 or 5. The B22t horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 6. The B2t horizon is clay loam, silty clay loam, or silty clay.

Chelsea series

The Chelsea series consists of deep, excessively drained, rapidly permeable soils on outwash plains. These soils formed in sandy deposits that were reworked by wind. Slopes range from 4 to 12 percent.

Chelsea soils are similar to Bloomfield and Oakville soils and are commonly adjacent to Maumee and Morocco soils. Bloomfield soils have more clay in the solum than Chelsea soils. Oakville soils do not have lamellae bands within 60 inches of the surface. Maumee soils have a mollic epipedon, are grayer throughout the profile, and are in depressional areas. Morocco soils are grayer throughout the profile and are on lower lying positions on the landscape.

Typical pedon of Chelsea loamy fine sand, 4 to 12 percent slopes, in a wooded area 1,320 feet south and 330 feet west of the northeast corner of sec. 30, T. 28 N., R. 1 W.

A1—0 to 4 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine roots; neutral; clear wavy boundary.

A21—4 to 11 inches; brown (10YR 4/3) fine sand; weak fine granular structure; very friable; many fine and few medium roots; medium acid; clear wavy boundary.

A22—11 to 22 inches; dark yellowish brown (10YR 4/4) fine sand; weak fine granular structure; very friable; common fine and few medium and coarse roots; medium acid; abrupt smooth boundary.

A&B—22 to 80 inches; brownish yellow (10YR 6/6) fine sand (A part); single grain; loose; and bands of strong brown (7.5YR 5/6) loamy sand (B part); massive; very friable; 1/4- to 3/4-inch thick discontinuous bands at depths of 45, 54, and 63 inches and have a combined thickness of 2 inches; clay bridges connect sand grains in the bands; medium acid.

The solum ranges from 48 inches to many feet in thickness.

The A1 horizon has hue of 10YR, value of 3, and chroma of 1 or 2. Cultivated areas have an Ap horizon that has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The A2 horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. The B part of the A&B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The bands in the A&B horizon are 1/4 to 1 inch thick, are spaced 3 to 9 inches apart, and have a cumulative thickness of 1/4 inch to 5 inches. The uppermost bands are at a depth of 27 to 46 inches.

Crosier series

The Crosier series consists of deep, somewhat poorly drained, moderately slowly permeable soils on till plains. These soils formed in loamy glacial till. Slopes range from 0 to 3 percent.

Crosier soils are similar to Fincastle and Sleeth soils and are commonly adjacent to Miami, Rensselaer, and Riddles soils. Fincastle soils have more silt in the upper part of the solum than Crosier soils. Sleeth soils are underlain by sand and very gravelly sand. Miami and Riddles soils are browner throughout the pedon and are on higher lying positions on the landscape. Rensselaer soils have a mollic epipedon, are grayer in the solum, and are in depressional areas.

Typical pedon of Crosier loam, 0 to 3 percent slopes, in a cultivated field 1,815 feet east and 907 feet south of the northwest corner of sec. 4, T. 28 N., R. 1 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

B21t—10 to 21 inches; brown (10YR 5/3) clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure parting to moderate medium subangular blocky; firm; few fine roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; neutral; clear wavy boundary.

B22tg—21 to 30 inches; light brownish gray (10YR 6/2) loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous gray (10YR 5/1) clay films on faces of peds; neutral; gradual smooth boundary.

Cg—30 to 60 inches; grayish brown (10YR 5/2) loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; strong effervescence; mildly alkaline.

The solum ranges from 26 to 40 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It is loam, silt loam, or sandy loam. The Bt horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is clay loam or loam.

Cyclone series

The Cyclone series consists of deep, poorly drained soils. Permeability is moderate in the solum and is moderately slow in the underlying till. These soils are on till plains and formed in loess and the underlying loamy glacial till. Slopes range from 0 to 2 percent.

Cyclone soils are similar to Patton and Rensselaer soils and are commonly adjacent to Fincastle and Starks soils. Patton soils do not have an argillic horizon. Rensselaer soils have less silt in the solum than Cyclone soils. Fincastle and Starks soils have an ochric epipedon, are browner in the solum, and are in higher lying areas.

Typical pedon of Cyclone silt loam, in a cultivated field 1,155 feet west and 165 feet south of the northeast corner of sec. 22, T. 26 N., R. 2 E.

Ap—0 to 12 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate medium granular structure; friable; few fine roots; few strong brown (7.5YR 5/6) iron and manganese oxide accumulations; slightly acid; clear wavy boundary.

B21tg—12 to 17 inches; dark gray (10YR 4/1) silt loam; many medium distinct light olive brown (2.5YR 5/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin discontinuous very dark gray (10YR 3/1) organic and clay films on faces of peds; common strong brown (7.5YR 5/6) iron and manganese oxide accumulations; neutral; clear wavy boundary.

B22tg—17 to 25 inches; grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/6) and many medium distinct light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; thin continuous gray (5Y 5/1) and dark gray (10YR 4/1) organic and clay films on faces of peds and along root channels; common strong brown (7.5YR 5/6) and black (5YR 2/1) iron and manganese oxide accumulations; neutral; clear wavy boundary.

B23tg—25 to 38 inches; grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; thin continuous dark gray (10YR 4/1) organic and clay films on faces of peds and along root channels; common strong brown (7.5YR 5/6) and black (5Y 2/1) iron and manganese oxide accumulations; neutral; clear wavy boundary.

B24tg—38 to 42 inches; gray (10YR 5/1) silt loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; thin discontinuous dark gray (10YR 4/1) organic and clay films on faces of peds and along root channels; common black (5YR 2/1) iron and manganese oxide accumulations; neutral; clear wavy boundary.

B3g—42 to 54 inches; gray (5Y 6/1) silt loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; common black (5YR 2/1) iron and manganese oxide accumulations; mildly alkaline; clear wavy boundary.

IICg—54 to 60 inches; gray (5Y 6/1) loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; few thin strata of sandy loam and loamy sand; mildly alkaline; clear wavy boundary.

The thickness of the solum ranges from 50 to 60 inches. The thickness of loess ranges from 45 to 60 inches.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. It is silt loam or silty clay loam and is slightly acid or neutral.

Fincastle series

The Fincastle series consists of deep, somewhat poorly drained soils. Permeability is moderately slow in the upper part and slow in the lower part. These soils are on till plains. They formed in loess and the underlying loamy glacial till. Slopes range from 0 to 3 percent.

Fincastle soils are similar to Crosier and Starks soils and are commonly near Cyclone, Russell, and Xenia soils. Crosier soils have less silt in the upper part of the solum than Fincastle soils. Starks soils have stratified loamy and sandy underlying material. Cyclone soils have a mollic epipedon, are grayer in the solum, and are in depressional areas. Russell soils are well drained and are in higher lying areas. Xenia soils are better drained than Fincastle soils and are in slightly higher lying areas.

Typical pedon of Fincastle silt loam, 0 to 3 percent slopes, in a cultivated field 500 feet west and 80 feet south of the center of sec. 7, T. 26 N., R. 15 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; slightly acid; abrupt smooth boundary.

B21t—8 to 23 inches; brown (10YR 5/3) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; few black (10YR 2/1) iron and manganese oxide concretions; medium acid; gradual smooth boundary.

B22tg—23 to 36 inches; grayish brown (10YR 5/2) silty clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; few black (10YR 2/1) iron and manganese oxide accumulations; strongly acid; gradual wavy boundary.

IIB23t—36 to 49 inches; brown (10YR 5/3) clay loam; many coarse distinct gray (10YR 5/1) and many coarse faint dark brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; strongly acid; gradual wavy boundary.

IIB3t—49 to 55 inches; brown (10YR 5/3) clay loam; many coarse distinct gray (10YR 5/1) and yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; friable; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; slightly acid; abrupt irregular boundary.

IIC—55 to 60 inches; yellowish brown (10YR 5/4) loam; many coarse distinct gray (10YR 5/1) and dark brown (10YR 4/3) mottles; massive; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 66 inches. The thickness of the loess is 24 to 40 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam or silt loam. The IIBt horizon is similar in color to the B2t horizon. It is loam or clay loam. The IIC horizon has hue of 10YR, value of 5, and chroma of 3 or 4.

Gessie Variant

The Gessie Variant consists of deep, well drained soils. Permeability is moderate in the solum and rapid in the underlying material. These soils are on flood plains and formed in silty and loamy sediments underlain by sandy material. Slopes range from 0 to 2 percent.

Gessie Variant soils are similar to Stonelick soils and are commonly near Shoals soils. Stonelick soils have less clay in the subsoil and less sand in the underlying material than Gessie Variant soils. Shoals soils are grayer in the subsoil, have less sand in the underlying material, and are in lower lying areas.

Typical pedon of Gessie Variant silt loam, occasionally flooded, in a wooded area 2,310 feet south and 247 feet west of the northeast corner of sec. 3, T. 26 N., R. 1 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine and medium roots; slight effervescence; mildly alkaline; clear wavy boundary.

B21—5 to 16 inches; brown (10YR 4/3) silt loam; moderate medium subangular blocky structure; friable; many fine and medium roots; thin continuous dark grayish brown (10YR 4/2) organic coatings on faces of peds; slight effervescence; mildly alkaline; abrupt smooth boundary.

B22—16 to 23 inches; brown (10YR 5/3) silt loam; moderate medium subangular blocky structure; friable; common fine and medium roots; thin continuous dark grayish brown (10YR 4/2) organic coatings on faces of peds; few thin discontinuous very pale brown (10YR 7/3) coatings on faces of peds; strong effervescence; moderately alkaline; clear wavy boundary.

B23—23 to 36 inches; brown (10YR 5/3) loam; moderate medium subangular blocky structure; friable; few medium and coarse roots; thin discontinuous very pale brown (10YR 7/3) coatings on faces of peds; strong effervescence; moderately alkaline; abrupt wavy boundary.

IIC—36 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; strong effervescence; moderately alkaline.

The A1 horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is silt loam or loam. In cultivated areas, the Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The C horizon contains strata of sandy loam, loamy sand, sand, and fine gravel in many places.

Gilford series

The Gilford series consists of deep, very poorly drained soils on outwash plains and lake plains. They formed in loamy and sandy sediments. Permeability is moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slopes range from 0 to 2 percent.

Gilford soils are similar to Maumee soils and are commonly adjacent to Morocco, Oakville, and Sleeth soils. Maumee soils have less clay in the solum than Gilford soils. Morocco soils are browner in the subsoil. Oakville soils are browner throughout the profile. Morocco and Oakville soils have an ochric epipedon and are in the slightly higher lying areas. Sleeth soils are better drained, have an ochric epipedon, and are in slightly higher lying areas.

Typical pedon of Gilford sandy loam, in a cultivated field 495 feet north and 80 feet east of the southwest corner of sec. 7, T. 28 N., R. 1 W.

Ap—0 to 11 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common fine roots; neutral; abrupt wavy boundary.

A12—11 to 17 inches; very dark gray (10YR 3/1) sandy loam, gray (10YR 5/1) dry; common medium distinct brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; friable; few fine roots; common strong brown (7.5YR 5/6) iron oxide accumulations; neutral; clear wavy boundary.

B2g—17 to 24 inches; dark gray (10YR 4/1) sandy loam; many medium distinct brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; friable; few fine roots; common strong brown (7.5YR 5/6) iron oxide accumulations; neutral; abrupt wavy boundary.

B3g—24 to 31 inches; grayish brown (10YR 5/2) loamy sand; few common distinct brownish yellow (10YR 6/8) mottles; weak fine granular structure; very friable; very dark gray (10YR 3/1) organic stains on faces of peds; neutral; clear smooth boundary.

IIC—31 to 42 inches; pale brown (10YR 6/3) sand; common medium distinct brownish yellow (10YR 6/6) mottles; single grain; loose; neutral; clear wavy boundary.

IIC2—42 to 60 inches; light brownish gray (10YR 6/2) sand; few medium brownish yellow (10YR 6/6) mottles; single grain; loose; strong effervescence; mildly alkaline.

The solum is 24 to 40 inches thick.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The C horizon is sand, loamy sand, or gravelly sand.

Glynwood series

The Glynwood series consists of deep, moderately well drained, slowly permeable soils on till plains. These soils formed in loess and the underlying loamy glacial till. Slopes range from 2 to 6 percent.

Glynwood soils are similar to Miami, Morley, and Riddles soils and are commonly adjacent to Blount soils. Miami and Riddles soils have less clay in the subsoil and the underlying material than Glynwood soils. Miami, Morley, and Riddles soils are well drained. Blount soils are grayer throughout the profile and are on the lower lying positions on the landscape.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, in a cultivated field 650 feet west and 660 feet north of the center of sec. 16, T. 27 N., R. 3 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; many fine and medium roots; slightly acid; abrupt smooth boundary.

B21t—8 to 15 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) and pale brown (10YR 6/3) mottles; moderate fine subangular blocky structure; firm; few fine and medium roots; thin discontinuous dark brown (10YR 3/3) clay films on faces of peds; slightly acid; abrupt smooth boundary.

IIB22t—15 to 32 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; thick continuous dark brown (10YR 3/3) clay films on faces of peds; neutral; clear wavy boundary.

IIC—32 to 60 inches; dark brown (10YR 4/3) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. The thickness of the loess is less than 18 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is silt loam or loam. The B2t and IIB2t horizons have hue of 10YR, value of 4 or 5, and chroma of 3 to 5. The IIC horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is silty clay loam or clay loam.

Hennepin series

The Hennepin series consists of deep, well drained soils. They are moderately permeable in the solum and moderately slowly permeable in the underlying material. These soils are on till plains and formed in loamy glacial till. Slopes range from 25 to 60 percent.

Hennepin soils are similar to Miami soils and are commonly adjacent to Crosier and Rensselaer soils.

Miami soils have more clay in the subsoil and have a thicker solum than Hennepin soils. Crosier and Rensselaer soils are grayer throughout the pedon. Rensselaer soils have a mollic epipedon. Crosier and Rensselaer soils are on the lower lying positions on the landscape.

Typical pedon of Hennepin loam, 25 to 60 percent slopes, in a wooded area 310 feet south and 80 feet east of the northwest corner of sec. 25, T. 27 N., R. 2 E.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; neutral; clear wavy boundary.

B2—5 to 18 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; friable; common fine and medium roots; 2 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C—18 to 60 inches; brown (10YR 5/3) loam; massive; firm; 5 percent gravel; strong effervescence; mildly alkaline.

The solum ranges from 12 to 20 inches in thickness.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2. It is loam or silt loam. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or sandy loam.

Houghton series

The Houghton series consists of deep, very poorly drained soils on outwash plains. Permeability is moderately slow to moderately rapid. These soils formed in organic material. Slopes range from 0 to 2 percent.

Houghton soils are similar to Ackerman soils and are commonly adjacent to Gilford and Maumee soils. Ackerman soils formed in 16 to 30 inches of muck and coprogenous earth underlain by sandy material. Gilford and Maumee soils have mollic epipedons, formed in mineral material, and are slightly higher on the landscape than Houghton soils.

Typical pedon of Houghton muck, drained, in a cultivated field 2,600 feet east and 1,900 feet south of the northwest corner of sec. 17, T. 28 N., R. 2 E.

Oap—0 to 7 inches; black (N 2/0) sapric material, broken face and rubbed, very dark gray (N 3/0) dry; about 1 percent fiber, a trace rubbed; weak medium granular structure; very friable; many fine roots; mostly herbaceous fiber; slightly acid; abrupt smooth boundary.

Oa2—7 to 17 inches; black (10YR 2/1) sapric material, broken face and rubbed; about 1 percent fiber, a trace rubbed; weak medium subangular blocky structure; very friable; many fine roots; mostly herbaceous fiber; slightly acid; clear smooth boundary.

Oa3—17 to 24 inches; dark reddish brown (5YR 3/2) sapric material, broken face and rubbed; about 10 percent fiber, a trace rubbed; weak coarse subangular blocky structure; friable; many fine roots; mostly herbaceous fiber; slightly acid; gradual smooth boundary.

Oa4—24 to 45 inches; very dark gray (10YR 3/1) sapric material, broken face and rubbed; about 30 percent fiber, about 10 percent rubbed; moderate thick platy structure; friable; mostly herbaceous fiber; slightly acid; gradual smooth boundary.

Oa5—45 to 60 inches; very dark gray (10YR 3/1) sapric material, broken face and rubbed; about 35 percent fiber, about 10 percent rubbed; moderate thick platy structure; friable; mostly herbaceous fiber; slightly acid.

The organic material is more than 51 inches thick. It is slightly acid or neutral and is primarily herbaceous. Some pedons contain woody fragments that are 1 to 6 inches in diameter.

The surface tier has hue of 10YR, value of 2 or 3, and chroma of 1 or 2 or is black (N 2/0). Fiber content is dominantly less than 5 percent when rubbed. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR; value of 2 or 3; and chroma of 1 to 3 or are black (N 2/0). They typically are sapric material, but in some pedons there are subhorizons of hemic material which, combined, are less than 10 inches thick. Fiber content is dominantly less than 11 percent when rubbed.

Kosciusko series

The Kosciusko series consists of deep, well drained soils. Permeability is moderate in the subsoil and very rapid in the underlying material. These soils are on outwash plains and terraces, and they formed in loamy outwash deposits. Slopes range from 0 to 12 percent. These soils that contain sandy material within a depth of 40 inches are not defined in the range for the Kosciusko series. This difference does not alter their use or behavior.

Kosciusko soils are similar to Miami, Rush, and Russell soils and are commonly near Gilford soils. Miami and Russell soils have underlying material that is loam. Rush soils have a thicker solum and more silt in the upper part of the subsoil than Kosciusko soils. Gilford soils have a mollic epipedon, are grayer throughout the profile, and are in depressional areas.

Typical pedon of Kosciusko silt loam, 2 to 6 percent slopes, in a cultivated field 760 feet south and 65 feet east of the northwest corner of sec. 11, T. 26 N., R. 1 N.

Ap—0 to 8 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine roots; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few black (10YR 2/1) iron and manganese oxide accumulations; medium acid; clear smooth boundary.

B21t—8 to 12 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium subangular blocky structure; friable; common fine roots; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; common black (10YR 2/1) iron and manganese oxide accumulations; medium acid; clear wavy boundary.

B22t—12 to 20 inches; dark brown (7.5YR 4/4) sandy clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common fine roots; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; common dark gray (10YR 4/1) silt coatings along root channels; common black (10YR 2/1) iron and manganese oxide accumulations; 10 percent gravel; medium acid; clear irregular boundary.

B23t—20 to 32 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; brown (10YR 5/3) and yellowish brown (10YR 5/6) sand grains; common black (10YR 2/1) iron and manganese oxide accumulations; 50 percent gravel; slightly acid; clear smooth boundary.

B3—32 to 36 inches; dark brown (7.5YR 4/4) gravelly sandy loam; moderate medium granular structure; friable; few fine roots; light brownish gray (10YR 6/2) silt coatings on surfaces of pebbles; 30 percent gravel; neutral; clear wavy boundary.

IIC—36 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand and strata of sand; single grain; loose; light brownish gray (10YR 6/2) silt coatings on surfaces of pebbles; 40 percent gravel; thin lenses of sand; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 40 inches. Reaction ranges from strongly acid to slightly acid in the upper part of the solum and from slightly acid to mildly alkaline in the lower part. Thickness of the loess is less than 10 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam, loam, sandy loam, or sandy clay loam. The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. The B3 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is loam, gravelly sandy loam, or sandy clay loam. Some gravel is coated with secondary carbonates.

Maumee series

The Maumee series consists of deep soils on outwash plains. They are very poorly drained and rapidly permeable. These soils formed in sandy glaciofluvial deposits. Slopes range from 0 to 2 percent. These soils have fluventic characteristics that are not definitive in the range for the Maumee series, but this difference does not alter their behavior or use.

Maumee soils are similar to Gilford soils and are commonly near Chelsea, Morocco, and Oakville soils. Gilford soils have more clay in the solum than Maumee soils. Chelsea and Oakville soils are well drained, and Morocco soils are better drained than Maumee soils. Chelsea, Morocco, and Oakville soils have an ochric epipedon and are in higher lying areas.

Typical pedon of Maumee loamy fine sand, in a cultivated field 1,280 feet east and 245 feet south of the northwest corner of sec. 31, T. 28 N., R. 1 W.

Ap—0 to 13 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak medium granular structure; friable, many fine roots; slightly acid; clear wavy boundary.

A12—13 to 19 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; common medium distinct strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; friable; few fine roots; slightly acid; clear wavy boundary.

C1g—19 to 31 inches; dark gray (10YR 4/1) fine sand; many medium distinct gray (10YR 6/1) and strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable; few fine roots; patchy black (10YR 2/1) organic coatings along old root channels and on faces of peds; few thin strata of fine sandy loam and loamy fine sand; medium acid; clear wavy boundary.

C2—31 to 36 inches; dark grayish brown (10YR 4/2) sand; common medium distinct brownish yellow (10YR 6/6) and common medium faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; very friable; patchy black (10YR 2/1) organic coatings along old root channels and on faces of peds; medium acid; clear wavy boundary.

C3—36 to 60 inches; grayish brown (10YR 5/2) sand; common medium distinct brownish yellow (10YR 5/6 & 6/6) mottles; single grain; loose; slightly acid.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 3. It is fine sand or sand with thin bands of loamy fine sand in some pedons.

Metea series

The Metea series consists of deep, well drained soils. Permeability is rapid in the upper part and moderately slow in the lower part. These soils are on till plains and formed in sandy and loamy outwash deposits and the underlying loamy glacial till. Slopes range from 3 to 10 percent.

Metea soils are commonly adjacent to Bloomfield, Crosier, and Miami soils. Bloomfield soils are sandy throughout the pedon and are on the same landscape position as Metea soils. Crosier and Miami soils have less sand in the upper part of the solum than Metea soils. Crosier soils are grayer throughout the profile and are in slightly lower convex areas. Miami soils are on the same landscape position as Metea soils.

Typical pedon of Metea loamy fine sand, 3 to 10 percent slopes, in a cultivated field 1,280 feet north and 700 feet west of the southeast corner of sec. 33, T. 28 N., R. 2 E.

Ap—0 to 13 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine roots; medium acid; abrupt smooth boundary.

A21—13 to 19 inches; yellowish brown (10YR 5/6) sand; weak medium subangular blocky structure; very friable; few fine roots; thin strata of loamy sand; medium acid; clear wavy boundary.

A22—19 to 29 inches; yellowish brown (10YR 5/4) sand; weak medium subangular blocky structure; very friable; few fine roots; thin strata of loamy sand; medium acid; abrupt wavy boundary.

B21t—29 to 34 inches; yellowish brown (10YR 5/6) sandy loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 4/4) clay films on faces of peds; medium acid; clear wavy boundary.

IIB22t—34 to 41 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark brown (10YR 4/3) clay films on faces of peds; 5 percent gravel; slightly acid; clear wavy boundary.

IIB3t—41 to 46 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous dark brown (10YR 4/3) clay films on faces of peds; 5 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

IIC—46 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 5 percent gravel; strong effervescence; mildly alkaline.

The solum ranges from 36 to 50 inches in thickness.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. It is loamy fine sand, loamy sand, or sand. The A2 horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is loamy fine sand, loamy sand, or sand and is slightly acid or medium acid. The B2t and IIB2t horizons have hue of 10YR, value of 4 or 5, and chroma of 3 to 8. They are sandy loam, sandy clay loam, or clay loam and range from medium acid to neutral.

Miami series

The Miami series consists of deep, well drained soils. Permeability is moderate in the subsoil and moderately slow in the underlying material. These soils are on till plains and formed in loess and the underlying loamy glacial till. Slopes range from 2 to 18 percent.

Miami soils are similar to Riddles and Russell soils and are commonly adjacent to Crosier, Metea, and Rensselaer soils. Riddles soils have a thicker solum than Miami soils. Russell soils have more silt in the upper part of the solum. Crosier soils are grayer throughout the pedon and are on lower lying positions. Metea soils have more sand in the upper part of the solum and are on the same landscape position as Miami soils. Rensselaer soils are grayer throughout the profile, have a mollic epipedon, and are in depressional areas.

Typical pedon of Miami silt loam, 2 to 6 percent slopes, eroded, in a cultivated field 900 feet east and 900 feet south of the center of sec. 4, T. 26 N., R. 1 E.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; many fine and medium roots; neutral; abrupt smooth boundary.

B21t—5 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine and medium roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; medium acid; clear smooth boundary.

IIB22t—13 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous dark brown (7.5YR 4/4) and pale brown (10YR 6/3) clay films on faces of peds; 5 percent gravel; medium acid; clear smooth boundary.

IIB3t—22 to 32 inches; dark brown (10YR 4/3) clay loam; weak coarse subangular blocky structure; firm; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; 5 percent gravel; slight effervescence; mildly alkaline; abrupt wavy boundary.

IIC—32 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 8 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. The thickness of the loess is less than 18 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or clay loam. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6.

The IIB2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is clay loam or loam. The IIB3t horizon is clay loam or loam.

Millsdale series

The Millsdale series consists of moderately deep, very poorly drained, moderately slowly permeable soils. They formed in a thin layer of till or glacial outwash underlain by limestone, on till plains or on terraces. Slopes range from 0 to 2 percent.

Millsdale soils are commonly adjacent to Gilford and NewGlarus soils. Gilford soils have less clay in the solum and are underlain by sand and gravelly sand on the same landscape position as Millsdale soils. NewGlarus soils have an ochric epipedon, are well drained, and are on higher positions on the landscape.

Typical pedon of Millsdale silty clay loam, in a wooded area 330 feet south and 413 feet east of the northwest corner of sec. 6, T. 27 N., R. 15 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium granular structure; friable; many fine and medium roots; slightly acid; clear smooth boundary.

B21t—8 to 14 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; common medium roots; thin continuous very dark gray (10YR 3/1) clay films on faces of peds; 3 percent gravel; slightly acid; clear wavy boundary.

B22tg—14 to 21 inches; dark gray (10YR 4/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; 5 percent gravel; neutral.

IIR—21 inches; limestone bedrock.

The solum ranges from 20 to 31 inches in thickness and coincides with the depth to limestone bedrock.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam. The B21t horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. The B22t horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The B2t horizon is silty clay loam, silty clay, or clay loam. In some pedons there is a thin layer of soil material below the solum that is weathered from the limestone bedrock.

Morley series

The Morley series consists of deep, well drained soils. Permeability is moderately slow or slow. These soils are on till plains and formed in loamy glacial till. Slopes range from 6 to 12 percent.

Morley soils are similar to Glynwood, Miami, and Riddles soils and are commonly adjacent to Blount soils. Glynwood soils are grayer in the solum than Morley soils. Miami and Riddles soils have less clay in the subsoil and underlying material. Blount soils are grayer throughout the profile and are on lower lying positions.

Typical pedon of Morley clay loam, 6 to 12 percent slopes, severely eroded, in a cultivated field 360 feet south and 100 feet east of the center of sec. 18, T. 28 N., R. 3 E.

Ap—0 to 6 inches; dark yellowish brown (10YR 4/4) clay loam, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; firm; slightly acid; abrupt smooth boundary.

B21t—6 to 17 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; thin discontinuous brown (10YR 4/3) clay films on faces of peds; medium acid; clear smooth boundary.

B22t—17 to 29 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; thick continuous dark yellowish brown (10YR 4/4) clay films on faces of peds; neutral; clear wavy boundary.

C—29 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 20 to 34 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 5. It is neutral to medium acid.

Morocco series

The Morocco series consists of deep soils on outwash plains. They are somewhat poorly drained and rapidly permeable. These soils formed in sandy deposits. Slopes range from 0 to 2 percent.

Morocco soils are commonly adjacent to Chelsea, Gilford, Maumee, and Oakville soils on the landscape. Chelsea and Oakville soils are well drained and are in slightly higher areas. Gilford and Maumee soils have a mollic epipedon, are grayer in the subsoil, and are in depressional areas.

Typical pedon of Morocco loamy fine sand, in a cultivated field 1,155 feet south and 495 feet east of the northwest corner of sec. 30, T. 28 N., R. 1 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A2—9 to 20 inches; pale brown (10YR 6/3) loamy fine sand; many medium distinct yellowish brown (10YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.

B21—20 to 32 inches; very pale brown (10YR 7/3) fine sand; common medium faint light gray (10YR 7/2) and many medium distinct brownish yellow (10YR 6/6) mottles; single grain; loose; very strongly acid; clear wavy boundary.

B22—32 to 43 inches; pale brown (10YR 6/3) fine sand; many medium distinct brownish yellow (10YR 6/6) and common medium faint light brownish gray (10YR 6/2) mottles; single grain; loose; strongly acid; clear wavy boundary.

C—43 to 60 inches; very pale brown (10YR 7/3) fine sand; many medium distinct yellow (10YR 7/6) and common medium faint light gray (10YR 7/2) mottles; single grain; loose; medium acid.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. The B horizon has hue of 10YR, value of 5 to 7, and chroma of 2 to 6. It is fine sand or sand. The C horizon has hue of 10YR, value of 6 or 7, and chroma of 2 or 3.

NewGlarus series

The NewGlarus series consists of moderately deep soils on terraces and till plains. They are well drained and moderately slowly permeable. These soils formed in a thin layer of loess and in the underlying limestone residuum. Slopes range from 2 to 12 percent.

NewGlarus soils are commonly adjacent to Kosciusko, Miami, and Millsdale soils. Kosciusko soils have underlying material that is gravelly coarse sand. Miami soils have underlying material that is loam. Kosciusko and Miami soils are on higher lying positions. Millsdale soils have a mollic epipedon, are grayer in the upper part of the solum than NewGlarus soils, and are in depressional areas.

Typical pedon of NewGlarus silt loam, 2 to 6 percent slopes, in a cultivated field 1,055 feet north and 790 feet east of the center of sec. 33, T. 27 N., R. 1 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) silt loam; light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

B1—11 to 15 inches; brown (10YR 5/3) silt loam; weak medium subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

B21t—15 to 21 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark brown (7.5YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

B22t—21 to 24 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; thin continuous dark brown (7.5YR 4/2) clay films on faces of peds; thin discontinuous grayish brown (10YR 5/2) silt coatings on faces of peds; slightly acid; abrupt smooth boundary.

IIB23tg—24 to 34 inches; dark brown (7.5YR 4/2) clay; moderate medium angular blocky structure; firm; few fine roots; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

IIB24tg—34 to 36 inches; dark brown (7.5YR 3/2) clay; weak medium subangular blocky structure; firm; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; slight effervescence; mildly alkaline.

IIR—36 inches; hard limestone bedrock with slight weathering less than one-half inch above hard rock.

The thickness of the solum ranges from 20 to 40 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B2t and IIB2tg horizons have hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. The B2t horizon is clay loam or silty clay loam, and the IIB2tg horizon is silty clay or clay. The IIC horizon, if there is one, is soil material weathered from limestone or glacial till.

Oakville series

The Oakville series consists of deep soils on outwash plains. They are moderately well drained and very rapidly permeable. These soils formed in sandy deposits. Slopes range from 0 to 3 percent.

Oakville soils are similar to Chelsea soils and are commonly adjacent to Gilford, Maumee, and Morocco soils. Chelsea soils have lamellae, or bands, within 60 inches of the surface. Gilford and Maumee soils have a mollic epipedon, are grayer throughout the profile than the Oakville soils, and are in depressional areas. Morocco soils are grayer throughout the profile and are on lower lying positions.

Typical pedon of Oakville loamy fine sand, 0 to 3 percent slopes, in a cultivated field 2,145 feet south and 495 feet east of the northwest corner of sec. 7, T. 28 N., R. 1 W.

Ap—0 to 9 inches; dark brown (10YR 4/3) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common fine roots; slightly acid; abrupt wavy boundary.

B21—9 to 21 inches; yellowish brown (10YR 5/6) fine sand; weak medium subangular blocky structure; very friable; common fine roots; dark brown (10YR 4/3) loamy sand in root channels; common yellowish brown (10YR 5/8) iron oxide accumulations; medium acid; gradual wavy boundary.

B22—21 to 33 inches; brownish yellow (10YR 6/6) fine sand; common medium faint light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; very friable; few fine roots; many strong brown (7.5YR 5/8) iron oxide accumulations; medium acid; gradual wavy boundary.

C—33 to 60 inches; pale brown (10YR 6/3) fine sand; common medium distinct very pale brown (10YR 7/4) and yellowish brown (10YR 5/8) mottles; single grain; very friable; many reddish yellow (7.5YR 6/8) and yellowish red (5YR 5/8) iron oxide accumulations; medium acid.

The thickness of the solum ranges from 20 to 36 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. It is loamy fine sand or fine sand. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 4 to 6. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6.

Ormas series

The Ormas series consists of deep, well drained soils. Permeability is moderately rapid in the solum and very rapid in the underlying material. These soils are on outwash plains and terraces. They formed in sandy and loamy deposits that were reworked by the wind. Slopes range from 2 to 6 percent.

Ormas soils are similar to Bloomfield soils and are commonly adjacent to Gilford, Rush, and Sleeth soils. Bloomfield soils have less clay in the solum than the Ormas soils. Gilford soils have a mollic epipedon, are grayer throughout the pedon, and are in depressional areas. Rush soils have less sand in the solum and are on the same landscape position as Ormas soils. Sleeth soils have gray mottles and less sand in the solum and are on lower lying positions.

Typical pedon of Ormas loamy fine sand, 2 to 6 percent slopes, in a cultivated field 1,485 feet east and 1,650 feet north of the southwest corner of sec. 32, T. 28 N., R. 1 W.

Ap—0 to 11 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

A21—11 to 24 inches; yellowish brown (10YR 5/6) loamy fine sand; weak medium granular structure; very friable; few fine roots; slightly acid; clear wavy boundary.

A22—24 to 33 inches; yellowish brown (10YR 5/6) loamy fine sand; common medium distinct pale brown (10YR 6/3) mottles; weak medium subangular blocky structure; friable; few fine roots; few strong brown (7.5YR 5/6) iron oxide accumulations; medium acid; clear wavy boundary.

B21t—33 to 38 inches; dark yellowish brown (10YR 4/6) sandy loam; common medium distinct pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous yellowish brown (10YR 5/8) clay films on faces of peds; common strong brown (7.5YR 5/6) iron oxide accumulations; few black (10YR 2/1) manganese oxide accumulations; strongly acid; clear wavy boundary.

IIB22t—38 to 47 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; common medium distinct brown (10YR 5/3) mottles; weak coarse subangular blocky structure parting to moderate medium subangular blocky; firm; thin discontinuous yellowish brown (10YR 5/8) clay films on faces of peds; common strong brown (7.5YR 5/6) iron oxide accumulations; strongly acid; abrupt wavy boundary.

IIB3t—47 to 56 inches; brown (10YR 4/3) gravelly sandy loam; weak fine subangular blocky structure; friable; thin discontinuous yellowish brown (10YR 5/8) clay films on faces of peds; common dark brown (7.5YR 4/4) iron oxide accumulations; slightly acid; clear irregular boundary.

IIC—56 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; single grain; loose; thin lens of sand; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 50 to 80 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The A2 horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is fine sand or loamy fine sand. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 8. It is sandy loam or sandy clay loam. The IIBt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, sandy clay loam, or gravelly analogs of these textures.

Patton series

The Patton series consists of deep soils on lake plains. They are very poorly drained and moderately permeable. These soils formed in loess and the underlying silty and loamy sediments. Slopes range from 0 to 2 percent.

Patton soils are similar to Cyclone and Rensselaer soils and are commonly adjacent to Fincastle and Starks soils on the landscape. Cyclone soils have an argillic horizon. Rensselaer soils have less silt in the solum than Patton soils. Fincastle and Starks soils have an ochric epipedon, are better drained, and are in higher lying areas.

Typical pedon of Patton silty clay loam, in a cultivated field 1,400 feet west and 50 feet north of the southeast corner of sec. 5, T. 25 N., R. 3 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium granular structure; firm; few fine roots; neutral; clear smooth boundary.

B1g—11 to 17 inches; dark gray (5Y 4/1) silt loam; few fine prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

B2g—17 to 31 inches; dark gray (5Y 4/1) silty clay loam; common medium prominent brownish yellow (10YR 6/6) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine roots; thin discontinuous dark gray (10YR 4/1) organic films on faces of peds; neutral; abrupt smooth boundary.

B3g—31 to 38 inches; gray (5Y 6/1) silt loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; thin discontinuous gray (5Y 5/1) organic films on faces of peds; slight effervescence; mildly alkaline; clear smooth boundary.

C1g—38 to 42 inches; gray (5Y 6/1) silt loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

C2g—42 to 60 inches; grayish brown (10YR 5/2) loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; 3 percent gravel; few thin strata of sandy loam and clay loam; strong effervescence; moderately alkaline; clear smooth boundary.

The thickness of the solum ranges from 24 to 40 inches.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silty clay loam or silt loam. The B2 horizon has hue of 5Y, 2.5Y, or 10YR; value of 4 or 5; and chroma of 0 to 2.

Rensselaer series

The Rensselaer series consists of deep, very poorly drained soils. They are moderately permeable in the solum and moderately slowly permeable in the underlying material. They are on till plains and formed in loamy and sandy outwash deposits and the underlying loamy glacial till. Slopes range from 0 to 2 percent.

Rensselaer soils are similar to Cyclone and Patton soils and are commonly adjacent to Crosier and Miami soils. Cyclone and Patton soils have more silt in the solum than Rensselaer soils. Crosier and Miami soils have an ochric epipedon, are better drained, and are on higher lying positions.

Typical pedon of Rensselaer loam, till substratum, in a cultivated field 2,062 feet west and 495 feet south of the northeast corner of sec. 31, T. 28 N., R. 2 E.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few fine roots; neutral; clear smooth boundary.

B1—10 to 14 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; medium distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous black (N 2/0) organic coatings on faces of peds; neutral; gradual smooth boundary.

B2tg—14 to 25 inches; dark gray (10YR 4/1) clay loam; common medium distinct yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; neutral; gradual smooth boundary.

B3g—25 to 41 inches; gray (10YR 5/1) stratified sandy loam, loam, and loamy sand; common medium distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles; massive; friable; neutral; clear wavy boundary.

IICg—41 to 60 inches; grayish brown (10YR 5/2) loam; many medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 35 to 60 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is clay loam or silty clay loam. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4.

Riddles series

The Riddles series consists of deep soils on moraines and till plains. They are well drained and moderately permeable. These soils formed in loamy glacial till. Slopes range from 2 to 12 percent.

Riddles soils are similar to Miami and Russell soils and are commonly adjacent to Crosier and Rensselaer soils. Miami soils have a thinner solum than Riddles soils. Russell soils have more silt in the upper part of the solum. Crosier and Rensselaer soils are grayer throughout the profile and are on lower lying positions on the landscape. Rensselaer soils have a mollic epipedon.

Typical pedon of Riddles silt loam, 2 to 6 percent slopes, in a cultivated field 1,155 feet north and 330 feet east of the center of sec. 17, T. 27 N., R. 2 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine and medium roots; slightly acid; clear wavy boundary.

B21t—10 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine and medium roots; thin continuous dark brown (10YR 4/3) clay films on faces of peds and along old root channels; medium acid; clear wavy boundary.

B22t—26 to 54 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; common fine roots; thin continuous dark brown (10YR 4/3) clay films on faces of peds and along old root channels; medium acid; clear wavy boundary.

B3t—54 to 64 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; firm; few fine roots; thin patchy dark brown (10YR 4/3) clay films on faces of peds and along old root channels; slightly acid; clear irregular boundary.

C—64 to 80 inches; yellowish brown (10YR 5/4) loam; massive; firm; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 72 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or silt loam. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or loam. The B3 horizon has the same range in color as the B2 horizon. The B3 horizon is loam or clay loam. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4.

Rush series

The Rush series consists of deep soils on outwash plains and terraces. They are well drained and moderately permeable. These soils formed in loess, loamy outwash deposits, and the underlying sandy deposits. Slopes range from 0 to 6 percent.

Rush soils are similar to Kosciusko, Miami, and Russell soils and are commonly adjacent to Sleeth soils. Kosciusko soils have a thinner solum than Rush soils. Kosciusko and Miami soils have less silt in the upper part of the subsoil. Miami and Russell soils have underlying material that is loam. Sleeth soils are grayer in the solum and are on lower lying positions on the landscape.

Typical pedon of Rush silt loam, 2 to 6 percent slopes, in a cultivated field 1,990 feet north and 2,390 feet west of the center of sec. 15, T. 26 N., R. 1 W.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; many fine and medium roots; slightly acid; abrupt smooth boundary.

B21t—9 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; firm; many fine roots; thin continuous brown (10YR 4/3) clay films on faces of peds; thin light brownish gray (10YR 6/2) silt coatings on faces of some peds; strongly acid; clear smooth boundary.

IIB22t—27 to 32 inches; dark brown (7.5YR 4/4) clay loam; weak fine subangular blocky structure; firm; common fine roots; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; strongly acid; abrupt smooth boundary.

IIB23t—32 to 44 inches; dark brown (7.5YR 4/4) loam; weak fine subangular blocky structure; firm; thin discontinuous dark brown (7.5YR 3/2) clay films on faces of peds; medium acid; clear smooth boundary.

IIB24t—44 to 54 inches; dark brown (7.5YR 4/4) clay loam; weak fine subangular blocky structure; firm; thin discontinuous dark brown (7.5YR 3/2) clay films on faces of peds; medium acid; abrupt smooth boundary.

IIB3—54 to 57 inches; reddish brown (5YR 4/4) gravelly sandy clay loam; weak coarse subangular blocky structure; firm; 25 percent gravel; medium acid; abrupt irregular boundary.

IIIC—57 to 60 inches; brown (10YR 5/3) very gravelly coarse sand; single grain; loose; thin lens of sand; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 45 to 70 inches. The thickness of the loess ranges from 20 to 40 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam and is medium acid or strongly acid. The IIB2t horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 to 5. It is medium acid or strongly acid. The IIB3 horizon is medium acid to mildly alkaline.

Russell series

The Russell series consists of deep soils on till plains. They are well drained and moderately permeable. These soils formed in loess and the underlying loamy glacial till. Slopes range from 2 to 12 percent.

Russell soils are similar to Miami and Rush soils and are commonly adjacent to Fincastle and Xenia soils. Miami soils have less silt in the upper part of the solum than Russell soils. Rush soils have underlying material that is very gravelly coarse sand. Fincastle and Xenia soils are grayer throughout the profile and are in lower lying areas.

Typical pedon of Russell silt loam, 2 to 6 percent slopes, in a cultivated field 495 feet east and 825 feet north of the southwest corner of sec. 7, T. 26 N., R. 1 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A2—6 to 10 inches; brown (10YR 5/3) silt loam; moderate medium platy structure; friable; common fine roots; medium acid; clear wavy boundary.

B1t—10 to 14 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common fine roots; thin patchy dark brown (10YR 4/3) clay films on faces of peds; medium acid; clear wavy boundary.

B21t—14 to 24 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; thin discontinuous yellowish brown (10YR 5/4) clay films on faces of peds; thin discontinuous pale brown (10YR 6/3) silt coatings on faces of peds; medium acid; gradual wavy boundary.

B22t—24 to 36 inches; yellowish brown (10YR 5/4) silty clay loam; weak medium prismatic structure parting to moderate coarse subangular blocky; firm; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; thin discontinuous brown (10YR 5/3) silt coatings on faces of peds; few black (10YR 2/1) iron and manganese oxide accumulations; medium acid; clear wavy boundary.

IIB23t—36 to 54 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; firm; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; medium acid; clear wavy boundary.

IIB3—54 to 60 inches; brown (10YR 5/3) loam; common fine faint grayish brown (10YR 5/2) and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; neutral; clear wavy boundary.

IIC—60 to 80 inches; brown (10YR 5/3) loam; massive; firm; 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 65 inches. The thickness of the loess ranges from 26 to 40 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam. The IIB2 horizon has colors similar to those of the B2 horizon. It is clay loam or loam. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4.

Shoals series

The Shoals series consists of deep soils on flood plains. They are somewhat poorly drained and moderately permeable. These soils formed in silty and loamy sediments. Slopes range from 0 to 2 percent.

Shoals soils are commonly adjacent to Gessie Variant and Stonelick soils. Gessie Variant and Stonelick soils are browner in the subsoil than Shoals soils. Gessie Variant soils have more sand in the underlying material. Stonelick soils have less clay in the subsoil. Gessie Variant and Stonelick soils are in higher lying areas.

Typical pedon of Shoals silty clay loam, frequently flooded, in a cultivated field 1,630 feet north and 1,300 feet east of the southwest corner of sec. 32, T. 27 N., R. 2 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; few fine roots; mildly alkaline; clear smooth boundary.

A12—7 to 15 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; few medium distinct yellowish brown (10YR 5/4) and few medium prominent reddish brown (5YR 4/4) mottles; weak medium angular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

B21g—15 to 23 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few black (10YR 2/1) manganese oxide accumulations; mildly alkaline; clear smooth boundary.

B22—23 to 30 inches; brown (10YR 4/3) silty clay loam; many medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few black (10YR 2/1) manganese oxide accumulations; slight effervescence; mildly alkaline; clear smooth boundary.

B23g—30 to 35 inches; dark grayish brown (10YR 4/2) sandy loam; many medium distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few black (10YR 2/1) manganese oxide accumulations; slight effervescence; mildly alkaline; clear smooth boundary.

B3g—35 to 42 inches; dark grayish brown (10YR 4/2) sandy loam; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few black (10YR 2/1) manganese oxide accumulations; few thin strata of silt loam; slight effervescence; mildly alkaline; clear smooth boundary.

Cg—42 to 60 inches; grayish brown (10YR 5/2) sandy loam; many coarse distinct strong brown (7.5YR 5/6) mottles; weak thick platy structure; friable; few black (10YR 2/1) manganese oxide accumulations; few thin strata of silt loam; slight effervescence; mildly alkaline.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silty clay loam, clay loam, silt loam, sandy loam, or loam. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 3. It is generally stratified and of variable texture.

Sleeth series

The Sleeth series consists of deep soils on terraces and outwash plains. They are somewhat poorly drained and moderately permeable. These soils formed in loess and loamy outwash over sand and gravel deposits. Slopes range from 0 to 2 percent. These soils have a thicker loess mantle than is defined in the range for the Sleeth series, but this difference does not alter their use or behavior.

Sleeth soils are similar to Crosier, Fincastle, and Starks soils and are commonly adjacent to Gilford and Rush soils. Crosier and Fincastle soils have underlying material that is loam. Starks soils have stratified loamy and sandy underlying material. Gilford soils are grayer in the solum than Sleeth soils, have a mollic epipedon, and are in depressional areas. Rush soils are browner in the solum and are in higher lying areas.

Typical pedon of Sleeth silt loam, in a cultivated field 990 feet north and 495 feet west of the center of sec. 15, T. 26 N., R. 1 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; strong medium granular structure; friable; few fine and medium roots; neutral; clear smooth boundary.

B21tg—8 to 13 inches; dark grayish brown (10YR 4/2) silt loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; neutral; clear smooth boundary.

B22t—13 to 18 inches; brown (10YR 5/3) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; strong medium subangular blocky structure; firm; few fine roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; slightly acid; clear smooth boundary.

B23tg—18 to 25 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; thin continuous brown (10YR 5/3) clay films on faces of peds; medium acid; abrupt smooth boundary.

IIB24tg—25 to 31 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; moderate coarse subangular blocky structure; firm; thin continuous brown (10YR 5/3) clay films on faces of peds; medium acid; clear smooth boundary.

IIB25t—31 to 43 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; firm; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; slightly acid; clear smooth boundary.

IIB3t—43 to 55 inches; yellowish brown (10YR 5/4) gravelly clay loam; common medium distinct reddish yellow (7.5YR 6/8) mottles; strong medium subangular blocky structure; firm; thick discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; slight effervescence; neutral; abrupt wavy boundary.

IIIC—55 to 60 inches; brown (10YR 5/3) stratified sand and very gravelly sand; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 44 to 60 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The Bt and IIBt horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. The IIBt horizon is clay loam, gravelly clay loam, or loam.

Starks series

The Starks series consists of deep soils on outwash plains and terraces. They are somewhat poorly drained and moderately slowly permeable. These soils formed in loess and the underlying loamy outwash deposits. Slopes range from 0 to 3 percent.

Starks soils are similar to Fincastle and Sleeth soils and are commonly adjacent to Cyclone and Patton soils. Fincastle soils have underlying material that is loam. Sleeth soils are underlain by sand and very gravelly sand. Cyclone and Patton soils have a mollic epipedon, are grayer in the solum, and are in depressional areas.

Typical pedon of Starks silt loam, 0 to 3 percent slopes, in a cultivated field 2,310 feet south and 85 feet east of the center of sec. 36, T. 26 N., R. 1 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; few fine roots; few fine and medium pores and earthworm channels; medium acid; abrupt smooth boundary.

B1tg—9 to 13 inches; dark grayish brown (10YR 4/2) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few fine roots; common fine and medium pores; medium acid; clear wavy boundary.

B21t—13 to 24 inches; yellowish brown (10YR 5/6) silty clay loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; thin discontinuous gray (10YR 5/1) clay films on faces of peds and prism faces and in worm channels; common fine and medium pores; strongly acid; clear wavy boundary.

B22tg—24 to 38 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; common fine pores; few black (10YR 2/1) manganese oxide accumulations; medium acid; clear wavy boundary.

B3t—38 to 50 inches; yellowish brown (10YR 5/6) silt loam; many medium distinct light brownish gray (2.5Y 6/2) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; dark gray (10YR 4/1) clay loam krotovinas; few black (10YR 2/1) manganese oxide accumulations; medium acid; gradual wavy boundary.

IICg—50 to 60 inches; gray (10YR 6/1) fine sandy loam; many medium distinct yellowish brown (10YR 5/8) mottles; massive; friable; thin strata of loam and loamy sand; slightly acid.

The thickness of the solum ranges from 42 to 60 inches.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. It is silt loam or silty clay loam. The IIC horizon is sandy loam or fine sandy loam.

Stonelick series

The Stonelick series consists of deep soils on flood plains. They are well drained and moderately rapidly permeable. These soils formed in sandy and loamy sediments. Slopes range from 0 to 2 percent.

Stonelick soils are similar to Gessie Variant soils and are commonly adjacent to Shoals soils. Gessie Variant soils have more clay in the subsoil and more sand in the underlying material than Stonelick soils. Shoals soils are grayer and have more clay in the subsoil. They are in lower lying areas.

Typical pedon of Stonelick loamy fine sand, occasionally flooded, in a cultivated field 1,650 feet west and 130 feet south of the corner of sec. 36, T. 27 N., R. 1 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine and medium roots; slight effervescence; mildly alkaline; clear wavy boundary.

B21—6 to 16 inches; brown (10YR 4/3) fine sandy loam; moderate medium subangular blocky structure; friable; many fine and medium roots; continuous dark grayish brown (10YR 4/2) organic coatings on faces of peds and in root channels; slight effervescence; mildly alkaline; clear wavy boundary.

B22—16 to 24 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; friable; common fine and medium roots; continuous dark grayish brown (10YR 4/2) organic coatings on faces of peds and in root channels; slight effervescence; mildly alkaline; clear wavy boundary.

B23—24 to 31 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium subangular blocky structure; friable; common fine and medium roots; discontinuous dark grayish brown (10YR 4/2) organic coatings on faces of peds; strong effervescence; mildly alkaline; clear wavy boundary.

C—31 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam; massive; friable; few fine and medium roots; few thin strata of sandy loam and loamy sand; strong effervescence; mildly alkaline.

This soil is mildly alkaline or moderately alkaline.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The A1 horizon, where there is one, has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is dominantly sandy loam or fine sandy loam, but individual horizons include loam or loamy sand. The C horizon is stratified. Textures include loam, sandy loam, fine sandy loam, or loamy sand.

Wawasee series

The Wawasee series consists of deep soils on till plains. They are well drained and moderately permeable. They formed in loamy glacial till. Slopes range from 2 to 8 percent.

Wawasee soils are similar to Miami soils and are commonly adjacent to Crosier and Rensselaer soils. Miami soils have more clay in the Bt horizon than Wawasee soils. Crosier and Rensselaer soils are grayer throughout the pedon. Rensselaer soils have a mollic epipedon. Crosier soils are on lower lying positions on the landscape. Rensselaer soils are in depressional areas.

Typical pedon of Wawasee sandy loam, 2 to 8 percent slopes, in a cultivated area 2,640 feet east of the center of sec. 17, T. 27 N., R. 2 E.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; many fine and medium roots; neutral; abrupt smooth boundary.

A2—4 to 11 inches; yellowish brown (10YR 5/4) sandy loam; weak medium platy structure; friable; many fine roots; neutral; clear wavy boundary.

B21t—11 to 18 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; firm; few fine roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; medium acid; clear wavy boundary.

B22t—18 to 27 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; uncoated sand grains on faces of peds; medium acid; abrupt smooth boundary.

B3—27 to 32 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; firm; 5 percent gravel; slight effervescence; mildly alkaline; clear irregular boundary.

C—32 to 60 inches; yellowish brown (10YR 5/4) loam; massive; friable; 10 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 40 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. The B3 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 6.

Xenia series

The Xenia series consists of deep soils on upland till plains. They are moderately well drained and moderately slowly permeable. They formed in loess and the underlying loamy glacial till. Slopes range from 1 to 3 percent.

Xenia soils are commonly adjacent to Fincastle and Russell soils. Fincastle soils are grayer in the upper part of the solum and are in slightly lower lying areas than Xenia soils. Russell soils are well drained and are in higher lying areas.

Typical pedon of Xenia silt loam, 1 to 3 percent slopes, in a cultivated field 575 feet east and 990 feet north of the southwest corner of sec. 7, T. 26 N., R. 1 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; many fine and medium roots; slightly acid; clear smooth boundary.

B1—8 to 13 inches; yellowish brown (10YR 5/4) silt loam; moderate medium granular structure; friable; many fine and medium roots; slightly acid; clear smooth boundary.

B21t—13 to 22 inches; dark brown (10YR 4/3) silty clay loam; few fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; medium acid; clear smooth boundary.

B22t—22 to 31 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; black (10YR 2/1) manganese oxide coatings on some faces of peds; strongly acid; clear smooth boundary.

IIB3t—31 to 49 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct dark brown (10YR 3/3) and gray (10YR 6/1) mottles; weak coarse subangular blocky structure; firm; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; 5 percent gravel; slightly acid; clear smooth boundary.

IIC—49 to 60 inches; brown (10YR 5/3) loam; many medium faint grayish brown (10YR 5/2) and many medium distinct gray (10YR 6/1) mottles; massive; firm; 10 percent gravel; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 42 to 65 inches. The thickness of the loess is 24 to 40 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. The Bt and IIBt horizons have hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The IIBt horizon is clay loam or loam.

formation of the soils

This section discusses the major factors of soil formation and their degree of importance in the formation of the soils in Cass County. It also discusses the processes of soil formation that have affected the development of soils in the county.

factors of soil formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also effects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

parent material

Parent material is the unconsolidated mass from which a soil is formed. The parent materials of the soils of Cass County were transported by glaciers or by melt water from the glaciers. Some of the materials deposited from water were reworked and redeposited by subsequent actions of wind. These glaciers covered the county from about 10,000 to 12,000 years ago. Parent material determines the limits of the chemical and mineralogical compositon of the soil. Although parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Cass County were deposited as glacial till, outwash deposits, lacustrine deposits, alluvium, and organic material.

Glacial till is material laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes that are mixed together. The small pebbles in glacial till have sharp corners, which indicate they have not been worn by water washing. The glacial till in Cass County is calcareous and firm. Its texture is loam or clay loam. An example of soils formed in glacial till are those of the Miami series.

Outwash materials were deposited by running water from melting glaciers. The size of the particles that make up outwash material varies according to the velocity of the water that carried them. When fast moving water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, can be carried by slower moving water. Outwash deposits generally consist of layers of particles of similar size, such as medium sand, coarse sand, and gravel. The Kosciusko soils, for example, formed in deposits of outwash material in Cass County.

Lacustrine materials were deposited from still, or ponded, glacial melt water. Because the coarser fragments dropped out of the moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remain to settle out in still water. Lacustrine deposits are silty or clayey in texture. In Cass County, soils formed in lacustrine deposits are typically moderately fine or fine textured. The Patton series is an example of soils formed in lacustrine materials.

Alluvial material was deposited by floodwaters of present streams in recent time. This material ranges in texture, depending on the speed of the water from which it was deposited. Shoals and Stonelick soils are examples of alluvial soils in Cass County.

Organic soils formed in lakes in outwash or lacustrine plains and till plains. Grasses and sedges growing around the edges of these lakes died, and their remains did not decompose but remained around the edge of the lake. Later white-cedar and other water-tolerant trees grew on the areas. As these trees died, their residues became a part of the organic accumulation. The lakes were eventually filled with organic material and developed into organic soils. Plant materials, animals, climate, the order of deposition, and the amount of decomposition determine whether the material is peat, muck, marl, or coprogenous earth. Soils of the Houghton series are an example of soils formed in organic material.

plant and animal life

Plants have been the principal organism influencing the soils in Cass County; however, bacteria, fungi, earthworms, and the activities of man have also been important. The chief contribution of plant and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kind of plants that grew on the soil. The remains of these plants decay and eventually become organic matter. Roots of the plants provide channels for downward movement of water through the soil and also add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The vegetation in Cass County was mainly deciduous forests. Differences in natural soil drainage and minor changes in parent material have affected the composition of the forest species.

In general, the well drained upland soils, such as those in the Riddles series, were mainly covered with white oak, red oak, hickory, and walnut. The Chelsea soils were covered with jack pine and scrub oak. The wet soils consisted primarily of water-tolerant shrubs and trees. A few wet soils also have sphagnum and other mosses which contributed substantially to the accumulation of organic matter. The Gilford and Maumee series were developed under wet conditions and contain considerable organic matter.

climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil. It determines the amount of water available for weathering of minerals, removal of the products of weathering, and the translocation of soil materials. Climate, through its influence on temperatures in the soil, determines the rate of chemical reactions that occur in the soil. These influences are important, but their affects are of minor importance in a relatively small area, such as a county.

The climate in Cass County is cool and humid. This is presumably similar to that which existed when the soils formed. The soils in Cass County differ, for example, from soils formed in a dry, warm climate or from those that formed in a hot, moist climate. Climate is fairly uniform throughout the county. For more detailed information on the climate of this county, see the section "General nature of the county."

relief

Relief or topography has a marked influence on the soils of Cass County, through its influence on depth of the water table, erosion, plant cover, and soil temperature. In Cass County, slopes range from nearly level to very steep. Depth to the water table largely determines natural soil drainage, which ranges from well drained on the ridgetops to very poorly drained in the depressions.

Relief influences the formation of soils by affecting runoff and drainage; drainage in turn, through its affect on aeration of the soil, affects the color of the soil. Runoff of water is greatest in the steeper areas, but in low areas water is temporarily ponded. Water and air move freely through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are bright colored and oxidized, and in poorly aerated soils the color is a dull gray and mottled. The Russell series provides an example of a well drained, well aerated soil, but the Gilford series includes an example of a poorly aerated, very poorly drained soil.

time

Time, generally a long time, is required by the agents of soil formation to form distinct horizons in the soil from parent material. The differences in length of time that the parent material has been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils in Cass County range from young to mature. The glacial deposits from which many of the soils formed have been exposed to soil-forming factors for a long enough time to allow distinct horizons to develop within the soil profile. Some soils, however, which formed in recent alluvial sediments, have not been in place long enough for distinct horizons to develop. The Stonelick soils which have weakly developed horizons, are examples of young soils formed in alluvial material. The Miami and Russell soils are examples of older soils in which the effect of time on leaching of lime from the soil can be noted. Today, the solum of the Miami and Russell soils has about the same amount of lime as the C horizon. The Stonelick soils were submerged under glacial lake water and protected from leaching. In contrast, the Miami soils were above water and subject to leaching. They are leached of lime to a depth of 20 to 40 inches. On the other hand, soils of the Russell series are calcareous at a depth of 40 to 65 inches.

processes of soil formation

Several processes have been involved in the formation of the soils of this county. These processes are the accumulation of organic matter; the solution, transfer, and removal of calcium carbonates and bases; and the liberation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in horizon differentiation.

Some organic matter has accumulated in the surface layer of all the soils of this county. The organic matter content of some soils is low, but that of others is high. Generally, the soils that have the most organic matter, like soils of the Cyclone or Gilford series, have a thick black surface horizon.

Carbonates and bases have been leached from the upper horizons of nearly all the soils of this county. Leaching is generally believed to precede the translocation of silicate clay minerals. Most of the carbonates and some of the bases have been leached from the A and B horizons of well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by an acid reaction. Leaching of wet soils is slow because the water table is high or because water moves slowly through such soils.

Clay accumulates in pores and other voids and forms films on the surfaces along which water moves. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils of this county. Soils of the Miami series are examples of soils in which translocated silicate clays have accumulated in the B2t horizon in the form of clay films.

The reduction and transfer of iron, or gleying, has occurred in all of the very poorly drained, poorly drained, and somewhat poorly drained soils of this county. In these naturally wet soils this process has been significant in horizon differentiation and is recognized by the gray color of the subsoil. The reduction is commonly accompanied by some transfer of the iron, either from upper horizons to lower horizons or completely out of the profile. Mottles, spots or flecks of one color in the background of another color, indicate redistribution and segregation of iron.

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(6) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

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; the air 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 granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Available water capacity (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 moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compact layers to depths below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

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 map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

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; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.
Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.
Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.
Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainage, subsurface. Removal of excess ground water through buried drains installed within the soil profile. The drains collect the water and convey it to a gravity or pump outlet.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, 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 the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded 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 of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	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.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of 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 plant and animal activities are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Underlying material. (See Substratum).

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature[1]: Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have--: Maximum temperature higher than--	2 years in 10 will have--: Minimum temperature lower than--	Average number of growing degree days[2]	Precipitation[1]: Average	2 years in 10 will have--: Less than--	2 years in 10 will have--: More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	35.2	17.5	26.4	62	-14	19	1.93	.92	2.75	5	4.5
February---	39.4	21.1	30.3	64	-9	26	1.89	.96	2.64	4	5.4
March------	49.5	29.1	39.3	79	4	131	2.71	1.64	3.67	6	3.5
April------	64.0	40.2	52.2	86	20	366	4.01	2.26	5.42	8	.7
May--------	74.0	49.3	61.7	92	29	673	3.82	2.32	5.17	7	.0
June-------	83.2	58.8	71.1	98	41	933	3.97	2.22	5.39	6	.0
July-------	86.1	62.3	74.2	98	46	1,060	4.79	2.64	6.55	6	.0
August-----	84.2	60.0	72.1	96	43	995	3.06	2.00	4.02	5	.0
September--	78.8	53.3	66.1	95	33	783	2.94	1.28	4.28	5	.0
October----	67.9	42.4	55.2	87	22	471	2.47	1.12	3.57	5	.0
November---	51.2	32.2	41.7	76	11	108	2.63	1.61	3.54	5	2.1
December---	39.1	23.0	31.1	66	-8	46	2.57	.88	3.92	6	5.2
Year-----	62.7	40.8	51.8	100	-14	5,611	36.79	32.13	41.31	68	21.4

[1]Recorded in the period 1951-74 at Delphi, Ind.

[2]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 15	May 3	May 18
2 years in 10 later than--	April 12	April 27	May 13
5 years in 10 later than--	April 4	April 16	May 3
First freezing temperature in fall:			
1 year in 10 earlier than--	October 20	October 7	September 22
2 years in 10 earlier than--	October 24	October 13	September 27
5 years in 10 earlier than--	November 1	October 22	October 6

[1]Recorded in the period 1951-74 at Delphi, Ind.

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	192	163	139
8 years in 10	198	172	145
5 years in 10	209	188	156
2 years in 10	221	205	167
1 year in 10	226	213	173

[1]Recorded in the period 1951-74 at Delphi, Ind.

TABLE 4.--POTENTIAL AND LIMITATIONS OF GENERAL SOIL MAP UNITS FOR SPECIFIED USES

Map unit	Extent of area	Cultivated farm crops	Specialty crops	Woodland	Urban uses	Intensive recreation areas	Extensive recreation areas
1. Cyclone-Fincastle	28	Good: ponding, wetness.	Fair: ponding, wetness.	Good: ponding, wetness.	Poor: ponding, wetness.	Poor: ponding, wetness.	Poor: ponding, erodes easily.
2. Russell-Miami	9	Fair: erosion.	Fair: erosion.	Good	Fair: slope, percs slowly.	Fair: slope, percs slowly.	Fair: slope, erodes easily.
3. Riddles-Rensselaer-Crosier	27	Good: erosion, wetness, ponding.	Fair: erosion, wetness, ponding.	Fair: ponding, wetness.	Fair: slope, wetness.	Poor: ponding, wetness.	Fair: ponding, wetness.
4. Metea-Miami-Rensselaer	5	Fair: erosion, ponding, soil blowing.	Fair: erosion, ponding, soil blowing.	Good: droughtiness, ponding.	Fair: ponding, slope.	Fair: ponding, slope.	Fair: ponding, slope.
5. Rensselaer-Crosier	5	Good: ponding, wetness.	Fair: ponding, wetness.	Good: ponding, wetness.	Poor: ponding, wetness.	Poor: ponding, wetness.	Poor: ponding, wetness.
6. Glynwood-Morley	6	Fair: erosion.	Fair: erosion.	Good	Fair: percs slowly, wetness.	Fair: percs slowly, wetness.	Poor: erodes easily.
7. Rush-Kosciusko	10	Good: erosion.	Fair: erosion.	Good	Fair: poor filter, shrink-swell potential.	Fair: slope.	Fair: erodes easily.
8. Rush-Gilford-Sleeth	2	Good: erosion, ponding, wetness.	Fair: erosion, ponding, wetness.	Fair: ponding, wetness.	Poor: ponding, wetness.	Fair: ponding, wetness.	Fair: ponding, wetness.
9. Gilford-Chelsea-Oakville	4	Fair: droughtiness, ponding, soil blowing.	Fair: droughtiness, ponding, soil blowing.	Fair: ponding, droughtiness, soil blowing.	Fair: ponding, poor filter.	Fair: ponding, slope.	Fair: ponding.
10. NewGlarus-Millsdale	4	Fair: ponding, shallow to bedrock, erosion.	Fair: ponding, shallow to bedrock, erosion.	Good: ponding, shallow to bedrock.	Poor: ponding, shallow to bedrock.	Fair: percs slowly, ponding.	Poor: erodes easily, ponding.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ad	Ackerman muck, drained	2,667	1.0
BmC	Bloomfield loamy fine sand, 4 to 12 percent slopes	3,879	1.5
BnA	Blount silt loam, 0 to 3 percent slopes	1,546	0.6
ChC	Chelsea loamy fine sand, 4 to 12 percent slopes	5,921	2.2
CpA	Crosier loam, 0 to 3 percent slopes	16,955	6.4
Cy	Cyclone silt loam	32,239	12.1
FcA	Fincastle silt loam, 0 to 3 percent slopes	28,527	10.7
Ge	Gessie Variant silt loam, occasionally flooded	1,913	0.7
Gf	Gilford sandy loam	4,187	1.6
Gg	Gilford loam, gravelly substratum	6,029	2.3
GwB	Glynwood silt loam, 2 to 6 percent slopes	4,292	1.6
HeE	Hennepin loam, 25 to 60 percent slopes	2,433	0.9
Hh	Houghton muck, drained	5,069	1.9
KoB	Kosciusko silt loam, 2 to 6 percent slopes	3,606	1.4
KsC3	Kosciusko sandy clay loam, 6 to 12 percent slopes, severely eroded	2,651	1.0
Ma	Maumee loamy fine sand	4,633	1.8
MkC	Metea loamy fine sand, 3 to 10 percent slopes	9,242	3.5
MnB2	Miami silt loam, 2 to 6 percent slopes, eroded	3,741	1.4
MnC2	Miami silt loam, 6 to 12 percent slopes, eroded	2,477	0.9
MnD2	Miami silt loam, 12 to 18 percent slopes, eroded	1,384	0.5
MoC3	Miami clay loam, 6 to 14 percent slopes, severely eroded	2,496	0.9
Ms	Millsdale silty clay loam	3,192	1.2
MxC3	Morley clay loam, 6 to 12 percent slopes, severely eroded	2,221	0.8
Mz	Morocco loamy fine sand	2,945	1.1
NeB	NewGlarus silt loam, 2 to 6 percent slopes	4,201	1.6
NeC	NewGlarus silt loam, 6 to 12 percent slopes	2,035	0.8
ObA	Oakville loamy fine sand, 0 to 3 percent slopes	2,947	1.1
OsB	Ormas loamy fine sand, 2 to 6 percent slopes	4,673	1.8
Po	Patton silty clay loam	5,433	2.1
Pp	Pits, gravel	656	0.3
Ps	Pits, quarries	357	0.1
Rn	Rensselaer loam, till substratum	25,862	9.7
RsB	Riddles silt loam, 2 to 6 percent slopes	15,977	6.0
RsC	Riddles silt loam, 6 to 12 percent slopes	4,531	1.7
RtA	Rush silt loam, 0 to 2 percent slopes	2,628	1.0
RtB	Rush silt loam, 2 to 6 percent slopes	8,187	3.1
RuB	Russell silt loam, 2 to 6 percent slopes	9,094	3.4
RuC	Russell silt loam, 6 to 12 percent slopes	2,965	1.1
Sh	Shoals silty clay loam, frequently flooded	6,231	2.4
Sm	Sleeth silt loam	5,363	2.0
SrA	Starks silt loam, 0 to 3 percent slopes	1,642	0.6
St	Stonelick loamy fine sand, occasionally flooded	1,160	0.4
WeB	Wawasee sandy loam, 2 to 8 percent slopes	5,010	1.9
XeA	Xenia silt loam, 1 to 3 percent slopes	1,648	0.6
	Water	755	0.3
	Total	265,600	100.0

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Ad------------------------ Ackerman	75	28	36	3.5	7.0
BmC----------------------- Bloomfield	75	29	39	3.0	4.0
BnA----------------------- Blount	106	35	48	4.3	7.2
ChC----------------------- Chelsea	52	20	30	1.8	4.0
CpA----------------------- Crosier	120	42	54	4.0	8.0
Cy------------------------ Cyclone	155	54	55	5.1	10.2
FcA----------------------- Fincastle	130	46	52	4.3	8.6
Ge------------------------ Gessie Variant	105	37	42	3.4	4.0
Gf------------------------ Gilford	120	42	54	4.0	8.0
Gg------------------------ Gilford	90	30	45	3.8	8.0
GwB----------------------- Glynwood	106	35	40	4.5	8.0
HeE----------------------- Hennepin	---	---	---	1.2	3.5
Hh------------------------ Houghton	115	34	---	4.0	8.0
KoB----------------------- Kosciusko	75	26	38	2.5	5.0
KsC3---------------------- Kosciusko	70	24	32	2.4	4.8
Ma------------------------ Maumee	110	38	50	3.6	7.2
MkC----------------------- Metea	75	26	38	2.5	4.0
MnB2---------------------- Miami	105	37	47	3.4	6.8
MnC2---------------------- Miami	95	33	43	3.1	6.2
MnD2---------------------- Miami	80	28	36	2.6	5.2
MoC3---------------------- Miami	90	32	40	3.0	6.0

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Ms: Millsdale	112	44	50	4.8	6.0
MxC3: Morley	95	38	39	3.6	5.5
Mz: Morocco	80	28	36	2.6	5.2
NeB: NewGlarus	95	38	39	4.5	6.0
NeC: NewGlarus	85	34	36	4.0	5.5
ObA: Oakville	60	20	30	2.5	4.0
OsB: Ormas	60	21	30	2.0	4.0
Po: Patton	148	48	56	5.6	9.0
Pp, Ps. Pits					
Rn: Rensselaer	155	54	62	4.5	9.0
RsB: Riddles	115	40	46	3.8	7.6
RsC: Riddles	105	37	42	3.4	6.8
RtA: Rush	125	44	50	4.1	8.2
RtB: Rush	125	44	50	4.1	8.2
RuB: Russell	120	42	48	4.0	8.0
RuC: Russell	110	38	44	3.6	7.2
Sh: Shoals	80	32	33	3.0	8.0
Sm: Sleeth	120	42	48	4.0	8.0
SrA: Starks	112	36	48	4.6	8.0
St: Stonelick	80	28	35	3.5	4.0
WeB: Wawasee	105	37	47	3.4	6.8
XeA: Xenia	120	42	48	4.0	8.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	4,276	---	---	---
II	181,560	50,502	131,058	---
III	51,103	27,507	18,923	4,673
IV	21,513	6,101	2,667	12,745
V	---	---	---	---
VI	---	---	---	---
VII	2,433	2,433	---	---
VIII	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Ad: Ackerman	4w	Slight	Severe	Severe	Severe	Red maple	46	
						Silver maple	---	
						White ash	---	
						Quaking aspen	---	
						Eastern cottonwood	---	
BmC: Bloomfield	3s	Slight	Slight	Moderate	Slight	Black oak	70	Eastern white pine, Scotch pine, red pine, jack pine.
						White oak	---	
						Scarlet oak	---	
BnA: Blount	3c	Slight	Slight	Severe	Severe	White oak	65	Eastern white pine, Scotch pine, red pine, yellow-poplar.
						Northern red oak	65	
						Green ash	---	
						Bur oak	---	
						Pin oak	---	
ChC: Chelsea	3s	Slight	Slight	Moderate	Slight	White oak	70	Eastern white pine, red pine, jack pine.
						Red pine	72	
						Eastern white pine	83	
						Jack pine	70	
						Quaking aspen	72	
						Northern red oak	70	
CpA: Crosier	3o	Slight	Slight	Slight	Slight	White oak	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak	85	
						Yellow-poplar	85	
						Sweetgum	80	
						Northern red oak	75	
Cy: Cyclone	2w	Slight	Severe	Severe	Severe	Pin oak	90	Eastern white pine, Norway spruce, red maple, white ash.
						White oak	75	
						Sweetgum	90	
FcA: Fincastle	3o	Slight	Slight	Slight	Slight	Northern red oak	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						White oak	75	
						Pin oak	85	
						Yellow-poplar	85	
						Sweetgum	80	
Ge: Gessie Variant	1o	Slight	Slight	Slight	Slight	Yellow-poplar	100	Eastern white pine, black walnut, eastern cottonwood, yellow-poplar.
Gf: Gilford	4w	Slight	Severe	Severe	Severe	Pin oak	70	Eastern white pine, European larch, white spruce, white ash.
						Eastern white pine	55	
						Bigtooth aspen	70	
						Red maple	60	
Gg: Gilford	4w	Slight	Severe	Severe	Severe	Pin oak	---	Eastern white pine, European larch, white ash.
						Eastern white pine	70	
						Bigtooth aspen	---	
						Red maple	---	
GwB: Glynwood	2c	Slight	Slight	Moderate	Moderate	Northern red oak	80	Eastern white pine, yellow-poplar, black walnut, white ash.
						Black oak	80	
						White oak	80	
						Black walnut	---	

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
HeE Hennepin	1r	Severe	Severe	Slight	Slight	Northern red oak White oak	85 ---	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine.
Hh Houghton	4w	Slight	Severe	Severe	Severe	White ash Red maple Quaking aspen Black willow Silver maple	51 51 56 --- 76	
KoB, KsC3 Kosciusko	2o	Slight	Slight	Slight	Slight	Northern red oak White oak Eastern white pine Black oak Jack pine	78 76 70 --- ---	Eastern white pine, red pine, jack pine.
Ma Maumee	4w	Slight	Severe	Slight	Severe	Pin oak Eastern white pine Bigtooth aspen Silver maple	70 55 70 ---	Eastern white pine, European larch, Norway spruce.
MkC Metea	2s	Slight	Slight	Moderate	Slight	White oak Yellow-poplar Eastern white pine Red pine	80 86 75 75	Eastern white pine, red pine, yellow-poplar, black walnut.
MnB2, MnC2, MnD2, MoC3 Miami	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
Ms Millsdale	2w	Slight	Severe	Severe	Severe	Pin oak Red maple Swamp white oak	86 --- ---	Red maple, American sycamore, eastern cottonwood, black willow.
MxC3 Morley	2o	Slight	Slight	Slight	Slight	White oak Northern red oak Yellow-poplar Black walnut Bur oak Northern red oak Shagbark hickory Bur oak	80 80 90 --- --- --- --- ---	White oak, black walnut, green ash, eastern white pine, Norway spruce, red pine, white spruce.
Mz Morocco	3o	Slight	Slight	Moderate	Slight	Northern red oak Pin oak Eastern white pine	70 85 65	Eastern white pine, European larch, red maple, American sycamore.
NeB, NeC NewGlarus	2o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Green ash White ash Black walnut	80 88 --- --- ---	Eastern white pine, black walnut, yellow-poplar.
ObA Oakville	3s	Slight	Slight	Moderate	Slight	White oak Red pine Eastern white pine Jack pine	70 78 85 68	Eastern white pine, red pine, jack pine.
OsB Ormas	3s	Slight	Slight	Moderate	Slight	White oak Yellow-poplar Eastern white pine Red pine	70 --- --- 78	Eastern white pine, red pine, yellow-poplar, black walnut.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
Po------------------ Patton	2w	Slight	Severe	Moderate	Moderate	Pin oak-------------	85	Eastern white pine, Norway spruce, red maple, white ash.
						White oak-----------	75	
						Sweetgum------------	80	
						Northern red oak----	75	
Rn------------------ Rensselaer	2w	Slight	Severe	Severe	Severe	Pin oak-------------	86	Eastern white pine, Norway spruce, red maple, white ash.
						White oak-----------	75	
						Sweetgum------------	90	
						Northern red oak----	76	
RsB, RsC----------- Riddles	1o	Slight	Slight	Slight	Slight	White oak-----------	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar-------	98	
						Sweetgum------------	76	
						Northern red oak----	90	
RtA, RtB----------- Rush	1o	Slight	Slight	Slight	Slight	White oak-----------	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Northern red oak----	90	
						Yellow-poplar-------	98	
						Sweetgum------------	---	
RuB, RuC----------- Russell	1o	Slight	Slight	Slight	Slight	White oak-----------	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Northern red oak----	90	
						Yellow-poplar-------	98	
						Sweetgum------------	76	
Sh------------------ Shoals	2o	Slight	Slight	Slight	Slight	Pin oak-------------	90	Red maple, swamp chestnut oak, pin oak, yellow-poplar.
						Sweetgum------------	86	
						Yellow-poplar-------	90	
						Virginia pine-------	90	
						Eastern cottonwood--	---	
						White ash-----------	---	
Sm------------------ Sleeth	3o	Slight	Slight	Slight	Slight	Pin oak-------------	85	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Yellow-poplar-------	85	
						Sweetgum------------	80	
						White oak-----------	70	
SrA----------------- Starks	2o	Slight	Slight	Slight	Slight	White oak-----------	80	Black walnut, American sycamore, yellow-poplar, white oak, green ash, sugar maple.
						Northern red oak----	80	
						Yellow-poplar-------	90	
						Black walnut--------	---	
St------------------ Stonelick	2s	Slight	Slight	Moderate	Slight	Northern red oak----	80	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, white oak.
						White oak-----------	---	
						Black walnut--------	---	
						Black cherry--------	---	
						Sugar maple---------	---	
						White ash-----------	---	
						Yellow-poplar-------	---	
WeB----------------- Wawasee	1o	Slight	Slight	Slight	Slight	White oak-----------	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar-------	98	
						Sweetgum------------	72	
XeA----------------- Xenia	1o	Slight	Slight	Slight	Slight	White oak-----------	90	Eastern white pine, red pine, black walnut, yellow-poplar, white ash.
						Yellow-poplar-------	98	
						Sweetgum------------	76	

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ad----------------- Ackerman	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
BmC----------------- Bloomfield	Siberian peashrub	Radiant crabapple, eastern redcedar, autumn-olive, Washington hawthorn, Amur honeysuckle, lilac, Tatarian honeysuckle.	Austrian pine, jack pine, red pine.	Eastern white pine	---
BnA----------------- Blount	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Amur privet, Washington hawthorn, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
ChC----------------- Chelsea	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Austrian pine, jack pine, red pine.	Eastern white pine	---
CpA----------------- Crosier	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, blue spruce, northern white-cedar, Washington hawthorn, white fir.	Norway spruce-----	Eastern white pine, pin oak.
Cy----------------- Cyclone	---	Amur honeysuckle, silky dogwood, Amur privet.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	---
FcA----------------- Fincastle	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
Ge----------------- Gessie Variant	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Gf: Gilford	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, northern white-cedar, Washington hawthorn, blue spruce, white fir, Austrian pine.	Eastern white pine	Pin oak.
Gg: Gilford	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Norway spruce, Washington hawthorn, blue spruce, white fir, Austrian pine.	Eastern white pine	Pin oak.
GwB: Glynwood	---	Amur honeysuckle, Washington hawthorn, Amur privet, arrowwood, eastern redcedar, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Pin oak, eastern white pine.	---
HeE: Hennepin	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
Hh: Houghton	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
KoB, KsC3: Kosciusko	Siberian peashrub	Eastern redcedar, lilac, radiant crabapple, autumn-olive, Amur honeysuckle, Tatarian honeysuckle, Washington hawthorn.	Eastern white pine, red pine, Austrian pine, jack pine.	---	---
Ma: Maumee	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
MkC: Metea	Siberian peashrub	Eastern redcedar, radiant crabapple, lilac, Washington hawthorn, Amur honeysuckle, autumn-olive, Tatarian honeysuckle.	Red pine, jack pine, Austrian pine.	Eastern white pine	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
MnB2, MnC2, MnD2, MoC3: Miami	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
Ms: Millsdale	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
MxC3: Morley	---	Amur honeysuckle, Washington hawthorn, osageorange, Amur privet, arrowwood, American cranberrybush, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	American cranberrybush, pin oak.	---
Mz: Morocco	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
NeB, NeC: NewGlarus	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
ObA: Oakville	Siberian peashrub	Eastern redcedar, lilac, radiant crabapple, autumn-olive, Washington hawthorn, Amur honeysuckle, Tatarian honeysuckle.	Red pine, Austrian pine, jack pine.	Eastern white pine	---
OsB: Ormas	Siberian peashrub	Eastern redcedar, lilac, radiant crabapple, autumn-olive, Washington hawthorn, Amur honeysuckle, Tatarian honeysuckle.	Red pine, Austrian pine, jack pine.	Eastern white pine	---
Po: Patton	---	Amur privet, silky dogwood, American cranberrybush, Amur honeysuckle.	White fir, northern white-cedar, blue spruce, Austrian pine, Washington hawthorn, Norway spruce.	Eastern white pine	Pin oak.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Pp, Ps. Pits					
Rn. Rensselaer	Gray dogwood, dwarf purple willow.	Redosier dogwood, Amur honeysuckle, silky dogwood.	Northern white-cedar, medium purple willow, tall purple willow.	---	Lombardy poplar.
RsB, RsC. Riddles	---	Amur privet, Amur honeysuckle, American cranberrybush, Washington hawthorn, Tatarian honeysuckle.	Eastern redcedar, Austrian pine, northern white-cedar, osageorange.	Eastern white pine, Norway spruce, red pine.	---
RtA, RtB. Rush	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
RuB, RuC. Russell	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
Sh. Shoals	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Northern white-cedar, Austrian pine, white fir, blue spruce, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
Sm. Sleeth	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
SrA. Starks	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar; Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
St. Stonelick	---	Tatarian honeysuckle, Siberian peashrub.	Green ash, eastern redcedar, osageorange, northern white-cedar, nannyberry viburnum, white spruce, Washington hawthorn.	Black willow	---
WeB. Wawasee	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
XeA: Xenia	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ad: Ackerman	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
BmC: Bloomfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
BnA: Blount	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
ChC: Chelsea	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
CpA: Crosier	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Cy: Cyclone	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
FcA: Fincastle	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
Ge: Gessie Variant	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
Gf, Gg: Gilford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
GwB: Glynwood	Moderate: percs slowly, wetness.	Moderate: wetness, percs slowly.	Moderate: wetness, slope, percs slowly.	Severe: erodes easily.	Slight.
HeE: Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hh: Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
KoB: Kosciusko	Slight	Slight	Moderate: slope, small stones.	Severe: erodes easily.	Moderate: droughty.
KsC3: Kosciusko	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
Ma: Maumee	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MkC: Metea	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: droughty, slope.
MnB2: Miami	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
MnC2: Miami	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MnD2: Miami	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
MoC3: Miami	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
Ms: Millsdale	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MxC3: Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Mz: Morocco	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
NeB: NewGlarus	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Severe: erodes easily.	Moderate: thin layer.
NeC: NewGlarus	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope, thin layer.
ObA: Oakville	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
OsB: Ormas	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Po: Patton	Severe: floods, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pp, Ps. Pits					
Rn: Rensselaer	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
RsB: Riddles	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
RsC: Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
RtA: Rush	Slight	Slight	Slight	Severe: erodes easily.	Slight.
RtB: Rush	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
RuB: Russell	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
RuC: Russell	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Sh: Shoals	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
Sm: Sleeth	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
SrA------------------- Starks	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
St-------------------- Stonelick	Severe: floods.	Moderate: small stones.	Severe: small stones.	Slight------------	Moderate: small stones, droughty, floods.
WeB------------------- Wawasee	Slight----------	Slight----------	Moderate: slope, small stones.	Slight------------	Slight.
XeA------------------- Xenia	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.	Slight.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ad------------------ Ackerman	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
BmC----------------- Bloomfield	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
BnA----------------- Blount	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
ChC----------------- Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
CpA----------------- Crosier	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Cy------------------ Cyclone	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
FcA----------------- Fincastle	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Ge------------------ Gessie Variant	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Gf------------------ Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Gg------------------ Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
GwB----------------- Glynwood	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HeE----------------- Hennepin	Very poor.	Poor	Good	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
Hh------------------ Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
KoB----------------- Kosciusko	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
KsC3---------------- Kosciusko	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
Ma------------------ Maumee	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
MkC----------------- Metea	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MnB2---------------- Miami	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MnC2---------------- Miami	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MnD2---------------- Miami	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MoC3---------------- Miami	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ms: Millsdale	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair	Fair.
MxC3: Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Mz: Morocco	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Fair	Fair	Poor.
NeB, NeC: NewGlarus	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
ObA: Oakville	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
OsB: Ormas	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Po: Patton	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Pp, Ps. Pits										
Rn: Rensselaer	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
RsB: Riddles	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RsC: Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
RtA, RtB: Rush	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RuB: Russell	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RuC: Russell	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Sh: Shoals	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
Sm: Sleeth	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
SrA: Starks	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
St: Stonelick	Poor	Poor	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
WeB: Wawasee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
XeA: Xenia	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ad: Ackerman	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
BmC: Bloomfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
BnA: Blount	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
ChC: Chelsea	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: slope.	Moderate: droughty.
CpA: Crosier	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Cy: Cyclone	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
FcA: Fincastle	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Ge: Gessie Variant	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Gf, Gg: Gilford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
GwB: Glynwood	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: slope, shrink-swell, wetness.	Severe: frost action, low strength.	Slight.
HeE: Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hh: Houghton	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: excess humus, ponding.
KoB: Kosciusko	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell.	Moderate: droughty.
KsC3: Kosciusko	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: droughty, slope.
Ma: Maumee	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MkC: Metea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MnB2: Miami	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, low strength.	Slight.
MnC2: Miami	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: slope.
MnD2: Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MoC3: Miami	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: slope.
Ms: Millsdale	Severe: depth to rock, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, depth to rock, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
MxC3: Morley	Moderate: too clayey, dense layer, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Mz: Morocco	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
NeB: NewGlarus	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action, shrink-swell.	Moderate: thin layer.
NeC: NewGlarus	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action, shrink-swell.	Moderate: slope, thin layer.
ObA: Oakville	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: droughty.
OsB: Ormas	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
Po: Patton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
Pp, Ps. Pits						
Rn: Rensselaer	Severe: ponding, cutbanks cave.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: frost action, ponding, low strength.	Severe: ponding.
RsB: Riddles	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: low strength, frost action.	Slight.
RsC: Riddles	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
RtA: Rush	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
RtB: Rush	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
RuB: Russell	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
RuC: Russell	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Sh: Shoals	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, frost action.	Severe: floods.
Sm: Sleeth	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
SrA: Starks	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
St: Stonelick	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: small stones, droughty, floods.
WeB: Wawasee	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
XeA: Xenia	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ad Ackerman	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
BmC Bloomfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
BnA Blount	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
ChC Chelsea	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
CpA Crosier	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Cy Cyclone	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
FcA Fincastle	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Ge Gessie Variant	Severe: floods, poor filter.	Severe: floods, seepage.	Severe: floods, seepage, too sandy.	Severe: floods, seepage.	Fair: thin layer.
Gf, Gg Gilford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
GwB Glynwood	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
HeE Hennepin	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Hh Houghton	Severe: ponding, percs slowly.	Severe: seepege, ponding, excess humus.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
KoB Kosciusko	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
KsC3 Kosciusko	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Ma Maumee	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, too sandy, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MkC: Metea	Severe: percs slowly.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
MnB2: Miami	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
MnC2: Miami	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
MnD2: Miami	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
MoC3: Miami	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ms: Millsdale	Severe: depth to rock, ponding, percs slowly.	Severe: depth to rock, ponding.	Severe: depth to rock, ponding, too clayey.	Severe: depth to rock, ponding.	Poor: too clayey, area reclaim, hard to pack.
MxC3: Morley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Mz: Morocco	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, too sandy, wetness.	Severe: seepage, wetness.	Poor: too sandy, wetness, seepage.
NeB: NewGlarus	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Poor: area reclaim.
NeC: NewGlarus	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Poor: area reclaim.
ObA: Oakville	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
OsB: Ormas	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Po: Patton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Pp, Ps. Pits					
Rn: Rensselaer	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
RsB: Riddles	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
RsC: Riddles	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
RtA------------------ Rush	Slight-----------	Moderate: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey, small stones.
RtB------------------ Rush	Slight-----------	Moderate: seepage, slope.	Severe: seepage.	Slight-----------	Fair: too clayey, small stones.
RuB------------------ Russell	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
RuC------------------ Russell	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Sh------------------- Shoals	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Sm------------------- Sleeth	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
SrA------------------ Starks	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
St------------------- Stonelick	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Poor: seepage.
WeB------------------ Wawasee	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
XeA------------------ Xenia	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ad: Ackerman	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
BmC: Bloomfield	Good	Probable	Improbable: too sandy.	Fair: too sandy, slope.
BnA: Blount	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
ChC: Chelsea	Good	Probable	Improbable: too sandy.	Fair: too sandy.
CpA: Crosier	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cy: Cyclone	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
FcA: Fincastle	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ge: Gessie Variant	Good	Probable	Improbable: too sandy.	Fair: area reclaim.
Gf, Gg: Gilford	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
GwB: Glynwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
HeE: Hennepin	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Hh: Houghton	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess humus.
KoB, KsC3: Kosciusko	Good	Probable	Probable	Poor: small stones, area reclaim.
Ma: Maumee	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
MkC: Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, slope.
MnB2: Miami	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
MnC2: Miami	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
MnD2: Miami	Poor: slope, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
MoC3------------------ Miami	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
Ms-------------------- Millsdale	Poor: low strength, area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.
MxC3------------------ Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Mz-------------------- Morocco	Fair: wetness.	Probable-------------	Improbable: too sandy.	Fair: too sandy.
NeB------------------- NewGlarus	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
NeC------------------- NewGlarus	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
ObA------------------- Oakville	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
OsB------------------- Ormas	Good-----------------	Probable-------------	Probable-------------	Fair: too sandy.
Po-------------------- Patton	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Pp. Ps. Pits				
Rn-------------------- Rensselaer	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
RsB------------------- Riddles	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
RsC------------------- Riddles	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
RtA, RtB-------------- Rush	Good-----------------	Probable-------------	Probable-------------	Fair: area reclaim.
RuB------------------- Russell	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
RuC------------------- Russell	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Sh-------------------- Shoals	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Sm-------------------- Sleeth	Fair: wetness.	Probable-------------	Probable-------------	Poor: area reclaim.
SrA------------------- Starks	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
St-------------------- Stonelick	Good-----------------	Probable-------------	Improbable: too sandy.	Good.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
WeB-------------------- Wawasee	Good------------------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
XeA-------------------- Xenia	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Ad: Ackerman	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, frost action.	Ponding, too sandy, soil blowing.	Wetness, percs slowly.
BmC: Bloomfield	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, droughty, rooting depth.
BnA: Blount	Slight	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily.
ChC: Chelsea	Severe: seepage.	Severe: piping, seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
CpA: Crosier	Slight	Severe: piping, wetness.	Severe: slow refill.	Frost action	Wetness	Wetness.
Cy: Cyclone	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Erodes easily, ponding.	Wetness, erodes easily.
FcA: Fincastle	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Wetness, erodes easily.
Ge: Gessie Variant	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Gf: Gilford	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness.
Gg: Gilford	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, too sandy.	Wetness.
GwB: Glynwood	Moderate: slope.	Moderate: wetness, piping.	Severe: no water.	Slope, percs slowly, frost action.	Erodes easily, wetness.	Erodes easily.
HeE: Hennepin	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, percs slowly.	Slope, droughty, percs slowly.
Hh: Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.
KoB: Kosciusko	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Erodes easily, too sandy.	Erodes easily, droughty.
KsC3: Kosciusko	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, too sandy.	Slope, droughty.
Ma: Maumee	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness, droughty.
MkC: Metea	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
MnB2---------------- Miami	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
MnC2, MnD2, MoC3-- Miami	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Ms---------------- Millsdale	Moderate: depth to rock.	Severe: ponding.	Severe: no water.	Depth to rock, frost action, ponding.	Depth to rock, ponding.	Wetness, depth to rock.
MxC3-------------- Morley	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Mz---------------- Morocco	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, too sandy, soil blowing.	Wetness, droughty.
NeB--------------- NewGlarus	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock, erodes easily.	Erodes easily, depth to rock.
NeC--------------- NewGlarus	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
ObA--------------- Oakville	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Too sandy, soil blowing.	Droughty.
OsB--------------- Ormas	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Soil blowing---	Droughty.
Po---------------- Patton	Moderate: seepage.	Severe: ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
Pp, Ps. Pits						
Rn---------------- Rensselaer	Moderate: seepage.	Severe: ponding, piping.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, erodes easily.	Wetness, percs slowly, erodes easily.
RsB--------------- Riddles	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Favorable------	Favorable.
RsC--------------- Riddles	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope.
RtA--------------- Rush	Moderate: seepage.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
RtB--------------- Rush	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
RuB--------------- Russell	Moderate: seepage, slope.	Moderate: thin layer.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
RuC--------------- Russell	Severe: slope.	Moderate: thin layer.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Sh---------------- Shoals	Moderate: seepage.	Severe: wetness, piping.	Moderate: slow refill.	Floods, frost action.	Erodes easily, wetness.	Wetness, erodes easily.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
Sm---------------- Sleeth	Moderate: seepage.	Severe: wetness.	Severe: cutbanks cave.	Frost action---	Wetness--------	Wetness.
SrA--------------- Starks	Moderate: seepage.	Severe: thin layer, wetness.	Severe: slow refill, cutbanks cave.	Frost action---	Erodes easily, wetness.	Wetness, erodes easily.
St---------------- Stonelick	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
WeB--------------- Wawasee	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Soil blowing---	Favorable.
XeA--------------- Xenia	Moderate: seepage.	Moderate: thin layer, wetness.	Severe: slow refill.	Frost action---	Erodes easily, wetness.	Erodes easily.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ad-- Ackerman	0-11	Sapric material	PT	A-8	0	---	---	---	---	---	---
	11-23	Coprogenous earth	OH, OL	A-8	0	---	---	---	---	---	---
	23-60	Fine sand, very fine sand, loamy sand.	SM, SP-SM	A-2-4	0	100	100	85-95	10-20	---	NP
BmC-- Bloomfield	0-25	Loamy fine sand, loamy sand, sand	SM, SP, SP-SM	A-2-4, A-3, A-4	0	100	100	70-90	4-40	---	NP
	25-76	Loamy fine sand, fine sandy loam, loamy sand.	SM, SP, SP-SM	A-2-4, A-4, A-3	0	100	100	65-80	4-40	<20	NP-3
	76-80	Fine sand--------	SP, SM, SP-SM	A-2-4, A-3	0	100	100	65-80	4-30	---	NP
BnA-- Blount	0-8	Silt loam--------	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
	8-25	Silty clay loam, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	90-100	80-95	35-60	15-35
	25-60	Silty clay loam, clay loam.	CL	A-6	0-10	90-100	90-100	80-100	70-90	25-40	10-25
ChC-- Chelsea	0-11	Loamy fine sand, fine sand.	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	11-80	Fine sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
CpA-- Crosier	0-10	Loam-------------	CL	A-4, A-6	0	100	95-100	85-95	60-80	22-33	8-15
	10-30	Clay loam, loam.	CL	A-6, A-7	0	90-95	85-95	75-90	60-70	33-47	15-26
	30-60	Loam-------------	CL, ML	A-4, A-6	0-3	85-90	80-90	70-85	50-60	25-35	2-12
Cy-- Cyclone	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-95	25-40	5-15
	12-54	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	15-30
	54-60	Loam-------------	CL-ML, CL	A-4, A-6	0	90-100	85-100	75-95	50-75	20-30	6-15
FcA-- Fincastle	0-8	Silt loam--------	CL, ML	A-4, A-6	0	100	95-100	90-100	75-93	27-36	4-12
	8-36	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-95	38-54	20-32
	36-55	Clay loam, loam, silty clay loam.	CH, CL	A-7	0	95-100	90-98	85-95	75-85	45-58	30-38
	55-60	Loam, clay loam	CL, ML, CL-ML	A-4, A-6	0-3	88-96	82-90	70-86	50-66	20-35	3-12
Ge-- Gessie Variant	0-5	Silt loam--------	CL-ML, ML, CL	A-6, A-4	0	100	95-100	80-100	70-85	26-40	5-15
	5-36	Silt loam, loam	CL-ML, ML, CL	A-6, A-4	0	100	95-100	80-100	70-85	26-40	5-15
	36-60	Gravelly coarse sand.	SP, SP-SM	A-3, A-1	0	60-75	55-75	30-55	3-10	---	NP
Gf-- Gilford	0-17	Sandy loam-------	SC, SM-SC	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	4-10
	17-24	Sandy loam, fine sandy loam.	SM, SC, SM-SC	A-2-4	0	90-100	90-100	55-70	20-35	15-30	NP-8
	24-60	Loamy sand, sand	SM, SP, SP-SM	A-3, A-1-B, A-2-4	0	90-100	85-100	18-60	3-20	---	NP
Gg-- Gilford	0-11	Loam-------------	CL	A-4, A-6	0	95-100	90-100	85-95	60-75	22-33	8-15
	11-38	Sandy clay loam, coarse sandy loam.	SM, SC, SM-SC	A-2-4	0	90-100	90-100	55-70	25-35	20-30	NP-8
	38-54	Coarse sand, sand, loamy sand.	SM, SP, SP-SM	A-3, A-1-B, A-2-4	0	90-100	85-100	18-60	3-18	---	NP
	54-60	Gravelly sand----	SP, SP-SM	A-1, A-3, A-2-4	5-15	80-95	75-90	40-60	3-10	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag-ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
GwB Glynwood	0-8	Silt loam	CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	55-90	23-40	4-15
	8-32	Clay, clay loam, silty clay loam.	CL, CH	A-7, A-6	0-5	95-100	85-100	75-100	65-95	35-55	15-30
	32-60	Clay loam, silty clay loam.	CL	A-6, A-4	0-5	95-100	80-100	75-95	65-90	25-40	7-18
HeE Hennepin	0-5	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-100	60-95	25-40	5-20
	5-18	Loam, sandy loam, silt loam.	SC, SM-SC, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	80-100	65-100	35-95	20-50	5-25
	18-60	Loam, sandy loam, clay loam.	SC, SM-SC, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	80-100	65-100	35-95	20-50	5-25
Hh Houghton	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
KoB Kosciusko	0-8	Silt loam	ML, CL-ML, CL	A-4	0	100	95-100	90-100	80-100	20-35	2-10
	8-20	Sandy clay loam, gravelly sandy loam.	SM-SC, SC, GC, GM-GC	A-4, A-6, A-2, A-1	0-3	55-80	55-75	35-65	15-40	20-40	5-20
	20-36	Gravelly loamy sand, gravelly sandy clay loam, gravelly sandy loam.	SM, GM, GP-GM, SP-SM	A-1, A-2-4	0-5	45-75	40-70	20-50	10-30	<20	NP
	36-60	Gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	1-8	30-60	30-55	15-40	2-10	<20	NP
KsC3 Kosciusko	0-4	Sandy clay loam.	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0	85-100	80-100	50-90	30-70	<25	NP-6
	4-16	Sandy clay loam, gravelly sandy clay loam.	SM-SC, SC, GC, GM-GC	A-4, A-6, A-2, A-1	0-3	55-80	55-75	35-65	15-40	20-40	5-20
	16-32	Gravelly loamy sand, very gravelly sandy loam, gravelly sandy loam.	SM, GM, GP-GM, SP-SM	A-1, A-2-4	0-5	45-75	40-70	20-50	10-30	<20	NP
	32-60	Very gravelly sand, sand.	SP, SP-SM, GP, GP-GM	A-1	1-8	30-60	30-55	15-40	2-10	<20	NP
Ma Maumee	0-19	Loamy fine sand	SM, SP-SM	A-2-4, A-3	0	95-100	90-100	50-75	5-30	<30	NP-5
	19-60	Sand, loamy fine sand, fine sand.	SP, SP-SM, SM	A-1-B, A-3, A-2-4	0	85-100	75-95	35-70	3-25	<30	NP
MkC Metea	0-13	Loamy fine sand	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	13-34	Loamy sand, sandy loam, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	34-46	Clay loam, sandy clay loam, loam.	CL, SC	A-6, A-7	0	90-100	90-95	75-95	40-75	25-50	12-30
	46-60	Loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-40	5-18
MnB2, MnC2, MnD2 Miami	0-5	Silt loam	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	22-34	6-15
	5-32	Clay loam, silty clay loam.	CL	A-6, A-7	0	92-99	89-97	78-95	64-95	35-50	17-31
	32-60	Loam	CL, CL-ML, ML	A-4, A-6	0-3	88-94	83-89	74-87	50-64	20-40	2-20
MoC3 Miami	0-6	Clay loam	CL	A-6, A-7	0	100	90-100	75-95	65-95	30-45	15-25
	6-27	Clay loam, loam.	CL	A-6, A-7	0	92-99	89-97	78-95	64-95	35-50	17-31
	27-60	Loam, sandy loam.	CL, CL-ML, ML	A-4, A-6	0-3	88-94	83-89	74-87	50-64	20-40	2-20

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ms----------------- Millsdale	0-8	Silty clay loam	CL	A-6, A-7	0	90-100	80-100	75-100	60-95	32-50	12-25
	8-21	Clay, silty clay, clay loam.	CH, CL	A-7	0-5	85-100	80-100	75-100	60-95	40-60	20-35
	21	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
MxC3--------------- Morley	0-6	Clay loam--------	CL	A-6	0-5	95-100	90-100	85-95	80-90	25-40	10-20
	6-29	Silty clay, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-55	15-30
	29-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-45	10-25
Mz----------------- Morocco	0-20	Loamy fine sand	SM, SM-SC	A-2-4	0	100	100	50-85	15-35	<20	NP-5
	20-60	Fine sand, sand	SM, SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-25	---	NP
NeB, NeC----------- NewGlarus	0-11	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	80-90	25-45	10-25
	11-24	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	85-95	35-50	20-30
	24-36	Clay, silty clay	CH, MH	A-7	0-10	85-100	85-100	80-95	65-95	60-90	35-60
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---
ObA---------------- Oakville	0-9	Loamy fine sand--	SM	A-2	0	100	100	55-75	15-25	---	NP
	9-60	Fine sand, sand, loamy fine sand.	SM, SP, SP-SM	A-2, A-3	0	100	95-100	65-95	0-25	---	NP
OsB---------------- Ormas	0-33	Loamy fine sand	SM	A-2-4	0	98-100	95-100	50-75	15-30	---	NP
	33-38	Sandy loam-------	SM-SC, SM	A-2-4, A-4	0	90-100	85-100	50-70	25-40	<15	NP-5
	38-56	Gravelly sandy clay loam, gravelly sandy loam.	SM-SC, SC, GC, GM-GC	A-4, A-6, A-2-4, A-2-6	0	60-80	55-80	35-70	20-45	20-40	6-20
	56-60	Very gravelly sand.	SP, SP-SM	A-3, A-1-B, A-2-4	0	60-80	55-80	30-55	3-12	---	NP
Po----------------- Patton	0-11	Silty clay loam	CL	A-6	0	100	100	95-100	75-95	30-40	15-25
	11-38	Silty clay loam, silt loam.	CL, CH, ML, MH	A-7	0	100	100	95-100	80-100	40-55	15-25
	38-60	Silt loam, loam.	CL	A-6	0	100	100	95-100	75-95	25-40	10-20
Pp, Ps. Pits											
Rn----------------- Rensselaer	0-10	Loam-------------	CL, ML	A-4, A-6	0	100	95-100	80-95	60-80	27-36	4-12
	10-25	Clay loam--------	CL	A-6, A-7	0	100	95-100	85-100	65-80	33-47	15-26
	25-41	Stratified loam to loamy sand.	CL, CL-ML, ML, SC	A-4, A-2-4	0-3	95-100	90-100	55-85	20-60	20-30	3-10
	41-60	Loam-------------	CL-ML, CL	A-4, A-6	0-3	90-100	85-95	70-90	55-70	20-30	6-15
RsB, RsC----------- Riddles	0-10	Silt loam--------	CL	A-4, A-6	0	95-100	85-95	80-90	60-75	20-35	8-15
	10-26	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	90-100	80-95	75-90	35-75	25-40	10-20
	26-64	Clay loam, loam.	CL	A-6, A-7	0	90-100	80-95	75-95	65-75	35-50	15-30
	64-80	Clay loam, sandy loam, loam.	CL, SM, SC, ML	A-4, A-6, A-2	0-3	85-95	80-90	50-90	30-70	15-30	2-15

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
RtA, RtB--------- Rush	0-9	Silt loam--------	CL	A-4, A-6	0	100	100	90-100	80-95	29-38	7-15
	9-27	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	85-95	40-50	21-26
	27-57	Clay loam, loam, gravelly sandy clay loam.	CL, SC	A-6, A-7, A-2	1-5	75-90	60-85	50-80	30-60	30-45	15-22
	57-60	Stratified sand and very gravelly coarse sand.	SP, SP-SM, GP-GM, GP	A-1	1-5	30-70	22-55	7-20	2-10	<30	NP
RuB, RuC--------- Russell	0-10	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	20-35	5-15
	10-36	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	35-50	20-35
	36-60	Clay loam, loam	CL	A-6, A-7	0	90-100	90-95	80-90	65-75	35-50	17-31
	60-80	Loam, clay loam	CL, ML, CL-ML	A-4, A-6	0-3	85-95	80-90	75-85	50-65	<30	2-14
Sh--------------- Shoals	0-15	Silty clay loam	CL	A-7	0	100	100	95-100	80-90	40-50	20-30
	15-35	Silt loam, sandy loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	25-40	4-15
	35-60	Sandy loam-------	ML	A-4	0-3	90-100	85-100	60-80	50-70	32-40	3-8
Sm--------------- Sleeth	0-8	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	90-100	75-95	50-85	20-35	3-15
	8-43	Silt loam, silty clay loam, clay loam.	CL	A-6	0	85-95	85-95	80-90	65-75	30-40	15-25
	43-55	Gravelly clay loam, gravelly sandy clay loam, gravelly loam.	CL	A-6	0-3	65-95	60-85	55-70	50-70	30-40	15-25
	55-60	Stratified sand and very gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	---	NP
SrA-------------- Starks	0-13	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	22-35	5-15
	13-38	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-100	35-45	15-24
	38-50	Loam, silty clay loam, silt loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	95-100	90-100	80-95	40-80	25-40	6-17
	50-60	Stratified loamy sand to silt loam.	SM, SC, ML, CL	A-2, A-4, A-6	0-5	90-100	80-95	40-90	30-60	<30	NP-15
St--------------- Stonelick	0-6	Loamy fine sand	SM	A-2, A-4, A-1-B	0	85-100	70-100	45-65	20-40	<15	NP
	6-60	Fine sandy loam, loamy sand.	SM, SP-SM	A-2, A-4, A-3, A-1-B	0	85-100	70-95	40-60	5-40	<15	NP
WeB-------------- Wawasee	0-11	Sandy loam-------	SM, SM-SC	A-2-4, A-4	0	90-95	85-95	80-95	30-50	<25	NP-6
	11-32	Loam, sandy clay loam.	CL, SC	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	32-60	Loam-------------	SM-SC, SC, CL-ML, CL	A-4, A-6, A-2	0	75-95	70-95	50-90	25-66	20-30	4-12
XeA-------------- Xenia	0-13	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-35	5-15
	13-31	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	31-49	Clay loam--------	CL	A-6, A-7	0-5	92-100	90-95	75-95	65-75	35-50	15-30
	49-60	Loam-------------	CL, ML, SC, SM	A-4, A-6	0-5	85-95	80-90	75-90	40-65	15-30	NP-15

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Ad----------------Ackerman	0-11	---	0.20-0.80	0.2-6.0	0.35-0.45	6.1-7.3	-------------	----	---	3	30-40
	11-23	---	0.50-1.20	0.06-0.2	0.18-0.24	6.1-7.3	-------------	----			
	23-60	2-5	1.55-1.60	6.0-20	0.06-0.08	6.6-8.4	Low----------	0.15			
BmC--------------Bloomfield	0-25	3-10	1.60-1.80	6.0-20	0.07-0.12	5.1-7.3	Low----------	0.15	5	1	.5-2
	25-76	6-18	1.60-1.80	2.0-20	0.06-0.17	5.1-7.3	Low----------	0.15			
	76-80	3-18	1.70-1.90	6.0-20	0.06-0.08	5.1-7.8	Low----------	0.15			
BnA--------------Blount	0-8	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.43	3	6	2-3
	8-25	35-50	1.40-1.70	0.06-0.6	0.12-0.19	4.5-6.5	Moderate-----	0.43			
	25-60	30-35	1.60-1.85	0.06-0.6	0.07-0.10	7.4-8.4	Moderate-----	0.43			
ChC--------------Chelsea	0-11	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	Low----------	0.17	5	2	.5-1
	11-80	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-6.0	Low----------	0.17			
CpA--------------Crosier	0-10	7-18	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.32	5	5	1-3
	10-30	20-33	1.40-1.60	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.32			
	30-60	10-20	1.40-1.60	0.2-0.6	0.10-0.19	6.1-8.4	Low----------	0.32			
Cy---------------Cyclone	0-12	18-27	1.30-1.50	0.6-2.0	0.23-0.25	6.1-7.3	Low----------	0.28	5	6	4-6
	12-54	27-35	1.40-1.60	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43			
	54-60	15-25	1.50-1.80	0.2-0.6	0.05-0.19	7.4-8.4	Low----------	0.43			
FcA--------------Fincastle	0-8	11-22	1.40-1.55	0.6-2.0	0.22-0.24	5.1-6.5	Low----------	0.37	5	5	1-3
	8-36	20-35	1.45-1.65	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.37			
	36-55	20-35	1.45-1.65	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.37			
	55-60	20-30	1.55-1.90	0.06-2.0	0.05-0.19	7.4-8.4	Low----------	0.37			
Ge---------------Gessie Variant	0-5	20-25	1.25-1.40	0.6-2.0	0.20-0.24	7.4-8.4	Low----------	0.37	5	5	1-2
	5-36	15-25	1.25-1.40	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	0.37			
	36-60	0-5	1.50-1.75	6.0-20	0.03-0.05	7.9-8.4	Low----------	0.10			
Gf---------------Gilford	0-17	10-20	1.50-1.70	2.0-6.0	0.13-0.15	5.6-7.3	Low----------	0.20	4	3	2-4
	17-24	8-17	1.60-1.80	2.0-6.0	0.12-0.14	5.6-7.3	Low----------	0.20			
	24-60	3-12	1.70-1.90	6.0-20	0.05-0.08	6.6-8.4	Low----------	0.15			
Gg---------------Gilford	0-11	10-20	1.50-1.70	2.0-6.0	0.20-0.22	5.6-6.5	Low----------	0.28	4	5	2-4
	11-38	8-17	1.60-1.80	2.0-6.0	0.10-0.14	5.6-7.3	Low----------	0.20			
	38-54	3-12	1.70-1.90	6.0-20	0.05-0.08	6.6-8.4	Low----------	0.15			
	54-60	1-5	1.70-1.90	>20	0.02-0.04	6.6-8.4	Low----------	0.10			
GwB--------------Glynwood	0-8	16-27	1.25-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.43	3	6	1-3
	8-32	35-55	1.45-1.75	0.06-0.2	0.11-0.18	4.5-8.4	Moderate-----	0.32			
	32-60	27-36	1.65-1.82	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			
HeE--------------Hennepin	0-5	20-30	1.20-1.40	0.6-2.0	0.18-0.24	6.1-7.8	Low----------	0.32	4	5	1-2
	5-18	18-30	1.30-1.60	0.2-2.0	0.14-0.22	6.1-7.8	Low----------	0.32			
	18-60	18-30	1.45-1.70	0.06-0.6	0.07-0.11	6.1-8.4	Low----------	0.32			
Hh---------------Houghton	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	---	3	>70
KoB--------------Kosciusko	0-8	10-20	1.30-1.45	0.6-2.0	0.19-0.23	5.1-6.5	Low----------	0.37	4	5	.5-2
	8-20	18-27	1.40-1.60	0.6-2.0	0.07-0.14	5.1-6.5	Moderate-----	0.28			
	20-36	4-12	1.50-1.70	0.6-2.0	0.05-0.11	5.1-7.8	Low----------	0.28			
	36-60	1-5	1.70-1.90	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
KsC3-------------Kosciusko	0-4	7-17	1.30-1.45	0.6-2.0	0.13-0.20	5.1-6.5	Low----------	0.28	4	3	.5-2
	4-16	18-27	1.40-1.60	0.6-2.0	0.07-0.14	5.1-6.5	Moderate-----	0.28			
	16-32	4-12	1.50-1.70	0.6-2.0	0.05-0.11	5.1-7.8	Low----------	0.28			
	32-60	1-5	1.70-1.90	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
Ma---------------Maumee	0-19	2-10	1.60-1.75	6.0-20	0.10-0.12	6.1-7.3	Low----------	0.17	5	2	2-4
	19-60	2-10	1.60-1.75	6.0-20	0.05-0.07	5.6-8.4	Low----------	0.17			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
MkC--------------	0-13	3-8	1.45-1.60	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	.5-2
Metea	13-34	2-10	1.50-1.70	6.0-20	0.06-0.11	5.1-7.3	Low----------	0.17			
	34-46	25-35	1.50-1.70	0.2-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	46-60	20-30	1.40-1.65	0.2-2.0	0.05-0.19	7.4-8.4	Low----------	0.32			
MnB2, MnC2, MnD2-	0-5	11-22	1.40-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.37	5	5	.5-3
Miami	5-32	25-35	1.45-1.65	0.6-2.0	0.15-0.20	5.6-7.8	Moderate-----	0.37			
	32-60	15-28	1.55-1.90	0.2-2.0	0.05-0.19	6.6-8.4	Moderate-----	0.37			
MoC3-------------	0-6	27-35	1.45-1.60	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.37	4	6	.5-3
Miami	6-27	25-35	1.45-1.65	0.6-2.0	0.15-0.20	5.6-7.8	Moderate-----	0.37			
	27-60	15-28	1.55-1.90	0.2-2.0	0.05-0.19	6.6-8.4	Moderate-----	0.37			
Ms---------------	0-8	27-32	1.30-1.50	0.6-2.0	0.19-0.22	6.1-7.3	Moderate-----	0.32	4	6	4-7
Millsdale	8-21	35-45	1.40-1.70	0.2-0.6	0.12-0.16	6.1-8.4	High---------	0.32			
	21	---	---	---	---	---	-------------	----			
MxC3-------------	0-6	27-35	1.40-1.60	0.2-0.6	0.18-0.22	5.1-6.5	Moderate-----	0.43	2	7	1-3
Morley	6-29	35-50	1.60-1.90	0.06-0.2	0.11-0.13	5.6-7.3	Moderate-----	0.43			
	29-60	27-40	1.60-1.90	0.2-0.6	0.09-0.20	6.6-8.4	Moderate-----	0.43			
Mz---------------	0-20	1-6	1.40-1.60	6.0-20	0.10-0.12	5.1-7.3	Low----------	0.17	5	2	.5-2
Morocco	20-60	1-6	1.50-1.70	6.0-20	0.05-0.07	4.5-6.0	Low----------	0.17			
NeB, NeC---------	0-11	12-27	1.20-1.40	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.37	4	5	1-3
NewGlarus	11-24	25-35	1.25-1.45	0.2-2.0	0.18-0.22	5.6-7.3	Moderate-----	0.37			
	24-36	55-75	1.25-1.50	0.2-0.6	0.09-0.13	5.6-7.8	High---------	0.37			
	36	---	---	---	---	---	-------------	----			
ObA--------------	0-9	2-14	1.30-1.55	6.0-20	0.09-0.12	5.6-7.3	Low----------	0.15	5	2	.5-2
Oakville	9-60	0-10	1.30-1.65	>20	0.06-0.08	5.6-7.3	Low----------	0.15			
OsB--------------	0-33	5-12	1.40-1.60	2.0-6.0	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	1-3
Ormas	33-38	10-20	1.50-1.70	2.0-6.0	0.12-0.14	5.1-6.5	Low----------	0.17			
	38-56	18-25	1.50-1.60	2.0-6.0	0.11-0.14	5.6-7.8	Low----------	0.32			
	56-60	1-8	1.55-1.70	>20	0.03-0.05	7.4-8.4	Low----------	0.15			
Po---------------	0-11	27-35	1.15-1.35	0.6-2.0	0.21-0.23	6.6-7.3	Moderate-----	0.28	5	7	3-5
Patton	11-38	27-35	1.25-1.45	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.28			
	38-60	22-35	1.30-1.50	0.6-2.0	0.18-0.22	7.4-8.4	Moderate-----	0.28			
Pp, Ps.											
Pits											
Rn---------------	0-10	18-27	1.30-1.45	0.6-2.0	0.21-0.24	6.1-7.3	Low----------	0.28	5	5	3-6
Rensselaer	10-25	27-32	1.40-1.55	0.6-2.0	0.15-0.19	6.6-7.3	Moderate-----	0.37			
	25-41	3-18	1.27-1.56	0.6-2.0	0.05-0.19	6.6-7.3	Low----------	0.37			
	41-60	18-27	1.45-1.70	0.2-0.6	0.05-0.19	7.4-8.4	Moderate-----	0.37			
RsB, RsC---------	0-10	8-16	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.3	Low----------	0.32	5	5	.5-2
Riddles	10-26	18-35	1.40-1.60	0.6-2.0	0.16-0.18	5.1-7.3	Moderate-----	0.32			
	26-64	20-35	1.40-1.60	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.32			
	64-80	8-25	1.40-1.60	0.6-2.0	0.05-0.19	6.6-8.4	Low----------	0.32			
RtA, RtB---------	0-9	10-20	1.25-1.40	0.6-2.0	0.22-0.24	5.1-6.5	Low----------	0.37	5	5	.5-2
Rush	9-27	22-30	1.35-1.50	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.37			
	27-57	20-30	1.40-1.55	0.6-2.0	0.15-0.19	5.1-7.8	Moderate-----	0.37			
	57-60	2-6	1.60-1.80	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
RuB, RuC---------	0-10	11-25	1.30-1.45	0.6-2.0	0.21-0.24	5.6-7.3	Low----------	0.37	5	5	.5-2
Russell	10-36	25-33	1.40-1.60	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	36-60	23-33	1.40-1.60	0.6-2.0	0.15-0.19	5.6-7.3	Moderate-----	0.37			
	60-80	14-30	1.60-1.80	0.6-2.0	0.05-0.19	7.4-8.4	Low----------	0.37			
Sh---------------	0-15	27-32	1.35-1.55	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.37	5	7	2-5
Shoals	15-35	18-32	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.8	Low----------	0.37			
	35-60	12-25	1.35-1.60	0.6-2.0	0.12-0.21	6.6-7.8	Low----------	0.37			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Sm----------------- Sleeth	0-8	11-22	1.30-1.45	0.6-2.0	0.20-0.24	6.6-7.3	Low-----------	0.32	5	5	.5-3
	8-43	20-35	1.45-1.60	0.6-2.0	0.15-0.19	5.6-7.3	Moderate-----	0.32			
	43-55	20-35	1.40-1.60	0.6-2.0	0.14-0.16	6.6-8.4	Moderate-----	0.32			
	55-60	2-5	1.60-1.80	>20	0.02-0.04	7.9-8.4	Low-----------	0.10			
SrA--------------- Starks	0-13	18-27	1.15-1.35	0.6-2.0	0.22-0.24	5.6-6.5	Moderate-----	0.37	5	6	1-3
	13-38	27-35	1.35-1.55	0.2-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	38-50	20-30	1.45-1.65	0.2-2.0	0.16-0.19	5.1-7.3	Moderate-----	0.37			
	50-60	5-20	1.55-1.75	2.0-6.0	0.08-0.18	5.6-7.3	Low-----------	0.37			
St----------------- Stonelick	0-6	5-12	1.30-1.55	2.0-6.0	0.07-0.11	7.4-8.4	Low-----------	0.24	5	2	.5-2
	6-60	5-18	1.20-1.55	2.0-6.0	0.05-0.11	7.4-8.4	Low-----------	0.24			
WeB--------------- Wawasee	0-11	10-18	1.20-1.40	0.6-2.0	0.13-0.15	6.1-7.3	Low-----------	0.28	5	3	1-3
	11-32	18-27	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.8	Low-----------	0.28			
	32-60	12-18	1.50-1.70	0.6-2.0	0.11-0.18	6.1-8.4	Low-----------	0.28			
XeA--------------- Xenia	0-13	11-22	1.40-1.55	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.37	5	5	1-3
	13-31	27-35	1.45-1.65	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.37			
	31-49	27-35	1.45-1.65	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.37			
	49-60	20-27	1.55-1.90	0.2-2.0	0.05-0.19	7.9-8.4	Low-----------	0.37			

TABLE 18.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ad----------------- Ackerman	A/D	None---------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
BmC---------------- Bloomfield	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
BnA---------------- Blount	C	None---------	---	---	1.0-3.0	Perched	Jan-May	>60	---	High-----	High-----	High.
ChC---------------- Chelsea	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
CpA---------------- Crosier	C	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
Cy----------------- Cyclone	B/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
FcA---------------- Fincastle	C	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
Ge----------------- Gessie Variant	B	Occasional	Brief-----	Oct-May	>6.0	---	---	>60	---	Moderate	Low------	Low.
Gf----------------- Gilford	B/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Moderate.
Gg----------------- Gilford	B	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Moderate.
GwB---------------- Glynwood	C	None---------	---	---	2.0-3.5	Perched	Jan-Apr	>60	---	High-----	High-----	Moderate.
HeE---------------- Hennepin	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Hh----------------- Houghton	A/D	None---------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
KoB, KsC3---------- Kosciusko	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Ma----------------- Maumee	A/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	Moderate	High-----	Moderate.
MkC---------------- Metea	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
MnB2, MnC2, MnD2, MoC3-------------- Miami	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ms---------------- Millsdale	B/D	None---------	---	---	+1-1.0	Perched	Jan-Apr	20-40	Hard	High-----	High-----	Low.
MxC3-------------- Morley	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
Mz---------------- Morocco	B	None---------	---	---	1.0-2.0	Apparent	Jan-Apr	>60	---	Moderate	Low------	High.
NeB, NeC---------- NewGlarus	B	None---------	---	---	>6.0	---	---	20-40	Soft	High-----	Moderate	Moderate.
ObA--------------- Oakville	A	None---------	---	---	3.0-6.0	Apparent	Nov-Apr	>60	---	Low------	Low------	Moderate.
OsB--------------- Ormas	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Po---------------- Patton	B/D	None---------	---	---	+.5-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
Pp, Ps. Pits												
Rn---------------- Rensselaer	B/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
RsB, RsC---------- Riddles	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
RtA, RtB---------- Rush	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
RuB, RuC---------- Russell	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
Sh---------------- Shoals	C	Frequent----	Brief-----	Oct-Jun	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
Sm---------------- Sleeth	C	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
SrA--------------- Starks	C	None---------	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Moderate.
St---------------- Stonelick	B	Occasional	Very brief	Nov-Jun	>6.0	---	---	>60	---	Moderate	Low------	Low.
WeB--------------- Wawasee	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
XeA--------------- Xenia	B	None---------	---	---	2.0-6.0	Apparent	Mar-Apr	>60	---	High-----	High-----	Moderate.

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Ackerman	Sandy, mixed, mesic Histic Humaquepts
*Bloomfield	Coarse-loamy, mixed, mesic Psammentic Hapludalfs
Blount	Fine, illitic, mesic Aeric Ochraqualfs
Chelsea	Mixed, mesic Alfic Udipsamments
Crosier	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Cyclone	Fine-silty, mixed, mesic Typic Argiaquolls
Fincastle	Fine-silty, mixed, mesic Aeric Ochraqualfs
Gessie Variant	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Udifluvents
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Glynwood	Fine, illitic, mesic Aquic Hapludalfs
Hennepin	Fine-loamy, mixed, mesic Typic Eutrochrepts
Houghton	Euic, mesic Typic Medisaprists
*Kosciusko	Fine-loamy, mixed, mesic Typic Hapludalfs
*Maumee	Sandy, mixed, mesic Typic Haplaquolls
Metea	Loamy, mixed, mesic Arenic Hapludalfs
Miami	Fine-loamy, mixed, mesic Typic Hapludalfs
Millsdale	Fine, mixed, mesic Typic Argiaquolls
Morley	Fine, illitic, mesic Typic Hapludalfs
Morocco	Mixed, mesic Aquic Udipsamments
NewGlarus	Fine-silty over clayey, mixed, mesic Typic Hapludalfs
Oakville	Mixed, mesic Typic Udipsamments
Ormas	Loamy, mixed, mesic Arenic Hapludalfs
Patton	Fine-silty, mixed, mesic Typic Haplaquolls
Rensselaer	Fine-loamy, mixed, mesic Typic Argiaquolls
Riddles	Fine-loamy, mixed, mesic Typic Hapludalfs
Rush	Fine-silty, mixed, mesic Typic Hapludalfs
Russell	Fine-silty, mixed, mesic Typic Hapludalfs
Shoals	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents
*Sleeth	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Starks	Fine-silty, mixed, mesic Aeric Ochraqualfs
Stonelick	Coarse-loamy, mixed (calcareous), mesic Typic Udifluvents
Wawasee	Fine-loamy, mixed, mesic Typic Hapludalfs
Xenia	Fine-silty, mixed, mesic Aquic Hapludalfs

* The soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

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